

DID LAB RENOVATION

PROJECT NO. PTS 4845

OTTAWA, ONTARIO

SPECIFICATIONS

Issued for Tender
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SPECIFICATIONS

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END OF SECTION

Part 1 General

1.1 MINIMUM STANDARDS

- .1 Materials shall be new and work shall conform to the minimum applicable standards of the Canadian General Standards Board, the Canadian Standards Association, the National Building Code of Canada 2015 (NBC) and all applicable Provincial and Municipal codes. In the case of conflict or discrepancy the most stringent requirement shall apply.

1.2 TAXES

- .1 Pay all taxes properly levied by law (including Federal, Provincial and Municipal).

1.3 FEES, PERMITS AND CERTIFICATES

- .1 Pay all fees and obtain all permits. Provide authorities with plans and information for acceptance certificates. Provide inspection certificates as evidence that work conforms to requirements of Authority having jurisdiction.

1.4 FIRE SAFETY REQUIREMENTS

- .1 Comply with both the National Building Code of Canada 2015 and the National Fire Code of Canada 2015 for safety of persons in buildings in the event of a fire and the protection of buildings from the effects of fire, as follows;
 - .1 The National Building Code (NBC): for fire safety and fire protection features that are required to be incorporated in a building during construction.
 - .2 The National Fire Code (NFC):
 - .1 The on-going maintenance and use of the fire safety and fire protection features incorporated in buildings.
 - .2 The conduct of activities that might cause fire hazards in and around buildings.
 - .3 Limitations on hazardous contents in and around buildings.
 - .4 The establishment of fire safety plans.
 - .5 Fire safety at construction and demolition sites.
- .2 Welding and cutting:
 - .1 Before welding, soldering, grinding and/or cutting work, obtain a permit as directed by the Departmental Representative. Store flammable liquids in approved CSA containers.
 - .2 At least one week prior to commencing cutting, welding or soldering procedure, provide to Departmental Representative:
 - .1 Notice of intent, indicating devices affected, time and duration of isolation or bypass.
 - .2 Completed welding permit as defined in NFC.
 - .3 Return welding permit to Departmental Representative immediately upon completion of procedures for which permit was issued.

- .3 “Fire Watchers” as described in NFC shall be assigned when welding or cutting operations are carried out in areas where combustible materials within 15m may be ignited by conduction or radiation.
- .3 Where work requires interruption or cause activation of fire alarms or fire suppression, extinguishing or protection systems:
 - .1 Provide “Watchman Service” as described in NFC; In general, watchman service is defined as an individual conversant with “Fire Emergency Procedures”, performing fire picket duty within an unprotected and unoccupied (no workers) area once per hour.
 - .2 Retain services of manufacturer for fire protection systems on daily basis or as approved by Departmental Representative, to isolate and protect all devices relating to:
 - .1 modification of fire alarms, fire suppression, extinguishing or protection systems; and/or
 - .2 cutting, welding, soldering or other construction activities that might activate fire protection systems.
 - .3 Immediately upon completion of work, restore fire protection systems to normal operation and verify that all devices are fully operational.
 - .4 Inform fire alarm system monitoring agency and local Fire Department immediately prior to isolation and immediately upon restoration of normal operation.
 - .5 When doing work that affects the existing fire alarm or fire suppression systems, ensure that both systems are fully active at the end of each daily work shift.
 - .6 Coordinate all work affecting fire alarm or fire suppression systems with Departmental Representative.

1.5 FIELD QUALITY CONTROL

- .1 Carry out Work using qualified licensed workers or apprentices in accordance with Provincial Act respecting manpower vocational training and qualification.
- .2 Permit employees registered in Provincial apprenticeship program to perform specific tasks only if under direct supervision of qualified licenced workers.
- .3 Determine permitted activities and tasks by apprentices, based on level of training attended and demonstration of ability to perform specific duties.

1.6 HAZARDOUS MATERIALS

- .4 Hazardous Materials: product, substance, or organism that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.
- .2 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and the provision of Material Safety Data Sheets (MSDS).
- .3 For work in occupied buildings give the Departmental Representative 48 hours notice for work involving designated substances (Ontario Bill 208), hazardous substances (Canada

Labour Code Part II Section 10), and before painting, caulking or using adhesives and other materials that cause off gassing.

1.7 TEMPORARY UTILITIES

- .1 Existing services required for work, may be used by the Contractor without charge. Ensure capacity is adequate prior to imposing additional loads. Connect and disconnect at own expense and responsibility and remove all such work after use.
- .5 Maximum power supply of 120 V, 15 A is available. Connect to existing power supply in accordance with Canadian Electrical Code and provide meters and switching.
- .3 Notify the Departmental Representative and utility companies of intended interruption of services, obtain requisite permission.

1.8 REMOVED MATERIALS

- .1 Unless otherwise specified, materials for removal become the Contractor's property and shall be taken from site.

1.9 PROTECTION

- .1 Protect finished work against damage until take-over.
- .2 Protect adjacent work against the spread of dust and dirt beyond the work areas.
- .3 Protect operatives and other users of site from all hazards.

1.10 CUT, PATCH and MAKE GOOD

- .1 Cut surfaces as required to accommodate work.
- .2 Remove all items so shown or specified.
- .3 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture.

1.11 SLEEVES, HANGERS AND INSERTS

- .1 Co-ordinate setting and packing of sleeves and supply and installation of hangers and inserts. Obtain Departmental Representative's approval before cutting into structure.

1.12 EXAMINATION

- .1 Examine site and conditions likely to affect work and be familiar and conversant with existing conditions.

1.13 SIGNS

- .1 Provide common-use signs related to traffic control, information, instruction, use of equipment, public safety devices, etcetera, in both official languages or by the use of commonly-understood graphic symbols to the Departmental Representative's approval.

-
- .2 No advertising will be permitted on this project.

1.14 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.
- .2 The adjacent lab space requires continuous emergency egress throughout construction through the construction zone to the west exit stairwell. Provide a temporary door that allows free egress in the corridor between gridlines L6 and K6, and maintain a clear path of travel from there to the exit stairwell. The closure comprising the door and its partition must be a one hour fire separation based on a ULC-listed assembly with a 45 minute rated door and frame.

1.15 SCAFFOLDS AND WORK PLATFORMS

- .1 Design, install, and inspect scaffolds and work platforms required for work in accordance with relevant municipal, provincial and other regulations.
- .2 Provide design drawings, signed and sealed by qualified Professional Engineer licensed in the province of Ontario, where prescribed.
- .3 Additions or modifications to scaffolding must be approved by Professional Engineer in writing.

1.16 SITE STORAGE

- .1 Storage will be allowed within the area of Work only; no other storage will be available.
- .2 Do not unreasonably encumber site with materials or equipment.

1.17 OPERATIONS AND MAINTENANCE MANUALS

- .1 Submit to Departmental Representative six (4) copies of approved Operations Data and Maintenance Manual, compiled as follows:
 - .1 Bind data in vinyl hard cover 3 "D" ring type loose leaf binders for 212 x 275 mm size paper. Binders must not exceed 75 mm thick or be more than 2/3 full.
 - .2 Enclose title sheet labelled "Operation Data and Maintenance Manual," project name, date and list of contents. Project name must appear on binder face and spine.
 - .3 Organize contents into applicable sections of work to parallel project specifications breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .2 Include following information plus data specified.
 - .1 Maintenance instruction for finished surface and materials.
 - .2 Copy of hardware and paint schedules.

.3 Description: Operation of the equipment and systems defining start-up, shut-down and emergency procedures, and any fixed or adjustable set points that affect the efficiency of the operation. Include nameplate information such as make, size, capacity and serial number.

.4 Maintenance: Use clear drawings, diagrams or manufacturers' literature which specifically apply and detail the following:

.1 lubrication products and schedules.

.2 trouble shooting procedures.

.3 adjustment techniques.

.4 operational checks.

.5 Suppliers names, addresses and telephone numbers and components supplied by them must be included in this section. Components must be identified by a description and manufacturers part number.

.5 Warranties of one year duration showing:

.1 Name and address of project.

.2 Warranty commencement date (date of Substantial Performance).

.3 Duration of warranty.

.4 Clear indication of what is being guaranteed and what remedial action will be taken under warranty.

.5 Signature and seal of Guarantor.

.6 Additional material used in project listed under various Sections showing name of manufacturer and source of supply.

.3 Spare parts: List all recommended spares to be maintained on site to ensure optimum efficiency. List all special tools appropriate to unique application. All parts/tools detailed must be identified as to manufacturer, manufacturer part number and supplier (including address).

.4 Include one complete set of final reviewed shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.

1.18 RECORDS

.1 As work progresses, maintain accurate records to show deviations from contract drawings. Just prior to Departmental Representative's inspection for issuance of final certificate of completion, supply to the Departmental Representative one (1) complete set of white prints of all drawings including changes due to Site Instructions and Change Orders, with all other deviations neatly inked in. The Departmental Representative will provide two sets of clean white prints for this purpose.

1.19 GUARANTEES AND WARRANTIES

- .1 Before completion of work collect all manufacturer's guarantees and warranties and deposit with Departmental Representative.
- .2 Work of this contract shall not compromise any warranties in effect for the existing building.

1.20 CLEAN UP

- .1 Clean up work area as work progresses. At the end of each work period, and more often if ordered by the Departmental Representative, remove debris from site, neatly stack material for use, and clean up generally.
- .2 Upon completion remove scaffolding, temporary protection and surplus materials. Make good defects noted at this stage.
- .3 Wash and polish glass, mirrors, ceramic tile, aluminum, chrome, stainless steel, baked or porcelain enamel, plastic laminate and other plastic surfaces, floors, hardware and washroom fixtures. Clean manufactured articles in accordance with manufacturer's directions. Clean all wall and ceiling surfaces, including existing building surfaces.
- .4 Clean areas under contract to a condition at least equal to that previously existing and to approval of Departmental Representative.

1.21 BUILDING SMOKING ENVIRONMENT

- .1 Smoking is not permitted on the site. Obey smoking restrictions on building property.

1.22 DUST CONTROL

- .1 Provide dust tight control on the construction site to localize dust generating activities, and for protection of workers, finished areas of work and public. All effort must be made to control dust from entering adjacent spaces occupied by others.

1.23 TESTING LABORATORY SERVICES

- .1 Departmental Representative will appoint and pay for costs of inspection and testing services, unless indicated otherwise.
- .2 Provide safe working areas and assist with testing procedures, including provisions for materials or services and co-ordination, as required by testing agency and as authorized by Departmental Representative.
- .3 Where tests indicate non-compliance with specifications, contractor to pay for initial test and all subsequent testing of work to verify acceptability of corrected work.

1.24 SCHEDULING

- .1 Within 5 days after award of contract submit bar chart construction schedule for work, formatted to be readily legible on letter or tabloid-sized paper, indicating anticipated progress stages within time of completion. When schedule has been reviewed by the Departmental Representative, make any corrections required and resubmit. Take

necessary measures to complete work within scheduled time. Do not change schedule without notifying Departmental Representative.

- .2 Ensure Project Schedule includes as minimum milestone and activity types the following (not necessarily in this order):
 - .1 Award
 - .2 Shop Drawings, Samples, broken down by category and connected as predecessors in the schedule to related site work
 - .3 Permits
 - .4 Site Mobilization
 - .5 Demolition
 - .6 Framing
 - .7 Plumbing
 - .8 Electrical
 - .9 HVAC
 - .10 Drywall
 - .11 Ceilings
 - .12 Benchwork
 - .13 Fume Hoods
 - .14 Millwork
 - .15 Fire Systems
 - .16 Lighting
 - .17 Painting
 - .18 Testing and Commissioning
 - .19 Final Review/Substantial Performance
 - .20 Deficiencies/Completion
- .3 Unless advised otherwise and approved, the work performed at the site by the Contractor shall be carried out during normal working hours (08:00 – 16:00) during the week and shall be carried out with the least possible interference or disturbance to other site activities or operations. Perform noisy work, work requiring Hot Work Permits, and otherwise disruptive work (at the discretion of the Departmental Representative) after hours and on weekends, including any drilling into the 3rd floor slab. Any work deemed by the Departmental Representative to affect operation of other labs in the building, such as work creating vibrations, dust generation, strong/harmful odours, or shut-downs, requires 15 working days prior notice and shall be performed after-hours. Shut-downs shall only occur between 18:00 and 06:00. Schedule after-hours work at least 3 working days in advance with the Departmental Representative. Hot Work Permits also require minimum 3 working days notice.
- .4 Update project schedule on bi-weekly basis reflecting activity changes and completions, as well as activities in progress.

1.25 CONSTRUCTION MEETINGS

- .1 Regular construction meetings will be scheduled weekly or as required by the Departmental Representative.
- .2 Attend all construction meetings along with any sub-contractors who may be required to address specific items on the agenda.

-
- .3 Provide a detailed “look-ahead” schedule of activities planned for the week following the meeting.

1.26 COST BREAKDOWN

- .1 Before submitting first progress claim submit breakdown of Contract Amount in detail as directed by Departmental Representative and aggregating the Contract Amount. After approval by Departmental Representative cost breakdown will be used as the basis of progress payments.

1.27 PRECEDENCE

- .3 Division 01 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

REPORT FOLLOWS



October 31, 2018

Our File Ref.: 180678

Royal Canadian Mounted Police
National HQ Assets Management
74 Leikin Drive
Suite 202-28, Mailstop 4
Ottawa, Ontario K1A 0R2

Attention: [REDACTED]

Subject: Project Specific Designated Substance Survey & Hazardous Material Survey –
Laboratory Renovation
Laboratory Centre for Disease Control Building
3rd Floor 100 Eglantine Driveway, Ottawa, Ontario

Dear [REDACTED]

LRL Associates Ltd. (LRL) conducted a Project Specific Designated Substance & Hazardous Material Survey (DSS) throughout the majority of the 3rd Floor of the Laboratory Centre for Disease Control Building located at 100 Eglantine Driveway, Ottawa, Ontario (herein referred to as the “Site”). The areas surveyed included the span of between Room 3178 through Room 3218, including CL3 area. The DSS was requested in support of proposed renovations activities to the existing laboratories to better suit future use as toxicology laboratories. It is understood that proposed renovation activities will include the following:

- Replace the flooring tiles;
- Replace the ceiling tiles;
- Removal of select walls; and
- Removal of fire suppression, fume hoods, duct work and cabinetry.

Section 30 of the Ontario Occupational Health and Safety Act (OHS Act) requires that the owners of a project determine if Designated Substances are present on a project and inform all potential contractors prior to entering into a binding contract. Ontario Environmental Protection Act (EPA) set out regulations for the handling and disposal of hazardous materials. This DSS will help to create an inventory of materials containing designated substances that are present within the building.



1 BUILDING DESCRIPTION

The Laboratory Centre for Disease Control Building located at 100 Eglantine Driveway in Ottawa, Ontario is part of the Tunney's Pasture complex. The Building is estimated to have been constructed in the early 1950's (est. 1954) with an estimated surface area of 11, 200 m². It is understood that the building underwent major renovations in the early 1990's including the inclusion of new building finishes. The area of focus for this survey was limited to the 3rd Floor of the building. The subject site, as part of this survey, includes the span of between Room 3178 through Room 3218, including CL3 area. The location of the Site is shown in the attached **Figure 1**.

The Site generally contains several individual and adjoined laboratory rooms. The generally finishes of the area surveyed, excluding the CL3 space, include terrazzo flooring (various colours throughout), gyproc (drywall) walls which conceal cement slab main walls or structural walls. The ceilings are suspended 0.6 m by 1.2 m acoustic ceiling tiles while the main ceiling overhead is cement. The finishes in the CL3 area include cement flooring with fibreglass wall finishes and fibreglass ceiling tiles.

The majority of the areas surveyed included lab benches with some fume hoods. Rooms along the southern face of the building were equipped with windows. In select rooms, a second window pane layer is present. A black seal was encountered at these select double pane windows along the trim. Florescent and recess lighting was observed throughout the areas surveyed. Above the suspended ceiling tiles was duct work and piping. These components were either insulated with fibreglass, or not insulated.

A pipe chase room is found at the north-western portion of the area surveyed. Several pipes, associated with the heating and cooling systems of the building, were observed to be running vertically. The piping appeared to be insulated with fibreglass and concealed with pipe wrap. The flooring in this room was steel grating and the walls were poured cement.

2 METHODOLOGY

Fieldwork was conducted by LRL on October 22, 2018. The survey included a visual assessment for the presence of the eleven (11) designated substances identified in the OHSAs:

- Acrylonitrile
- Arsenic
- Asbestos
- Benzene
- Coke Oven Emissions
- Ethylene Oxide
- Isocyanates
- Lead
- Mercury
- Silica
- Vinyl Chloride

The following hazardous materials were also included in the survey:

- Ozone Depleting Substances (ODS);
- Polychlorinated Biphenyls (PCB);
- Urea Formaldehyde Foam Insulation (UFFI); and



- Microbial Contamination.

The survey was conducted in each room, corridor etc., where practical. The following building systems and components were surveyed:

- | | | |
|--------------|--------------------|--------------|
| • Flooring | • Walls | • Ducts |
| • Structures | • Pipes | • Mechanical |
| • Ceilings | • Other components | |

2.1 Potential Asbestos Containing Materials

2.1.1 General

Asbestos containing materials (ACMs) are classified as either friable or non-friable as defined by Ontario Regulation (O. Reg.) 278/05. Friable material is material that is crumbled, pulverized or powdered or when dry, can be crumbled, pulverized or powdered by hand pressure. Non-friable ACMs are materials that do not meet the conditions for friable material and are generally bound together with materials such as cement, vinyl or asphalt. O. Reg. 490/09 provides insight and producers for the safe the handling of ACM, in conjunction with O. Reg. 278/05.

Components were inspected for the following materials that can potentially be ACM:

- | | |
|---|-------------------------|
| • Sprayed or trowel fireproofing and thermal insulation | • Texture finishes |
| • Other building Insulation (attic, wall, block) | • Vermiculite |
| • Acoustic ceiling tiles | • Cementitious products |
| • Drywall compounds | • Plaster |
| • Vinyl and sheet flooring | • Roofing material |
| • Mechanical insulation: | • Other materials |
| • Pipe, boilers and tank systems | |
| • Ductwork | |

2.1.2 Sampling and Analysis

The survey involved visual identification of building material that is potentially ACM. Representative bulk samples of each visually identical material were collected according to the minimum frequency outlined Table 1 of O. Reg. 278/05 and is generally as follows:

- Surfacing materials (plaster, fireproofing) per contiguous area:
 - Three (3) samples for areas less than 90 m²;
 - Five (5) samples for areas between 90 and 450 m²; and
 - Seven (7) samples for areas greater than 450 m².
- Three (3) samples of each visually identical type of mechanical insulation, ceiling tiles and vinyl floor tile; and
- Three (3) samples of other suspected ACM.

Visual identification of potential ACMs were supported by the collection and analysis of a limited number of bulk samples. The bulk asbestos samples were submitted to Paracel Laboratories Ltd. in Ottawa Ontario (accredited under the National Voluntary Laboratory Accreditation

Program). The samples were analysed by Polarized Light Microscopy (PLM) analysis. A “Stop Positive” approach was conducted on the samples analysed where each sample in a visually identical group of samples are analysed in succession. Once a sample in the group is identified as being ACM¹ the remaining samples in the same group are not analysed and the material from which the sample is collected is considered as ACM. Laboratory Certificates of Analysis are attached. Locations and descriptions of samples collected are included in the attached **Table 1**.

2.2 Potential Lead-Based Paint

In 1976, the Canadian federal government limited the concentration of lead in interior and exterior paints as well as additional liquid coating to a maximum of 5000 ppm. The Hazardous Products Act, 2005, limited the acceptable concentration of lead content to surface coating materials to 600 ppm. This concentration was updated in October 2010 to a maximum limit of 90 ppm and is located in the Surface Coating Materials Regulation (SOR/2005-109).

The occupational exposure limit for elemental, inorganic and organic compounds of lead, as specified under the occupational health and safety act (O. Reg. 490/09, Designated Substances), equals 0.05 milligrams per cubic metre (mg/m³) of air as an 8-hour daily or 40-hour weekly time-weighted average limit.

The Ministry of Labour (MOL) guideline, *Lead on Construction Projects*, 2004, provides measures and procedures that should be followed during construction projects when lead-containing materials are present. Construction activities that include handling lead-containing material are grouped into three (3) individual categories based on the presumed airborne concentrations that could be released during the work. The categories are as follows:

- Type 1 (low risk) when concentrations less than 0.05 mg/m³;
- Type 2 (medium risk) when concentrations are between greater than 0.05 and less than 1.25 mg/m³. This category is separated into two (2) sub-categories (Type 2a and Type 2b); and
- Type 3 (high risk) when concentrations are between 1.25 mg/m³ and 2.5 mg/m³ ppm. This category is separated into two (2) sub-categories (Type 3a and Type 3b).

Representative paint chip samples were collected and submitted for the analysis of lead to Paracel Laboratories Ltd. (Ottawa, Ontario) (accredited under the Canadian Association for Laboratory Accreditation). Laboratory Certificates of Analysis are attached. Locations and descriptions of samples collected are included in the attached **Table 2**.

2.3 Other Designated Substances and Hazardous Materials

A visual survey of the Site building was conducted to assess if other designated substances or hazardous materials (ODSs, PCBs, UFFI and mould) may be present.

¹ O. Reg. 278/05 defines asbestos-containing material as material containing 0.5% or more asbestos by weight.

2.4 Limitations

The survey was a non-destructive evaluation and limited to the proposed areas to be renovated as specified by the client. Samples were collected of the building materials which are suspected of being disturbed or potentially in contact with during the proposed renovation activities of the 3rd Floor of the Laboratory Centre of Disease Control. It is possible that designated substances are present in non-accessible areas and concealed spaces (i.e. wall and ceiling cavities). In addition, this survey did not include substances that may be present in the day-to-day usage for specialized equipment or areas of the building. Analytical results reflect sampled materials at specific sample locations. Visually similar materials were referenced to specific analysed samples. Observations presented in this report are based on specific areas inspected and, hence findings may not be consistent throughout the building.

3 RESULTS AND DISCUSSION

Based on our inspection, the following designated substances and hazardous materials were not identified at the subject site:

- Acrylonitrile
- Arsenic
- Vinyl Chloride
- Coke Oven Emissions
- Ethylene Oxide
- Isocyanates

These substances were either not identified, presumed not to be present due to the Site's activities or are present but in a stable form within paints, plastics or adhesives.

3.1 Asbestos

3.1.1 Friable Asbestos Containing Materials

Potential friable ACM identified during the survey included:

3.1.1.1 Acoustic Ceiling Tile

0.6 m by 1.2 m acoustic ceiling tiles were encountered throughout the areas included in the survey, excluding the CL3 area. The acoustic ceiling tiles were grey with a painted white face (CT1). At the time of the survey, the material appeared to be in good condition with few areas of minimal water damage, potentially the result of overhead condensation on the pipe work and ducts. Various bulk samples of the visually similar material were collected of which three (3) samples were submitted for PLM analysis. The analysis revealed that the ceiling tiles encountered did not have asbestos fibres detected above the laboratory detection limit of 0.5%. Therefore, the acoustic ceiling tiles encountered in the proposed work area are not considered ACM.

3.1.2 Non-Friable Asbestos Containing Materials

Potential non-friable ACM identified during the survey included:

3.1.2.1 Vinyl Baseboards

Two (2) visually different vinyl baseboard materials were encountered in the areas surveyed. A grey vinyl baseboard was encountered along the lower perimeter of the walls throughout the majority of the area surveyed (VB1) while a beige vinyl baseboard was encountered in select locations along the laboratory work benches (VB2). Both materials were considered to be in good condition at the time of the survey with some areas observed to be missing or peeled off the wall and laying on the floor. Three (3) bulk samples were collected of each visually similar material and submitted for PLM analysis. The PLM analysis revealed that the vinyl baseboards encountered did not have asbestos fibres detected above the laboratory detection limit of 0.5%. Therefore, the grey and the beige vinyl baseboards encountered in the proposed work area are not considered ACM.

A yellow mastic was encountered adhered on the underside of the baseboards both grey and beige. It was requested that the laboratory analyse this material (“analyse separate layers”) located on the underside of the three (3) bulk vinyl baseboard samples submitted for PLM analysis (VB1 Mastic). The PLM analysis revealed that the vinyl baseboard mastic encountered did not have asbestos fibres detected above the laboratory detection limit of 0.5%. Therefore, the mastic on the underside of the vinyl baseboards encountered in the proposed work area are not considered ACM.

3.1.2.2 Vinyl Tile

Three (3) 0.3 m by 0.3 m beige vinyl floor tiles were encountered in Room 3246 (VT1). The vinyl floor tiles were considered to be in good condition at the time of the survey. Three (3) bulk samples were collected and submitted for PLM analysis. The PLM analysis revealed that none of the samples submitted had asbestos fibres detected (<0.5%). Therefore, the vinyl floor tiles encountered in Room 3246 is not considered ACM.

A yellow mastic was encountered adhered on the underside of the tiles. It was requested that the laboratory analyse this material located on the underside of the three (3) bulk vinyl floor tiles samples (“analyse separate layers”) submitted for PLM analysis (VT1 Mastic). The PLM analysis revealed that the vinyl tile mastic encountered did not have asbestos fibres detected above the laboratory detection limit of 0.5%. Therefore, the mastic on the underside of the vinyl floor tiles encountered in Room 3246 are not considered ACM.

3.1.2.3 Sealant

Black sealant was encountered in select rooms surveyed which was similar to a “roller-back” material. Select areas surveyed were observed to have a double pane of window glass. The black sealant was encountered along the trim of the outer window (S1). At the time of the survey, the material was considered to be in good condition. Three (3) bulk samples were collected and submitted for PLM analysis. The PLM analysis revealed that the sealant encountered did not have asbestos fibres detected above the laboratory detection limit of 0.5%. Therefore, the black sealant encountered in select rooms of the proposed work area is not considered ACM.

3.1.2.4 *Caulking*

Five (5) visually dis-similar caulking material was encountered throughout the area surveyed. These materials include:

- Grey caulking around the outer trim of the windows throughout the 3rd floor (CA1);
- White caulking around the workbenches throughout the 3rd floor (CA2);
- Black caulking around the window panes throughout the 3rd floor (CA3);
- Colourless caulking along the seam of the floor and vinyl baseboard in Room 3176 (CA4); and
- White caulking along the seams of the fibreglass ceiling tiles in area CL3 (CA5).

The caulking was considered to be in good condition at the time of the survey with the exception to CA2 which was observed in areas to be weathered and cracked. Three (3) bulk samples were collected of each individual material and submitted for PLM analysis. The PLM analysis revealed that none of the samples submitted had asbestos fibres detected (<0.5%). Therefore, the various caulking materials encountered throughout the 3rd floor are not considered ACM.

3.1.2.5 *Joint Compound*

White drywall joint compound material was encountered throughout the areas surveyed (JC1). The materials appeared to be generally in good condition at the time of the survey with some cracking, likely the result of water damage, in Room 3170. Various bulk samples were collected, of which seven (7) bulk were submitted for analysis. The PLM analysis revealed drywall joint compound samples submitted did not have asbestos fibres detected (<0.5%). Therefore, the white drywall joint compound material encountered throughout the 3rd Floor is not considered ACM.

3.2 Benzene

Benzene is a clear, colourless inflammable liquid with a sweet, aromatic odour which is regulated under the O. Reg. 839/90 of the Occupation Health and Safety Act. This product is produced in Canada, primarily from petroleum refining and processing as well but it is also associated with the extraction from natural gas condensate and slow distillation from coal.

In addition to benzene use in the production of various chemicals and pharmaceuticals including ethylbenzene, styrene, cyclohexane, cumene and maleic acid anhydride, benzene can also be found in building materials such as synthetic rubber, paint, varnish, stains, adhesives, roofing materials and sealants. Benzene is also used in the manufacturing of tires and other rubber products, in solvents and is a component of paints and adhesives, however its use in these products has declined considerably as it is becoming replaced with more benign compounds. Benzene is also a natural component of petroleum and typically makes up between 1% and 4% of gasoline sold in Canada.

It is possible that benzene can be present in paints, adhesives and roofing materials present during the original construction of the facility. However, overtime the benzene component typically volatilizes out of these materials and is released into the ambient air. Therefore, it is

likely to be present in trace levels. The maximum allowable TWAEV for a work to benzene is 0.05 ppm.

3.3 Lead

Nine (9) paint samples were collected from various locations included in this survey. The samples collected are summarized as follows:

- Blue encountered on the walls throughout the 3rd Floor hallways and select rooms (PS1);
- White encountered on the walls throughout the 3rd Floor hallways and select rooms (PS2);
- Beige encountered on the walls of Room 3248 (PS3);
- Blue-green encountered on the ceiling of Room 3248 (PS4);
- White encountered on the walls of Room 3246, however appeared visually similar to PS2 (PS5);
- White-beige encountered on the walls of Room 3310 (PS6);
- Peach encountered on the Floor of the CL3 Area (PS7);
- Beige encountered on the Walls of the CL3 Area (PS8); and
- White encountered on the walls of Room 3178, visually similar to samples PS2 and PS5 (PS9).

Samples were collected from each distinct paint type encountered throughout the building, in the select areas specified by the client. The paint samples represent the various colours or pigments encountered in these select areas. All samples collected were submitted for analysis of their lead content.

Laboratory analysis revealed that all but one (1) of the paint samples submitted for analysis of lead meet provincial standards with a reported value of between <5 and 19 ppm. Sample PS6, collected from the walls of Room 3310, was found to have a value of 136 ppm, above the provincial standard of 90 ppm. However, after calculating the TWA for lead using Ontario TWA for Particles Not Otherwise Specified (PNOS), the samples do not exceed the O. Reg. 490/09 regulation of 0.05 mg/m³, provided appropriate dust control measures are implemented. Demolition activities should be carried out in accordance with Type 1 Operations outlined in MOL's "Guideline: Lead on Construction Projects" and ensure lead fumes do not exceed the Time Weighted Average Exposure Value (TWAEV) of 0.05 mg/m³.

According to published information by Health Canada concerning lead-based paints, buildings constructed before 1960 were likely painted with lead based paints, and until 1980, lead based paint was more common to exterior applications. After 1980, there is little concern of lead levels in interior paints but lead could still be found in some exterior paints. However after 1992, all consumer paints produced in Canada and the U.S. were considered virtually lead free.

Based on the historical use of lead in construction, it may also be present in solder on copper domestic water pipes and drainpipe joint caulking. Lead in these materials is considered to be in a stable form and not expected to be of concern during the proposed demolition activities.

3.4 Silica

Silica in its crystalline form is present in concrete and cement based building products, such as concrete and cement, masonry blocks and mortar, hard plaster finishes, and acoustic ceiling tiles. Cement, hard plaster finishes (i.e. Joint Compound) and acoustic ceiling tiles were identified throughout the areas of concern. It is anticipated that the proposed work activities associated with renovation activities result in a moderate to high potential for silica containing materials being disturbed.

3.5 Mould

A visual inspection for the presence of mould or water damage was conducted. Water damage was observed to the wall along the window of Room 3170. Select ceiling tiles throughout the areas surveyed were also noted to have minor amounts of water staining to them. This water damage, and warm indoor climate may encourage the growth of mould in these area.

3.6 Mercury

Minor amounts of mercury are commonly found in a variety of building material including mercury vapour lamps, fluorescent light tubing and thermostats and other electrical control switches. Fluorescent lighting and thermostats was encountered in the areas surveyed which may potentially be mercury containing.

3.7 Polychlorinated Biphenyls (PCBs)

Use of PCBs in electrical equipment such as transformers and capacitors, including capacitors found in fluorescent lamp ballasts, was common up to the 1980's. Electrical equipment and fluorescent lighting was encountered throughout the survey area, which may potentially contain PCBs.

3.8 Ozone Depleting Substances

Ozone depleting substances are potentially present inside the building. These substances are likely to be encountered in refrigeration and air conditioning systems and fire extinguishers. Fire extinguishers were identified in the proposed work areas.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Asbestos

Disturbance of all asbestos is regulated by O. Reg. 490/09 and Reg. 278/05, which outline the construction practices involving asbestos containing materials. The MOL's Regulation: "Asbestos on Construction Projects and in Buildings and Repair Operations" (O. Reg. 278/05) sets out guidelines for the protection of workers and indicates that asbestos containing material must be removed to the extent practicable prior to any demolition. Disturbance or removal of all ACM should be carried out according to the O. Reg. 278/05.

ACM may be present in concealed spaces such as in non-accessible areas and concealed spaces (i.e. wall and ceiling cavities). If any suspected ACM materials not discussed in the report are encountered, the material should be considered ACM and handled as such. Otherwise, LRL should be contacted to assess the material and collect samples of the material for laboratory testing, if warranted.

No friable or non-friable asbestos containing materials were identified in the area surveyed.

4.2 Lead

Concentrations of lead exceeding provincial surface coating standards were encountered in one (1) paint samples submitted. The level exceeding the applicable provincial standard (90 ppm) was 136 ppm, and was collected from the walls in Room 3310. Type I procedures should be followed when handling these paint substances. Lead can potentially be present on building material such as solder on pipes and drainpipe joint caulking.

Procedures for lead-based paint removal are outlined under O.Reg. 490/09. The MOL's "*Guideline: Lead on Construction Projects*" does not require removal of lead-based materials unless work on these materials is likely to cause worker exposure to lead fumes or dust. Worker exposure can be caused by welding, cutting, grinding or sanding. If these activities are performed on lead-based materials, the procedures outlined in the guideline must be adhered to. Airborne lead should not exceed the maximum time weighted exposure value (TWA_{EV}) of 0.05 mg/m³, provided appropriate dust control measures are implemented.

4.3 Silica

Silica may be present in concrete and cement based products throughout the building. Precautions should be taken as required during the proposed ladder repair or replacement project affecting concrete and cement based products to ensure that silica exposure levels to workers do not exceed the TWA_{EV} of 0.05 mg/m³ for cristobalite and 0.1 mg/m³ for quartz and tripoli. This can be achieved by:

- Wetting the surface of the materials to prevent dust emissions;
- Providing workers with respiratory protection; and
- Providing workers with facilities to properly wash prior to exiting the work area.

Silica occurs naturally as crystalline material in cement. Crystalline silica is significantly more hazardous than amorphous silica, therefore for health reasons; only crystalline varieties are regulated under O. Reg. 490/90 of the Occupational Health and Safety Act. The MOL's document "*Guideline – Silica on Construction Projects*" has become an industry standard for protecting workers from silica exposure. This document outlines method for controlling silica hazard and offers classification criteria and measures and procedures for different types of operations.

4.4 Mould

Mould is typically associated with wet building materials and was not observed during this assessment. Health effects related to inhalation of microbials are detailed in the report of the Federal-Provincial Advisory Committee on Environmental and Occupational Health entitled “*Indoor Air Quality in Office Buildings: A Technical Guide*”. Chronic exposure to most fungi can induce allergic or asthmatic reactions in humans, and a very few species can cause diseases directly. Some individuals, classed as immuno-compromised, are very susceptible to some microbial exposures. The Canadian Construction Association’s “*Mould Guidelines for the Canadian Construction Industry*” is one of a number of peer reviewed guidelines or standards recognized by the provincial and regulatory authorities for mould management.

4.5 Mercury

Mercury is governed by O. Reg. 490/09, under the Occupational Health and Safety Act. Regulations provide requirements for allowable exposure levels. In addition, mercury waste is considered a hazardous waste under R.R.O. 1990, Reg. 347 of the Ontario Environmental Protection Act. During renovation or demolition projects, mercury equipment and all suspected mercury-containing materials should be collected and properly stored. If they are not to be reused, they should be disposed of according to R.R.O. 1990, Reg. 347.

4.6 Polychlorinated Biphenyls (PCBs)

When removing the fluorescent light ballasts, they should be inspected for labelling indicating that they do not contain PCBs or cross referenced with manufacturer’s information to confirm the presence or absence of PCBs. Lamp ballasts can be compared to Environment Canada’s Environmental Protection Series Identification of Lamp Ballasts Containing PCBs, Report EPS 2/CC/2 (revised), August 1991. If the ballasts cannot be confirmed to be PCB free, they should be assumed to be PCBs containing and disposed as such in accordance to R.R.O. 1990, Reg. 347, as amended.

4.7 Ozone Depleting Substances

Regulations require that any equipment suspected of containing CFCs and HCFCs must be certified emptied before they can be disposed. Disposing of these substances should conform to the O. Reg. 463/10 – Ozone Depleting Substances and Other Halocarbons made under the Environmental Protection Act and Federal Halocarbon Regulations SOR/2003-289.

4.8 Waste Management

All generation, transportation and disposal of hazardous waste must be done in accordance with the *Ontario General Waste Regulations* R.R.O 1990, Reg. 347. Asbestos waste must be transported and disposed of in sealed double containers that are properly labelled and free of cuts and punctures. Waste must be disposed of at a licensed waste facility that has been properly notified of the presence of asbestos waste. Transportation of ACM waste is governed under the Transportation of Dangerous Goods Act.

5 LIMITATIONS AND USE OF THE REPORT

This report details designated substances and hazardous materials found within or forming part of the building envelope. This survey only considered the structure and finishes, and does not consider current or past owners, or occupant articles within the building.

Due to the nature of building construction, some inherent limitations exist as to possible thoroughness of the survey. It is possible that designated substances are present in non-accessible areas and concealed spaces (i.e. wall and ceiling cavities). Quantities reported are approximate visual estimates. Accurate measurements for tendering or estimating may be required.

Work conducted by LRL Associates Ltd. was conducted in accordance with generally accepted engineering or scientific practices current at the time the work was performed. Analysis results contained in this report are based solely on site conditions encountered at locations tested at the time of our site work conducted on October 22, 2018. No assurance is made regarding changes in conditions subsequent to the time of this investigation. Work is limited to those 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 assessment.

This report is intended for the sole use of Royal Canadian Mounted Police and their authorized agents. LRL Associates Ltd. will not be responsible for any use of the information contained within this report by any third party.

We trust the information presented in this report meets your current requirements. Please do not hesitate to contact us should you have any questions or concerns.



Encl.

Figure 1 Site Location

Table 1 Summary of potential asbestos containing material collected and analysis results

Table 2 Summary of potential lead containing paint samples and analysis results

Laboratory Certificates of Analysis (9 pages)





LRJ

ENGINEERING | INGÉNIÉRIE

5430 Canotek Road | Ottawa, ON, K1J 9G2
www.lrl.ca | (613) 842-3434

PROJECT
PROJECT SPECIFIC DESIGNATED SUBSTANCE SURVEY
LABORATORY RENOVATIONS
LABORATORY CENTRE FOR DISEASE CONTROL BUILDING 3RD
FLOOR, 100 EGLANTINE DRIVEWAY
OTTAWA, ONTARIO

DRAWING TITLE

SITE LOCATION
(Source: geoOttawa)
Not to scale

CLIENT

RCMP

DATE

OCTOBER 2018

PROJECT

180678

FIGURE 1



Table 1
Summary of Potential Asbestos Containing Material Collected and Analysis Results
 Project Specific Designated Substance & Hazardous Material Survey - Laboratory Renovation
 100 Eglantine Drive, Ottawa, Ontario
 LRL File: 180678

Type of Material	Description	Location	Sample Number	Asbestos Content %
Ceiling Tile	0.6 m by 1.2 m, Grey Painted White	Ceiling Throughout 3rd Floor Including Hallway and Rooms	CT1A-C	<0.5
Vinyl Baseboards	Grey	Lower Perimeter of Walls Throughout 3rd Floor Including Hallway and Rooms	VB1A-C	<0.5
	Beige	Lower Perimeter of Lab Benches Throughout 3rd Floor	VB2A-C	<0.5
Vinyl Tile	0.3 m by 0.3 m, Beige	Small Section of Flooring in Room 3246	VT1A-C	<0.5
Vinyl Tile Mastic	Yellow	Underside of Vinyl Floor Tile in Room 3246	VT1A-C (Mastic)	<0.5
Vinyl Baseboard Mastic	Yellow	Underside of Vinyl Baseboards Throughout 3rd Floor Including Hallway and Rooms	VB1A-C (Mastic)	
Sealant	Black	Around Window Trim at Select Windows (Double Pane) on 3rd Floor	S1A-C	<0.5
Caulking	Grey	Around Trim of Windows Throughout 3rd Floor	CA1A-C	<0.5
	White	Around Work Benches Throughout 3rd Floor	CA2A-C	<0.5
	Black	Around Window Panes Throughout 3rd Floor	CA3A-C	<0.5
Joint Compound	Colourless	Along Seam where Floor and Vinyl Baseboard Intercept in Room 3176	CA4A-C	<0.5
	White	Along Seams of Fibreglass Ceiling Tiles in CL3 Area	CA5A-C	<0.5
Joint Compound	White	Walls Throughout 3rd Floor	JC1A, C- H	<0.5

Notes

A, B,C... Replicate sample collected of homogeneous material

O. Reg. 278/05 defines asbestos-containing material as material containing 0.5% or more asbestos by weight.

Table 2
Summary of Potential Lead Containing Paint Samples and Analysis Results
 Project Specific Designated Substance & Hazardous Material Survey - Laboratory Renovation
 100 Eglantine Driveway, Ottawa, Ontario
 LRL File: 180678

Location	Description	Sample Number	Lead Concentration (ppm)	*Est. Lead Fumes and Dust (mg/m ³)	Mitigation Measures
3rd Floor Hallway Walls	Blue	PS1	8	0.0008	None Required
3rd Floor Hallway Walls	White	PS2	7	0.0007	None Required
3rd Floor Room 3248 Walls	Beige	PS3	11	0.0011	None Required
3rd Floor Room 3248 Ceiling	Blue-Green	PS4	<6	<0.0006	None Required
3rd Floor Room 3246 Walls	White	PS5	11	0.0011	None Required
4th Floor Room 3310 Walls	White	PS6	136	0.0136	Demolition activities should be carried out in accordance with Type 1 Operations outlined in MOL's "Guideline: Lead on Construction Projects" and ensure lead fumes do not exceed the Time Weighted Average Exposure Value (TWAEV) of 0.05 mg/m ³ .
3rd Floor CL3 Area Floor	Peach	PS7	<10	<0.0010	None Required
3rd Floor CL3 Area Walls	Beige	PS8	19	0.0019	None Required
3rd Floor Room 3178 Walls	White	PS9	<5	<0.0005	None Required

Notes

Lead containing material above 90 ppm provincial standard
 MOL Ministry of Labour

*Calculated based on the lead concentration (%) multiplied by Particles Not Otherwise Specified (PNOS) of 10 mg/m³ (Ontario TWA) eg. (1000 ug/g or 0.1% or 0.001) * 10 mg/m³ = 0.01 mg/m³ (est. lead fumes and dust)

Certificate of Analysis

LRL Associates Ltd.

5430 Canotek Road
Ottawa, ON K1J 9G2
Attn: Jessica Arthurs

Client PO:
Project: 180678
Custody: 30390

Report Date: 30-Oct-2018
Order Date: 23-Oct-2018

Order #: 1843232

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1843232-01	CT1A
1843232-02	CT1B
1843232-03	CT1C
1843232-04	VB1A
1843232-05	VB1B
1843232-06	VB1C
1843232-07	VB1A
1843232-08	VB1B
1843232-09	VB1C
1843232-10	VB2A
1843232-11	VB2B
1843232-12	VB2C
1843232-13	VB2A
1843232-14	VB2B
1843232-15	VB2C
1843232-16	VT1A
1843232-17	VT1B
1843232-18	VT1C
1843232-19	VT1A
1843232-20	VT1B
1843232-21	VT1C
1843232-22	S1A
1843232-23	S1B
1843232-24	S1C
1843232-25	I1A
1843232-26	I1B

Approved By:



Heather S.H. McGregor, BSc

Laboratory Director - Microbiology

Any use of these results implies your agreement that our total liability in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis

Client: **LRL Associates Ltd.**

Client PO:

Report Date: 30-Oct-2018

Order Date: 23-Oct-2018

Project Description: **180678**

1843232-27	I1C
1843232-28	CA1A
1843232-29	CA1B
1843232-30	CA1C
1843232-31	CA2A
1843232-32	CA2B
1843232-33	CA2C
1843232-34	CA3A
1843232-35	CA3B
1843232-36	CA3C
1843232-37	CA4A
1843232-38	CA4B
1843232-39	CA4C
1843232-40	CA5A
1843232-41	CA5B
1843232-42	CA5C
1843232-43	JC1A
1843232-44	JC1C
1843232-45	JC1D
1843232-46	JC1E
1843232-47	JC1F
1843232-48	JC1G
1843232-49	JC1H

Certificate of Analysis
 Client: LRL Associates Ltd.
 Client PO:

Report Date: 30-Oct-2018
 Order Date: 23-Oct-2018
 Project Description: 180678

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Parcel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1843232-01	22-Oct-18	sample homogenized	White/Grey	Ceiling Tile	No	Client ID: CT1A	
						Cellulose	30
						MMVF	40
						Non-Fibers	30
1843232-02	22-Oct-18	sample homogenized	White/Grey	Ceiling Tile	No	Client ID: CT1B	
						Cellulose	30
						MMVF	40
						Non-Fibers	30
1843232-03	22-Oct-18	sample homogenized	White/Grey	Ceiling Tile	No	Client ID: CT1C	
						Cellulose	30
						MMVF	40
						Non-Fibers	30
1843232-04	22-Oct-18	sample homogenized	Grey	Vinyl Baseboard	No	Client ID: VB1A	
						Non-Fibers	100
1843232-05	22-Oct-18	sample homogenized	Grey	Vinyl Baseboard	No	Client ID: VB1B	
						Non-Fibers	100
1843232-06	22-Oct-18	sample homogenized	Grey	Vinyl Baseboard	No	Client ID: VB1C	
						Non-Fibers	100
1843232-07	22-Oct-18	sample homogenized	Yellow	Mastic	No	Client ID: VB1A	
						Non-Fibers	100
1843232-08	22-Oct-18	sample homogenized	Yellow	Mastic	No	Client ID: VB1B	
						Non-Fibers	100
1843232-09	22-Oct-18	sample homogenized	Yellow	Mastic	No	Client ID: VB1C	
						Non-Fibers	100
1843232-10	22-Oct-18	sample homogenized	Beige	Vinyl Baseboard	No	Client ID: VB2A	
						Non-Fibers	100
1843232-11	22-Oct-18	sample homogenized	Beige	Vinyl Baseboard	No	Client ID: VB2B	
						Non-Fibers	100
1843232-12	22-Oct-18	sample homogenized	Beige	Vinyl Baseboard	No	Client ID: VB2C	
						Non-Fibers	100
1843232-13	22-Oct-18	sample homogenized	Yellow	Mastic	No	Client ID: VB2A	
						Non-Fibers	100
1843232-14	22-Oct-18	sample homogenized	Yellow	Mastic	No	Client ID: VB2B	
						Non-Fibers	100

Certificate of Analysis
 Client: LRL Associates Ltd.
 Client PO:

Report Date: 30-Oct-2018
 Order Date: 23-Oct-2018
 Project Description: 180678

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Parcel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1843232-15	22-Oct-18	sample homogenized	Yellow	Mastic	No	Client ID: VB2C Non-Fibers	100
1843232-16	22-Oct-18	sample homogenized	Pink	Vinyl Tile	No	Client ID: VT1A Non-Fibers	100
1843232-17	22-Oct-18	sample homogenized	Pink	Vinyl Tile	No	Client ID: VT1B Non-Fibers	100
1843232-18	22-Oct-18	sample homogenized	Pink	Vinyl Tile	No	Client ID: VT1C Non-Fibers	100
1843232-19	22-Oct-18	sample homogenized	Yellow	Mastic	No	Client ID: VT1A Non-Fibers	100
1843232-20	22-Oct-18	sample homogenized	Yellow	Mastic	No	Client ID: VT1B Non-Fibers	100
1843232-21	22-Oct-18	sample homogenized	Yellow	Mastic	No	Client ID: VT1C Non-Fibers	100
1843232-22	22-Oct-18	sample homogenized	Black	Sealant	No	Client ID: S1A Non-Fibers	100
1843232-23	22-Oct-18	sample homogenized	Black	Sealant	No	Client ID: S1B Non-Fibers	100
1843232-24	22-Oct-18	sample homogenized	Black	Sealant	No	Client ID: S1C Non-Fibers	100
1843232-25	22-Oct-18	sample homogenized	Grey	Insulation	No	Client ID: I1A Non-Fibers	100
1843232-26	22-Oct-18	sample homogenized	Grey	Insulation	No	Client ID: I1B Non-Fibers	100
1843232-27	22-Oct-18	sample homogenized	Grey	Insulation	No	Client ID: I1C Non-Fibers	100
1843232-28	22-Oct-18	sample homogenized	Grey	Caulking	No	Client ID: CA1A Non-Fibers	100
1843232-29	22-Oct-18	sample homogenized	Grey	Caulking	No	Client ID: CA1B Non-Fibers	100
1843232-30	22-Oct-18	sample homogenized	Grey	Caulking	No	Client ID: CA1C Non-Fibers	100
1843232-31	22-Oct-18	sample homogenized	White	Caulking	No	Client ID: CA2A Non-Fibers	100

Certificate of Analysis
 Client: LRL Associates Ltd.
 Client PO:

Report Date: 30-Oct-2018
 Order Date: 23-Oct-2018
 Project Description: 180678

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Parcel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1843232-32	22-Oct-18	sample homogenized	White	Caulking	No	Client ID: CA2B Non-Fibers	100
1843232-33	22-Oct-18	sample homogenized	White	Caulking	No	Client ID: CA2C Non-Fibers	100
1843232-34	22-Oct-18	sample homogenized	Black	Caulking	No	Client ID: CA3A Non-Fibers	100
1843232-35	22-Oct-18	sample homogenized	Black	Caulking	No	Client ID: CA3B Non-Fibers	100
1843232-36	22-Oct-18	sample homogenized	Black	Caulking	No	Client ID: CA3C Non-Fibers	100
1843232-37	22-Oct-18	sample homogenized	Colourless	Caulking	No	Client ID: CA4A Non-Fibers	100
1843232-38	22-Oct-18	sample homogenized	Colourless	Caulking	No	Client ID: CA4B Non-Fibers	100
1843232-39	22-Oct-18	sample homogenized	Colourless	Caulking	No	Client ID: CA4C Non-Fibers	100
1843232-40	22-Oct-18	sample homogenized	White	Caulking	No	Client ID: CA5A Non-Fibers	100
1843232-41	22-Oct-18	sample homogenized	White	Caulking	No	Client ID: CA5B Non-Fibers	100
1843232-42	22-Oct-18	sample homogenized	White	Caulking	No	Client ID: CA5C Non-Fibers	100
1843232-43	22-Oct-18	sample homogenized	White	Joint Compound	No	Client ID: JC1A Non-Fibers	100
1843232-44	22-Oct-18	sample homogenized	White	Joint Compound	No	Client ID: JC1C Non-Fibers	100
1843232-45	22-Oct-18	sample homogenized	White	Joint Compound	No	Client ID: JC1D Non-Fibers	100
1843232-46	22-Oct-18	sample homogenized	White	Joint Compound	No	Client ID: JC1E Non-Fibers	100
1843232-47	22-Oct-18	sample homogenized	White	Joint Compound	No	Client ID: JC1F Non-Fibers	100
1843232-48	22-Oct-18	sample homogenized	White	Joint Compound	No	Client ID: JC1G Non-Fibers	100

Certificate of Analysis
 Client: LRL Associates Ltd.
 Client PO:

Report Date: 30-Oct-2018
 Order Date: 23-Oct-2018
 Project Description: 180678

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Paracel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1843232-49	22-Oct-18	sample homogenized	White	Joint Compound	No	Client ID: JC1H Non-Fibers	100

* MMVF: Man Made Vitreous Fibers: Fiberglass, Mineral Wool, Rockwool, Glasswool

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	NVLAP Lab Code *	Analysis Date
Asbestos, PLM Visual Estimation	by EPA 600/R-93/116	2 - Ottawa West Lab	200812-0	30-Oct-18

* Reference to the NVLAP term does not permit the user of this report to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Work Order Revisions / Comments

None

Certificate of Analysis

LRL Associates Ltd.

5430 Canotek Road
Ottawa, ON K1J 9G2
Attn: Jessica Arthurs

Client PO:
Project: 180678
Custody: 44840

Report Date: 26-Oct-2018
Order Date: 23-Oct-2018

Order #: 1843199

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Parcel ID	Client ID
1843199-01	PS1
1843199-02	PS2
1843199-03	PS3
1843199-04	PS4
1843199-05	PS5
1843199-06	PS6
1843199-07	PS7
1843199-08	PS8
1843199-09	PS9

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

Any use of these results implies your agreement that our total liability in connection with this work, however arising shall be limited to the amount paid by you for this work, and that our employees or agents shall not under circumstances be liable to you in connection with this work

Certificate of Analysis
Client: LRL Associates Ltd.
Client PO:

Report Date: 26-Oct-2018
Order Date: 23-Oct-2018
Project Description: 180678

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Metals, ICP-MS	EPA 6020 - Digestion - ICP-MS	26-Oct-18	26-Oct-18

Sample and QC Qualifiers Notes

1- GEN01 :Elevated Reporting Limits due to limited sample volume.

Sample Data Revisions

None

Work Order Revisions/Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

Certificate of Analysis
 Client: LRL Associates Ltd.
 Client PO:

Report Date: 26-Oct-2018
 Order Date: 23-Oct-2018
 Project Description: 180678

Sample Results

Lead				Matrix: Paint	
				Sample Date: 22-Oct-18	
Paracel ID	Client ID	Units	MDL	Result	
1843199-01	PS1	ug/g	5	8	
1843199-02	PS2	ug/g	5	7	
1843199-03	PS3	ug/g	5	11	
1843199-04	PS4	ug/g	5	<6	
1843199-05	PS5	ug/g	5	11	
1843199-06	PS6	ug/g	5	136	
1843199-07	PS7	ug/g	5	<10 [1]	
1843199-08	PS8	ug/g	5	19	
1843199-09	PS9	ug/g	5	<5	

Laboratory Internal QA/QC

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Matrix Blank									
Lead	ND	5	ug/g						
Matrix Duplicate									
Lead	ND	5	ug/g	ND			0.0	50	
Matrix Spike									
Lead	47.2		ug/L	ND	94.1	70-130			

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..
- .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 will be confirmed by the Contractor's stamp and represents that necessary requirements have been determined and verified, including field measurements, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario.
- .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 5 days for Departmental Representative's review of each submission.

-
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
 - .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
 - .7 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
 - .8 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details, including anchors and/or other means of connection, as well as written verification that base building structure can support the connection at that point.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
 - .9 After Departmental Representative's review, distribute copies.
 - .10 Submit PDF electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request. PDF files shall be scaled so that a 1:1 print produces properly scaled drawings. Provide paper copies as requested, up to 6 copies as requested.

-
- .11 Submit PDF electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product. Provide paper copies as requested, up to 6 copies as requested.
 - .12 Submit PDF electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative. Provide paper copies as requested, up to 6 copies as requested.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
 - .13 Submit PDF electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative. Provide paper copies as requested, up to 6 copies as requested.
 - .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 PDF electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative. Provide paper copies as requested, up to 6 copies as requested.
 - .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 PDF electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative. Provide paper copies as requested, up to 6 copies as requested.
 - .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
 - .17 Submit PDF electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative. Provide paper copies as requested, up to 6 copies as requested.
 - .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 the Departmental Representative is for sole purpose of ascertaining conformance with general concept.

- .1 This review shall not mean that the Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
- .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 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 address(s) provided by Departmental Representative.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 MOCK-UPS

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

1.5 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of colour digital photography in jpg format, fine resolution weekly and as directed by Departmental Representative
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints: minimum 8 locations.
 - .1 Viewpoints and their location as determined by Departmental Representative.
- .4 Frequency of photographic documentation: weekly and as directed by Departmental Representative, but to include completion of framing, services prior to concealment, and substantial completion.

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 Occupational Health and Safety Act R.S.O. 1990, c. 0.1, and Regulations for Construction Projects O. Reg. 213/91, current edition.
- .2 CAN/CSA, Z462-15 (Workplace Electrical Safety Standard)
- .3 CAN/CSA-Z460-05 (R2010) - Control of Hazardous Energy.

1.2 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within seven (7) working 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 Written safe work procedures to address the known hazards.
- .3 Submit three (3) copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, weekly.
- .4 Submit copies of reports or directions issued by Federal and Provincial health and safety inspectors.
- .5 Submit copies of incident and accident reports within 24 hours after the event.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets to Departmental Representative.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within seven (7) working days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within seven (7) working days after receipt of comments from Departmental Representative.
- .8 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.
- .9 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF NOTICE

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

1.4 SAFETY ASSESSMENT

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

1.5 MEETINGS

- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.6 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.

1.7 RESPONSIBILITY

- .1 Be responsible and assume the role of "Constructor" as described in the Ontario Occupational Health & Safety Act and Regulations for Construction Projects for only their scope and areas of work as defined in this Project Specification.
- .2 Assume responsibility for health and safety of all other contractors present on site under the prescriptions of the present section.
- .3 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.8 COMPLIANCE REQUIREMENTS

- .1 Comply with the Ontario Occupational Health and Safety Act, R.S.O. 1990, c. 0.1.
- .2 Comply with the Ontario Regulations for Construction Projects, O. Reg. 213/91.
- .3 Comply with CAN/CSA, Z462-15 (Workplace Electrical Safety Standard)
- .4 Comply with CAN/CSA-Z460-05 (R2010) - Control of Hazardous Energy.

1.9 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 specified Work. Submit relevant experience to Departmental Representative.
 - .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.

1.10 POSTING OF DOCUMENTS

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

1.11 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.

1.12 BLASTING

- .1 Blasting or other use of explosives is not permitted.

1.13 POWDER ACTUATED DEVICES

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

1.14 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.

END OF SECTION

Part 1 General

1.1 INSPECTION

- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative will order part of Work to be examined/inspected/tested if Work is suspected to be not in accordance with Contract Documents. If, upon examination/inspection/testing such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination/inspection/testing and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.2 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Departmental Representative or Contractor subject to item 1.1.4 above.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and reinspection.

1.3 ACCESS TO WORK

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

1.4 PROCEDURES

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

-
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
 - .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.5 REPORTS

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

1.6 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Departmental Representative and may be authorized as recoverable.

1.7 MOCK-UPS

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to Departmental Representative or as specified in specific Section.
- .3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.
- .5 Remove mock-up at conclusion of Work or when acceptable to Departmental Representative.
- .6 Mock-ups may remain as part of Work at the discretion of Departmental Representative.

1.8 MILL TESTS

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

1.9 EQUIPMENT AND SYSTEMS

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

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-S269.2-16, Access Scaffolding for Construction Purposes.
 - .2 CAN/CSA-Z321-96 (R2001), Signs and Symbols for the Occupational Environment.
- .2 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', latest version.

1.2 SUBMITTALS

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

1.3 SCAFFOLDING

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

1.4 ELEVATORS

- .1 Designated existing elevators to be used by construction personnel and transporting of materials. Co-ordinate use with Departmental Representative.
- .2 Provide protective coverings for finish surfaces of cars and entrances.

1.5 SITE STORAGE/LOADING

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.6 CONSTRUCTION PARKING

- .1 Only paid parking is available near the site.

1.7 OFFICES

- .1 Provide office space of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Maintain a complete and updated set of all contract documents and approved submittals, including, but not limited to, drawings, specifications, addenda, shop drawings, site instructions, change orders

- .3 Provide marked and fully stocked first-aid case in a readily available location.
- .4 Provide 2-914 x 2440 mm tables and 12 chairs for site meetings.

1.8 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.9 SANITARY FACILITIES

- .1 Existing sanitary facilities may not be used. Provide temporary outdoor facilities for use by Contractor personnel.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.10 CONSTRUCTION SIGNAGE

- .1 No advertising will be permitted on site.
- .2 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .3 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative.

1.11 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Store materials resulting from demolition activities that are salvageable.
- .3 Stack stored new or salvaged material not in construction facilities.

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 Conform to reference standards in whole or in part as specifically requested in specifications.
- .2 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .3 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

- .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.4 TRANSPORTATION

- .1 Be responsible for transportation of products required in performance of Work.
- .2 The Departmental Representative is responsible for transportation of products supplied by Departmental Representative.
- .3 Unload, handle and store all products, including those supplied by Departmental Representative.

1.5 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.6 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.7 CO-ORDINATION

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

1.8 CONCEALMENT

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

1.9 REMEDIAL WORK

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

1.10 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate and subject to relocation prior to installation within a radius of up to 3000mm from the location shown to suit site conditions, interferences or other conditions determined by the Departmental Representative.
- .2 Inform Departmental Representative of conflicting installation. Install as directed.

1.11 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 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.
- .4 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .5 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.12 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.13 PROTECTION OF WORK IN PROGRESS

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

1.14 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.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. 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 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of elements of project.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of operational elements.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of Departmental Representative or separate contractor.
- .3 Include in request:
 - .1 Identification of project.
 - .2 Location and description of affected Work.
 - .3 Statement on necessity for cutting or alteration.
 - .4 Description of proposed Work, and products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on Work of Departmental Representative or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

1.2 MATERIALS

- .1 Required for original installation.

1.3 PREPARATION

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

1.4 EXECUTION

- .1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.
- .2 Fit several parts together, to integrate with other Work.

- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Remove samples of installed Work for testing as requested.
- .6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .7 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .8 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .10 Restore work with new products in accordance with requirements of Contract Documents.
- .11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .12 Provide firestopping in accordance with Section 07 84 00 - Firestopping to maintain the integrity of fire separations, including:
 - .1 Protecting penetrations at fire-resistance rated wall, ceiling or floor construction.
 - .2 Using construction joint fire stops and building perimeter fire stops to protect gaps at fire separations and between fire separations and other construction assemblies..
- .13 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .14 Conceal pipes, ducts and wiring in floor, wall and ceiling construction except where indicated otherwise.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Waste Management Goals

- .1 Prior to start of Work conduct meeting with Departmental Representative to review and discuss Waste Management Plan and Goals.
- .2 Waste Management Goal 75 percent of total Project Waste to be diverted from landfill sites. Provide Departmental Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3 Accomplish maximum control of solid construction waste.
- .4 Preserve environment and prevent pollution and environment damage.
- .5 Waste materials (i.e. materials that cannot be reused, refurbished or recycled) will be properly labelled, stored, transported and disposed in compliance with the requirements of all applicable rules and regulations of Federal, Provincial and Municipal authorities having jurisdiction and the requirements of the protocols designated in the Specifications.
- .6 The Ontario regulations mandate waste audits, waste reduction work plans and source separation (recycling) programs.
- .7 The Ontario 3Rs Regulations consist of four regulations, made under the Ontario *Environmental Protection Act* (EPA). Two of the regulations apply to federal facilities (O. Reg 102 and 103).

1.2 Definitions

- .1 Class III: non-hazardous waste - construction renovation and demolition waste.
- .2 Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices. Refer to Schedule C.
- .3 Demolition Waste Audit (DWA): relates to actual waste generated from project.
- .4 Inert Fill: inert waste - exclusively asphalt and concrete.
- .5 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

- .9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
- .10 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .11 Separate Condition: refers to waste sorted into individual types.
- .12 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .13 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.
- .14 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .15 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).
- .16 Waste Management Summary Report (MWSR): a one page report summarizing the total reuse, recycling and landfill percentages of all materials removed from site accompanied by copies of all material tracking forms. Refer to Schedule D.

1.3 Documents

- .1 Maintain at job site, one copy of following documents:
 - .1 Waste Audit.
 - .2 Waste Reduction Workplan.
 - .3 Material Source Separation Plan.
 - .4 Waste Management Summary Report
 - .5 Schedules A, B, C and D completed for project.

1.4 Submittals

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit following prior to project site start-up:
 - .1 Submit 2 copies of completed Waste Audit (WA): Schedule A.
 - .2 Submit 2 copies of completed Waste Reduction Workplan (WRW): Schedule B.
 - .3 Submit 2 copies of Cost/Revenue Analysis Workplan (CRAW): Schedule C.
 - .4 Submit 2 copies of template for Waste Management Summary Report (WMSR): Schedule D, for review, revision as directed, and approval by Departmental Representative

- .5 Submit 2 copies of template for Materials Source Separation Program (MSSP) description, for review, revision as directed, and approval by Departmental Representative
- .3 Submit before final payment the following documentation of waste materials salvaged for reuse, recycling or disposal by project:
 - .1 Submit 2 copies of completed Waste Management Summary Report (WMSR).
 - .1 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.
 - .2 For each material reused, sold or recycled from project, include amount in tonnes or quantities by number, type and size of items and the destination.
 - .3 For each material land filled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

1.5 Quality Assurance – Compliance Requirements

- .1 Comply with the Environmental Protection Act
- .2 Comply with (Ontario Regulation 101/94 - Recycling and Composting of Municipal Wastes
- .3 Comply with Ontario Regulation 102/94) - Waste Audits and Waste Reduction Work Plans
- .4 Comply with Ontario Regulation 103/94- Industrial, Commercial and Institutional (IC&I) Source Separation Programs
- .5 Comply with Ontario Regulation 105/94 - General Waste Management Amendment

1.6 Waste Audit (WA)

- .1 Conduct WA prior to project start-up.
- .2 Prepare WA: Schedule A.
- .3 Record, on WA - Schedule A, extent to which materials or products used consist of recycled or reused materials or products.

1.7 Waste Reduction Workplan (WRW)

- .1 Prepare WRW (Schedule B) prior to project site start-up.
- .2 WRW should include but not limited to:
 - .1 Destination of materials listed.
 - .2 Deconstruction/disassembly techniques and sequencing.
 - .3 Schedule for deconstruction/disassembly.
 - .4 Location.
 - .5 Security.
 - .6 Protection.
 - .7 Clear labelling of storage areas.
 - .8 Details on materials handling and removal procedures.
 - .9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.

- .3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .4 Describe management of waste.
- .5 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.
- .6 Post WRW or summary where workers at site are able to review content.
- .7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

1.8 Cost /Revenue Analysis Workplan (CRAW)

- .1 Prepare CRAW: Schedule C.

1.9 Waste Management Summary Report (WMSR)

- .1 Prepare WMSR after project completion.
- .2 Prepare WMSR: Schedule D
- .3 Provide details of quantities of materials salvaged for reuse, recycling or disposal. Reports must be accompanied by copies of weigh bills/receipts/manifests/invoices from authorized facilities validating the figures stated in the reports.

1.10 Materials Source Separation Program (MSSP)

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Departmental Representative.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials.
- .5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .6 Locate separated materials in areas which minimize material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
 - .1 Transport to approved and authorized recycling facility.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.
 - .1 Ship materials to site operating under Certificate of Approval.
 - .2 Materials must be immediately separated into required categories for reuse or recycling.

1.11 Storage, Handling and Protection

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Protect structural components not removed for demolition from movement or damage.
- .5 Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.
- .6 Protect surface drainage, mechanical and electrical from damage and blockage.
- .7 Separate and store materials produced during dismantling of structures in designated areas.
- .8 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
 - .1 On-site source separation is recommended.
 - .2 Remove co-mingled materials to off-site processing facility for separation.
 - .3 Provide waybills for separated materials.

1.12 Disposal of Wastes

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Total tonnage generated.
 - .4 Tonnage reused or recycled.
 - .5 Reused or recycled waste destination.
- .4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.
- .6 The Contractor shall not undertake any off-site transportation of demolition materials, rubble or debris unless all required permits have been obtained. The contractor shall be responsible for obtaining the necessary permits.
- .7 All workers, haulers and subcontractors must possess current, applicable Certificates of Approval and Licenses in accordance with all applicable Ontario regulations to remove, handle and dispose of non-hazardous wastes. Provide proof of compliance within 24 hours upon written request of Departmental Representative.

- .8 The Contractor is required to protect all recoverable materials from but not limited to: weather, theft, vandalism, animals, etc.

1.13 Use of Site and Facilities

- .1 Execute work with least possible interference or disturbance to normal use of premises.
.2 Maintain security measures established by existing facility.

1.14 Scheduling

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

1.15 Sequencing

- .1 Coordinate Work with other activities at site to ensure timely and orderly progress of work.
.2 Organize the site and workers in a manner that promotes waste reduction and the salvage and separation of materials for reuse and recycling.
.3 As a minimum, and in accordance with Ontario Regulation 103/94, separate and divert the following materials from landfill or incineration. (*Italics indicate those items required to be separated under 3Rs regulations*). Diverted materials shall be transported to approved facilities.
.1 Construction and Demolition Wastes
.2 Wood (not including painted or treated or laminated wood)
.3 Brick, Portland Cement Concrete (not including lead painted, adhesives or otherwise contaminated)
.4 Steel
.5 Metals (Metal work, electrical wire, metal plumbing, metal roofing, etc.)

PART 2 PRODUCTS

2.1 Not Used

- .4 Not Used.

PART 3 EXECUTION

3.1 Application

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

3.2 Cleaning

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.

- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

3.3 Waste Management Plan Implementation

- .1 Manager: Contractor to designate an on-site party (or parties) responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.
- .2 Distribution: Contractor to distribute copies of the Waste Management Plan to the Job Site Foreman, each Subcontractor, and the Departmental Representative.
- .3 Instruction: Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.
- .4 Separation facilities: Contractor shall lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.
- .5 Hazardous wastes: Hazardous wastes shall be separated, stored, and disposed of according to local regulations.
- .6 Application for Progress Payments: Contractor shall submit with each Application for Progress Payment a Summary of Waste Generated by the Project:
 - .1 Failure to submit this information shall render the Application for Payment incomplete and shall delay Progress Payment.
 - .2 The Summary shall be submitted on a form acceptable to the Departmental Representative and shall contain the following information:
 - .1 The amount in tonnes or cubic metres (tons or cubic yards) of material land filled from the Project,
 - .2 The identity of the landfill, the total amount of tipping fees paid at the landfill, and
 - .3 The total disposal cost. Include manifests, weight tickets, receipt, and invoices.
 - .3 For each material recycled, reused, or salvaged from the Project, the amount tonnes of cubic metres (tons or cubic yards), the date removed from the job site, the receiving party, the transportation cost, the amount of any money paid or received for the recycled or salvaged material, and the net total cost or savings of salvage or recycling each material.
 - .4 Attach manifests, weight tickets, receipts, and invoices.

3.4 Canadian Governmental Departments Chief Responsibility for the Environment

- .1 Schedule E – Government Chief Responsibility for the Environment
- .2 Ontario Ministry of Environment 135 St. Clair Avenue West, Toronto, ON M4V 1P5. Tel: 416 323-4321, 800- 565-4923. Fax: 416- 323-4682.
- .3 Environment Canada, Toronto, ON. Tel: 416-734-4494.

3.5 Waste Audit (WA)

- .1 Schedule A - Waste Audit (WA):

(1) Material Category	(2) Material Quantity Unit	(3) Estimated Waste %	(4) Total Quantity of Waste (unit)	(5) Generation Point	(6) % Recycled	(7) % Reused
Wood and Plastics Material Description						
Off-cuts						
Warped Pallet Forms						
Plastic Packaging						
Cardboard Packaging						
Other						
Doors and Windows Material Description						
Painted Frames						
Glass						
Wood						
Metal						
Gypsum Board						
Flooring						
Other (Specify)						

3.6 Waste Reduction Workplan (WRW)

.1 Schedule B – Waste

(1) Material Category	(2) Person(s) Respon- sible	(3) Total Quantity of Waste (unit)	(4) Reused Amount (units) Projected	Actual	(5) Recycled Amount (unit) Projected	Actual	(6) Material(s) Destina- tion
Wood and Plastics Material Description							
Chutes							
Warped Pallet Forms							
Plastic Packag ing							
Card- board Packag ing							
Other							
Doors and Windows Material Description							
Painted Frames							
Glass							
Wood							
Metal							
Gypsum Board							
Other (Specify)							

3.7 Cost/Revenue Analysis Workplan (CRAW)

.1 Schedule C - Cost/Revenue Analysis Workplan (CRAW):

(1) Material Description	(2) Total Quantity (unit)	(3) Volume (cum)	(4) Weight (cum)	(5) Disposal Cost/Credit \$(+/-)	(6) Category Sub-Total \$(+/-)
Wood					
Wood Stud					
Plywood					
Baseboard - Wood					
Door Trim - Wood					
Cabinet					
Doors and Windows					
Panel Regular					
Slab Regular					
Wood Laminate					
Gypsum Board					
Flooring					
Glazing					
Metal					
		(7) Cost (-) / Revenue (+)			

3.8 Waste Management Summary Report (WMSR)

.1 Schedule D – Waste Management Summary Report (WMSR):

(1) Material Description	(2) Quantity	(3) Unit	(4) Total	(5) Volume (cum)	(6) Weight (cum)	(7) Remarks and Assumptions
Wood						
Wood Stud						
Plywood						
Baseboard-Wood						
Door Trim - Wood						
Cabinet						
Doors and Windows						
Panel Regular						
Slab Regular						
Wood Laminate						
Gypsum Board						
Flooring						
Glazing						
Metal						

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 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 operated interactively with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by 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.

1.3 COMMISSIONING OVERVIEW

- .1 For Cx responsibilities refer to Section 01 91 13.13 - Commissioning Plan.
- .2 Cx to be a line item of Contractor's cost breakdown.
- .3 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .4 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built 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.
- .5 Departmental Representative will issue Interim Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

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

1.5 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review Contract Documents, confirm by writing 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.

1.6 CONFLICTS

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

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Contractor's Cx agent, credentials, qualifications, list of projects completed and Client references..
 - .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 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

- .1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) /Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Departmental Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Departmental Representative.
- .4 Refer to Appendix 'A' - Start-up and Process Verifications Checklists.

1.9 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.
 - .5 Duration of Cx activities per system/major equipment.

1.10 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings: Section 01 00 10 - General Instructions 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. Section Section 01 00 10 - General Instructions. 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 Departmental Representative, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.11 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.

1.12 WITNESSING OF STARTING AND TESTING

- .1 Provide 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.

1.13 MANUFACTURER'S INVOLVEMENT

- .1 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.

1.14 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 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.

1.15 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 Operate and maintain systems for length of time required for commissioning to be completed.
- .3 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.16 TEST RESULTS

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

1.17 START OF COMMISSIONING

- .1 Notify Departmental Representative at least 21 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.18 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.

1.19 COMMISSIONING PERFORMANCE VERIFICATION

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

1.20 WITNESSING COMMISSIONING

- .1 Departmental Representative to witness activities and verify results.

1.21 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.

1.22 EXTENT OF VERIFICATION

- .1 Laboratory areas:
 - .1 Provide manpower and instrumentation to verify up to 100% of reported results.
- .2 Elsewhere:
 - .1 Provide manpower and instrumentation to verify up to 30% of reported results, unless specified otherwise in other sections.
- .3 Number and location to be at discretion of Departmental Representative.
- .4 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .5 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .6 Perform additional commissioning until results are acceptable to Departmental Representative.

1.23 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.

1.24 SUNDRY CHECKS AND ADJUSTMENTS

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

1.25 DEFICIENCIES, FAULTS, DEFECTS

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

1.26 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Departmental Representative.

1.27 ACTIVITIES UPON COMPLETION OF COMMISSIONING

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

1.28 OCCUPANCY

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

1.29 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.

1.30 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 $\pm 10\%$ of specified values.

- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within $\pm 2\%$ of recorded values.

1.31 DEPARTMENTAL REPRESENTATIVE'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 REFERENCE STANDARDS

- .1 Public Works and Government Services Canada (PWGSC)
 - .1 PWGSC - Commissioning Guidelines CP.3.

1.2 GENERAL

- .1 Provide a fully functional facility:
 - .1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
 - .2 Optimized life cycle costs.
 - .3 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this section means "Commissioning".
- .3 Use this Cx Plan as master planning document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
 - .3 Sets out deliverables relating to O&M, process and administration of Cx.
 - .4 Describes process of verification of how built works meet design requirements.
 - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
 - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Cx.
 - .2 General description of elements that make up Cx Plan.
 - .3 Process and methodology for successful Cx.
- .4 Acronyms:
 - .1 Cx - Commissioning.
 - .2 BMM - Building Management Manual.
 - .3 EMCS - Energy Monitoring and Control Systems.
 - .4 WHMIS Safety Data Sheets (SDS).
 - .5 PI - Product Information.
 - .6 PV - Performance Verification.
 - .7 TAB - Testing, Adjusting and Balancing.
 - .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
 - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
 - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.3 DEVELOPMENT OF 100% CX PLAN

- .1 Cx Plan to be 95% completed before added into Project Specifications.
- .2 Cx Plan to be 100% completed within 8 weeks of award of contract to take into account:
 - .1 Contractor's project schedule.
 - .2 Cx schedule.
 - .3 Contractor's, sub-contractor's, suppliers' requirements.
 - .4 Project construction team's and Cx team's requirements.
- .3 Submit completed Cx Plan to Departmental Representative and obtain written approval.

1.4 REFINEMENT OF CX PLAN

- .1 Revise, refine and update every 6 weeks during construction phase. At each revision, indicate revision number and date.
- .2 Submit each revised Cx Plan to Departmental Representative for review and obtain written approval.
- .3 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

1.5 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

- .1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
- .2 Departmental Representative will select Cx Team consisting of following members:
 - .1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.
 - .2 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
 - .1 Review of Cx documentation from operational perspective.
 - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
 - .3 Protection of health, safety and comfort of occupants and O&M personnel.
 - .4 Monitoring of Cx activities, training, development of Cx documentation.
 - .5 Work closely with members of Cx Team.
 - .3 Departmental Representative is responsible for:
 - .1 Organizing Cx.
 - .2 Monitoring operations Cx activities.
 - .3 Witnessing, certifying accuracy of reported results.
 - .4 Witnessing and certifying TAB and other tests.
 - .5 Developing BMM.
 - .6 Ensuring implementation of final Cx Plan.
 - .7 Performing verification of performance of installed systems and equipment.

- .8 Implementation of Training Plan.
- .4 Construction Team: contractor, subcontractors, suppliers and support disciplines, is responsible for construction/installation in accordance with Contract Documents, including:
 - .1 Testing.
 - .2 TAB.
 - .3 Performance of Cx activities.
 - .4 Delivery of training and Cx documentation.
 - .5 Assigning one person as point of contact with Consultant and PWGSC Cx Manager for administrative and coordination purposes.
- .5 Contractor's Cx agent implements specified Cx activities including:
 - .1 Testing.
 - .2 Preparation, submission of test reports.
- .6 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:
 - .1 Receiving facility.
 - .2 Day-To-Day operation and maintenance of facility.

1.6 CX PARTICIPANTS

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

1.7 EXTENT OF CX

- .1 Commission mechanical systems and associated equipment:
 - .1 Mechanical systems:
 - .1 HVAC systems.
 - .2 General exhaust systems.
 - .3 Exhaust systems and related systems.
 - .4 Laboratory fume hoods and related systems.
 - .5 Compressed air.
 - .6 Nitrogen.
 - .2 Architectural:
 - .1 Air tightness of wall between RCMP and HC.
 - .3 Electrical:
 - .1 Electrical panels.
 - .2 Circuit identification.

1.8 DELIVERABLES RELATING TO THE CX PROCESS

- .1 General:
 - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
 - .1 Cx as used in this section includes:
 - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
 - .2 Factory inspections and performance verification tests.
- .3 Deliverables: provide:
 - .1 Cx Specifications.
 - .2 Startup, pre-Cx activities and documentation for systems, and equipment.
 - .3 Completed performance verification (PV) report forms.
 - .4 Results of Performance Verification Tests and Inspections.
 - .5 Description of Cx activities and documentation.
 - .6 Description of Cx of integrated systems and documentation.
- .4 Departmental Representative to witness and certify tests and reports of results provided to Departmental Representative.
- .5 Departmental Representative to participate.

1.9 START-UP

- .1 Start up components, equipment and systems.
- .2 Departmental Representative to monitor some of these start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of Departmental Representative.

- .3 Performance Verification (PV):
 - .1 Approved Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to Departmental Representative.
 - .2 Use procedures modified generic procedures to suit project requirements.
 - .3 Departmental Representative to witness and certify reported results using approved PV forms.
 - .4 Departmental Representative to approve completed PV reports and provide to Departmental Representative.
 - .5 Departmental Representative will verify up to 30% of reported results at random.
 - .6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

1.10 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency using procedures developed by Departmental Representative and approved by Departmental Representative.
- .2 Departmental Representative to monitor Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .4 Departmental Representative to witness, certify reported results of, Cx activities and forward to Departmental Representative.
- .5 Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

1.11 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Cx to be performed by specified Cx specialist, using procedures developed by Departmental Representative and approved by Departmental Representative.
- .2 Tests to be witnessed by Departmental Representative and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Departmental Representative and submitted to Departmental Representative for review.
- .4 Departmental Representative reserves right to verify percentage of reported results.
- .5 Integrated systems to include:
 - .1 HVAC and associated systems forming part of integrated HVAC systems.
 - .2 Lab & fume hood controls.

1.12 PERFORMANCE VERIFICATION (PV) REPORT

- .1 Refer to Section 01 91 13.16 - Commissioning Forms: Installation Check Lists and Product Information (PI) /Performance Verification (PV) Forms.

1.13 CX SCHEDULES

- .1 Prepare detailed critical path Cx Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule. Include:
 - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
 - .1 Design criteria, design intents.
 - .2 Cx agents' credentials: 20 days before start of Cx.
 - .3 Cx procedures: 1 month after award of contract.
 - .4 Cx Report format: 1 months after contract award.
 - .5 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
 - .6 Notification of intention to start TAB: 21 days before start of TAB.
 - .7 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
 - .8 Notification of intention to start Cx: 14 days before start of Cx.
 - .9 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
 - .10 Identification of deferred Cx.
 - .11 Implementation of training plans.
 - .12 Cx reports: immediately upon successful completion of Cx.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Consultant, Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

1.14 CX REPORTS

- .1 Submit reports of tests, witnessed and certified by Departmental Representative to Departmental Representative who will verify reported results.
- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by Departmental Representative.

1.15 FINAL SETTINGS

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

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

- END OF SECTION -

PART 1 - GENERAL

1.1 INSTALLATION/START-UP CHECK LISTS

- .1 Include the following data:
 - .1 Product manufacturer's installation instructions and recommended checks.
 - .2 Special procedures as specified in relevant technical sections.
 - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.

1.2 PERFORMANCE VERIFICATION (PV) FORMS

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

1.3 SAMPLES OF COMMISSIONING FORMS

- .1 Departmental Representative will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
- .2 Revise items on Commissioning forms to suit project requirements.

1.4 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

- .1 When additional forms are required, but are not available from Departmental Representative develop appropriate verification forms and submit to Departmental Representative for approval prior to use.

1.5 COMMISSIONING FORMS

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
 - .1 Departmental Representative provides Contractor project-specific Commissioning forms with Specification data included.
 - .2 Confirm operation as per design criteria and intent.

- .3 Identify variances between design and operation and reasons for variances.
- .4 Verify operation in specified normal and emergency modes and under specified load conditions.
- .5 Record analytical and substantiating data.
- .6 Verify reported results.
- .7 Form to bear signatures of recording technician and reviewed and signed off by Departmental Representative.
- .8 Submit immediately after tests are performed.
- .9 Reported results in true measured SI unit values.
- .10 Provide Departmental Representative with originals of completed forms.
- .11 Maintain copy on site during start-up, testing and commissioning period.
- .12 Forms to be both hard copy and electronic format with typed written results in Building Management Manual in accordance with Section 01 92 00 - Facility Operation.

1.6 LANGUAGE

- .1 To suit the language profile of the awarded contract.

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 07 84 00 – Fire Stopping
- .2 Section 09 21 99 – Partitions
- .3 Section 09 51 13 – Acoustical Panel Ceilings
- .4 Section 09 65 16- Resilient Sheet Flooring
- .5 Section 09 68 13 – Tile Carpeting
- .6 Section 09 91 99 - Painting

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI A10.8 2011, Safety Requirements for Scaffolding
- .2 ASTM International (ASTM)
 - .1 ASTM C475/C475M-15, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
- .3 CSA Group (CSA)
 - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 2012
 - .2 Canadian Environmental Protection Act (CEPA), 2012
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34
 - .2 Hazardous Materials Information Review Act, 1985
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 241 13, Standard for Safeguarding Construction, Alteration, and Demolition Operations

1.3 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.
- .2 Remove and Salvage: Detach items from existing construction and deliver them to Departmental Representative.
- .3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.

- .5 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .6 Waste Audit (WA): Detailed inventory of materials in building indicating estimated quantities of reuse, recycling and landfill, prepared in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal and as follows:
 - .1 Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project.
- .7 Waste Reduction Workplan (WRW): Written plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .8 Waste Management Summary Report (WMSR): Written report identifying actual materials that formed WRW Plan for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .9 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB s, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with Departmental Representative for the material ownership as follows:
 - .1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Departmental Representative’s property, demolished materials shall become Contractor ’s property and shall be removed from Project site.
 - .2 Coordinate selective demolition work so that work of this Section adheres to aesthetic criteria established by the Drawings and specified dimensions with all elements in planes as drawn, maintaining their relationships with all other building elements.
 - .3 Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Departmental Representative that may be encountered during selective demolition remain Departmental Representative’s property:
 - .1 Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Departmental Representative.
 - .2 Coordinate with Departmental Representative’s archaeologist historical adviser, who will establish special procedures for removal and salvage.
- .2 Pre Demolition Meeting: Convene pre-installation meeting 1 week prior to beginning work of this Section on-site installation, with Departmental Representative to:
 - .1 Confirm extent of salvaged and demolished materials

- .2 Review Contractor's demolition plan
 - .1 Verify existing site conditions adjacent to demolition work
 - .2 Coordination with other construction sub trades
- .3 Hold project meetings every week.
- .4 Ensure key personnel attend.
- .5 WMC must provide written report on status of waste diversion activity at each meeting.
- .6 Departmental Representative will provide written notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.

1.5 ACTION AND INFORMATION SUBMITTALS

- .1 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Schedule of Selective Demolition Activities: Coordinate with Section 01 00 10 – General Instructions and indicate the following:
 - .1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 - .2 Coordinate with Departmental Representative ongoing site operations, and limit the number of interruptions during regular business hours.
 - .3 Interruption of utility services.
 - .4 Coordination for shutoff, capping, and continuation of utility services.
 - .5 Use of elevator and stairs.
 - .6 Locations of temporary partitions and means of egress, including for others affected by selective demolition operations.
 - .7 Coordination with Departmental Representative's continuing occupancy of portions of existing building and of Departmental Representative's partial occupancy of completed Work
 - .2 Demolition Plan: Submit a plan of demolition area indicating extent of temporary facilities and supports, methods of removal and demolition prepared by a professional engineer in accordance with requirements of Authority Having Jurisdiction, and as follows:
 - .1 Proposed Noise Control and Dust Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Departmental Representative reserves the right to make modifications where proposed methods interfere with the Departmental Representative's ongoing operation
 - .2 Inventory: Submit a list of items that have been removed and salvaged after selective demolition is complete.
 - .3 Pre demolition Photographs: Submit photographs indicating existing conditions of adjoining construction and site improvements prior to starting Work. Include finish surfaces that may be misconstrued as damage caused by selective demolition operations.

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- .2 Informational Submittals: Provide the following submittals when requested by the Departmental Representative :
 - .1 Qualification Data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this Section including; but not limited to, lists of completed projects with project names and addresses, names and addresses of architects and owners, for work of similar complexity and extent.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work as follows; use most restrictive requirements where differences occur between the municipal, provincial and federal jurisdictions:
 - .1 Provincial and Federal Requirements: Perform work in accordance with governing environmental notification requirements and regulations of the Authority Having Jurisdiction.
 - .2 Municipal Requirements: Perform hauling and disposal operations in accordance with regulations of Authority Having Jurisdiction.
- .2 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project:
 - .1 Conform to the provincial Occupational Health and Safety Act and Regulation.
 - .2 Conform to Workers Compensation Board Regulations.
 - .3 Conform to City of Ottawa bylaws and regulations governing this type of work.

1.7 SITE CONDITIONS

- .1 Departmental Representative will occupy portions of building immediately adjacent to selective demolition area:
 - .1 Conduct selective demolition so that Departmental Representative's operations will not be disrupted.
 - .2 Provide not less than 72 hours notice to Departmental Representative of activities that will affect Departmental Representative's operations.
- .2 Maintain access to existing means of egress, walkways, corridors, exits, and other adjacent occupied or used facilities:
 - .1 Do not close or obstruct means of egress, walkways, corridors, exits, or other occupied or used facilities without written acceptance from authorities having jurisdiction.
- .3 Departmental Representative assumes no responsibility for condition of areas to be selectively demolished:
 - .1 Conditions existing at time of Pre Bid Site Review will be maintained by Departmental Representative as far as practical.

- .4 Discovery of Hazardous Substances: if Hazardous Substances are encountered in the Work; immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:
 - .1 Refer to Section 01 14 25 – Designated Substances Report for directives associated with specific material types.
 - .2 Hazardous materials will be as defined in the Hazardous Materials Act.
 - .3 If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Departmental Representative.

Part 2 Products

2.1 TEMPORARY SUPPORT STRUCTURES

- .1 Design temporary support structures required for demolition work necessary for the project using a qualified professional engineer registered or licensed in province of the Work.

2.2 DESCRIPTION

- .1 This section of the Work includes, but is not necessarily limited to, the following:
 - .1 Demolition, removal completely from site, and disposal of all identified components, materials, equipment and debris
 - .2 Selective demolition to allow new walls, bulkheads, ceilings and other materials to meet existing construction as indicated
 - .3 All material from demolition shall be removed from site immediately with no salvage, selling, sorting or burning permitted on site
 - .4 Retain items indicated on drawings for re use in new construction

2.3 DEBRIS

- .1 Make all arrangements for transport and disposal of all demolished materials from the site.

2.4 EQUIPMENT

- .1 Provide all equipment required for safe and proper demolition of the building interiors indicated.

2.5 REPAIR MATERIALS

- .1 Use repair materials identical to existing materials:
 - .1 If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - .2 Use a material whose installed performance equals or surpasses that of existing material.
 - .3 Comply with material and installation requirements specified in individual Specification Sections.

- .2 Floor Patching and Levelling Compounds: Cement based, trowelable, self levelling compounds compatible with specified floor finishes (provide written confirmation from flooring supplier upon request); gypsum based products are not acceptable for work of this Section.
- .3 Concrete Unit Masonry: Lightweight concrete masonry units, and mortar, cut and trimmed to fit existing opening to be filled. Provide standard hollow core units, square end units and bond beam units as indicated on drawings..
- .4 Gypsum Board Patching Compounds: Joint compound to ASTM C475/C475M, bedding and finishing types thinned to provide skim coat consistency to patch and prepare existing gypsum board walls ready for new finishes in accordance with Section 09 21 16– Gypsum Board Assemblies.
- .5 Hoarding and Dust Screens: provide as required to fully separate area of work from adjacent occupied areas to satisfaction of the Departmental Representative, and to maintain the required fire separation described elsewhere

2.6 EXISTING MATERIALS

- .1 Items to be retained for re use in new construction include, but are not limited to the following:
 - .1 Metal benchwork
 - .2 Ceiling components
 - .3 Window blinds
 - .4 Confirm with Departmental Representative any materials that appear to be in re usable condition prior to disposal.
 - .5 Confirm with Departmental Representative any materials scheduled for re use that are not in re usable condition prior to installation.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that utilities have been disconnected and capped.
- .2 Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- .3 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- .4 Notify the Departmental Representative where existing mechanical, electrical, or structural elements conflict with intended function or design:
 - .1 Investigate and measure the nature and extent of conflict and submit a written report to Departmental Representative.
 - .2 Departmental Representative will issue additional instructions or revise drawings as required to correct conflict.
- .5 Perform surveys as the work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- .1 Coordinate existing services indicated to remain and protect them against damage during selective demolition operations.
- .2 Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - .1 Arrange to shut off affected utilities with utility companies.
 - .2 If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 - .3 Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - .4 Cut off pipe or conduit to a minimum of 25 mm below slab, and remove concrete mound. Patch concrete using cementitious grout.
- .3 Coordinate with Mechanical and Electrical Divisions for shutting off, disconnecting, removing, and sealing or capping utilities.
- .4 Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

- .1 Identify and mark all equipment and materials identified to be retained by Departmental Representative or to be re used in subsequent construction. Separate and store items to be retained in an area away from area of demolition and protect from accidental disposal.
- .2 Post warning signs on electrical lines and equipment that must remain energized to serve other areas during period of demolition.
- .3 Confirm that all electrical and telephone service lines entering buildings are not disconnected.
- .4 Do not disrupt active or energized utilities crossing the demolition site.
- .5 Provide and maintain barricades, warning signs, protection for workmen and the public during the full extent of the Work. Read drawings carefully to ascertain extent of protection required.
- .6 Mark all materials required to be re used, store in a safe place until ready for re installation.
- .7 Adjust all junction boxes, receptacles and switch boxes flush with new wall construction where additional layers to existing construction are indicated.
- .8 Remove permanent marker lines used or found on exposed surfaces and at surfaces indicated for subsequent finish materials. Mechanically remove permanent marker lines and associated substrates where permanent marker lines occur and patch surface. Sealing or priming over permanent marker lines is not acceptable.

3.4 CONCRETE SLAB REINFORCING

- .1 Locate location of reinforcing steel in concrete slabs prior to cutting or coring using non destructive, non ionizing radio frequency locators.
- .2 Core concrete slabs to avoid reinforcing steel, electrical conduit or water pipes; adjust core location and coordinate with Departmental Representative where slab features interfere with core drilling.
- .3 Notify the Departmental Representative immediately for further instructions where coring or cutting will damage existing slab features.

3.5 SELECTIVE DEMOLITION

- .1 Demolish and dismantle work in a neat and orderly manner and in strict accordance with all regulations.
- .2 At end of each day s work, leave Work in safe condition so that no part is in danger of toppling or falling.
- .3 Demolish in a manner to minimize dusting and to prevent migration of dust.
- .4 Selling or burning of materials on the site is not permitted.
- .5 Remove concrete bases by cutting and chipping, take precautions against slab cracking and degradation. Grind edges smooth, fill and make level with self levelling grout.
- .6 Fill all openings in concrete block walls with concrete masonry units, coursing to match existing, prepare ready to receive new finishes to match existing.
 - .1 Provide bond beams in new openings cut into existing concrete masonry unit walls.
 - .2 Provide finished end masonry units to patch and repair for new jamb sections in existing concrete masonry unit walls.
- .7 Fill all openings in gypsum board walls with gypsum board and steel framing to match existing, skim coat to make wall smooth and even.
- .8 Demolish existing carpet, resilient flooring and adhesive remnants as follows:
 - .1 Vacuum existing carpet thoroughly, prior to removal, using vacuum equipped with power head/sweeper.
 - .2 Apply fine mist water spray to carpet as required to minimize dust generation during removal. Avoid spraying near electrical outlets.
 - .3 Demolish existing carpet and resilient floor finishes, remove and dispose of off site.
 - .4 Remove adhesive to the greatest extent possible using scrapping tools and as follows:
 - .1 Do not use solvent based cleaners to remove adhesive remnants.
 - .2 Lightly shot blast or grind floor using machine designed for purpose to remove adhesive remnants.
 - .3 Vacuum floor ready for application of skim coating.
 - .4 Repair all slab depressions and damage with cementitious patching compound.

- .5 Skim coat floor with minimum 1 mm thick cementitious floor underlayment compatible with new flooring materials and following underlayment supplier recommendations.
- .5 Floor substrate shall be smooth, free from ridges and depressions, and adhesive remnants that could telegraph through resilient flooring materials and carpets.
- .6 Recycle materials in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .9 Demolish existing ceramic tile finishes. Remove setting bed or adhesive to the greatest extent possible using mechanical scrapping tools and as follows:
 - .1 Saw cut edge of tile for clean and even transition joint between existing tile to remain and new flooring materials
 - .2 Lightly shot blast or grind floor to remove remnants of setting materials
 - .3 Vacuum floor ready for application of skim coating
 - .4 Repair all slab depressions and damage with cementitious patching compound. Skim coat floor with minimum 1 mm thick cementitious floor underlayment compatible with new flooring materials
- .10 Demolish completely all ceiling panels and grid as indicated.
- .11 Remove all wall coverings scheduled for demolition. Patch and repair wall surfaces with skim coat of gypsum board joint compound leaving wall surfaces smooth and even ready for new wall finishes.
- .12 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.
- .13 Patch and repair all radiation cabinets, mechanical equipment and electrical fixtures damaged or exposed during demolition to match adjacent finished surfaces.

3.6 PATCHING AND REPAIRING

- .1 Floors and Walls:
 - .1 Where walls or partitions that are demolished extend from one finished area into another, patch and repair floor and wall surfaces in the new space.
 - .2 Provide a level and smooth surface having uniform finish colour, texture, and appearance.
 - .3 Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.
 - .4 Patch with durable seams that are as invisible as possible.
 - .5 Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - .6 Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - .7 Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

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- .2 Ceilings: patch, repair, or re hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.7 PROTECTION

- .1 Prevent debris from blocking drainage inlets and systems and ground draining, and protect material and electrical systems and services that must remain in operation.
- .2 Arrange demolition and shoring work so that interference with the use of adjoining areas by the Departmental Representative and users is minimized.
- .3 Maintain safe access to and egress from occupied areas adjoining.
- .4 Provide and maintain fire prevention equipment and alarms accessible during demolition.

3.8 CLEANING

- .1 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .2 Waste Management: Separate waste materials for reuse recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal, and as follows:
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .3 Divert excess materials from landfill to site approved by Departmental Representative.
- .4 Promptly as the Work progresses, and on completion, clean up and remove from the site all rubbish and surplus material. Remove rubbish resulting from demolition work daily.
- .5 Maintain access to exits clean and free of obstruction during removal of debris.
- .6 Keep surrounding and adjoining roads, lanes, sidewalks, municipal rights of way clean and free of dirt, soil or debris that may be a hazard to vehicles or persons.
- .7 Transport material designated for alternate disposal using approved facilities listed in WRW and in accordance with applicable regulations.
 - .1 Written authorization from Departmental Representative is required to deviate from receiving organizations haulers facilities listed in WRW.
- .8 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.
 - .1 Disposal facilities must be those approved of and listed in WRW.
 - .2 Written authorization from Departmental Representative is required to deviate from disposal facilities listed in WRW.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 - Joint Sealants
- .2 Section 09 91 99 - Interior Painting for Minor Works

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASME 18.6.1 1981 (R2016) Wood Screws (Inch Series).
 - .2 ANSI/BHMA A156.9-2015, Cabinet Hardware.
 - .3 ANSI/BHMA A156.11-2014, Cabinet Locks.
 - .4 ANSI/BHMA A156.16-2013, Auxiliary Hardware.
 - .5 ANSI/BHMA A156.18-2016, Materials and Finishes.
 - .6 ANSI A208.1-R2016, Particleboard.
 - .7 ANSI A208.2-2016, Medium Density Fiberboard (MDF) for Interior Applications.
 - .8 ANSI/HPVA HP-1-2016, Standard for Hardwood and Decorative Plywood.
- .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC)
 - .1 North American Architectural Woodwork Standards (AWMAC AWS), 2017.
- .3 ASTM International
 - .1 ASTM A 153/A 153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .2 ASTM E 1333-14, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates From Wood Products Using a Large Chamber.
 - .3 ASTM F1667-17 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .4 CSA International
 - .1 CSA O112-M Series 1977 (R2006) Standards for Wood Adhesives.
 - .2 CSA O121-08 (R2013), Douglas Fir Plywood.
 - .3 CSA O141-05 (R2014), Softwood Lumber.
 - .4 CSA O151-17, Canadian Softwood Plywood.
 - .5 CSA O153-M1980 (R2017), Poplar Plywood.
 - .6 CAN/CSA-Z809-08 (R2013), Sustainable Forest Management.
- .5 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2015, FSC Principle and Criteria for Forest Stewardship.
- .6 Green Seal Environmental Standards (GS)
 - .1 GS-11-2015, Paints, Coatings, Stains and Sealers.

- .2 GS-36-2013, Adhesives for Commercial Use.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .8 National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA LD-3-05, High-Pressure Decorative Laminates (HPDL).
- .9 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2016, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2017, Adhesives and Sealants Applications.
- .10 Sustainable Forestry Initiative (SFI)
 - .1 SFI-2015-2019 Standard and Rules.

1.3 PRE-INSTALLATION MEETING

- .1 Prior to enclosing framing, convene a meeting of contractor, casework fabricator, casework installer, framing subcontractor.
 - .1 Review locations of backing required for casework installation as shown on shop drawings and as necessary for installation.
 - .2 Review method of attachment for backing to wall system.
 - .3 Review coordination with other affected sections.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Prepare and submit material list in accordance with AWMAC AWS, cross-referenced to specifications.
 - .2 Include manufacturer's instructions, printed product literature, data sheets and catalogue pages for all materials and products to be incorporated into architectural wood casework and include product characteristics, performance criteria, dimensions and profiles, finish and limitations on use.
 - .3 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Hardware List:
 - .1 Submit hardware list cross-referenced to specifications.
 - .2 Include manufacturer's specification sheets indicating name, model, material, function, finish, BHMA designations and other pertinent information.
- .4 Shop Drawings:
 - .1 Prepare and submit shop drawings in accordance with AWMAC AWS and as follows.
 - .2 Submit of shop drawings review in accordance with requirements of Division 01.

- .3 Indicate details of construction, profiles, jointing, fastening and other related details.
 - .1 Scales: details 1:2 or 1:5 as appropriate.
- .4 Indicate materials, thicknesses, finishes and hardware.
- .5 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.
- .6 Show location on casework elevations of backing required in supporting structure for attachment of casework.
- .7 Indicate AWMAC AWS quality grade where different from predominant grade specified.
- .8 Include color schedule of all casework items, including all countertop, exposed, and semi-exposed cabinet finishes, finish material manufacturer, pattern, and color.
- .9 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
- .5 Samples:
 - .1 Prepare and submit samples in accordance with AWMAC AWS and as follows.
 - .2 Apply sample finishes to specified substrate or core material minimum 300 x 300 mm. For veneers with transparent finish submit duplicate samples to illustrate range and colour of grain expected.
 - .3 Submit duplicate samples of laminated plastic for each specified colour selection.
 - .4 Submit duplicate samples of laminated plastic joints, edging, cutouts.
 - .5 Certifications: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .6 Submit statement of experience and qualifications of architectural wood casework fabricator.

1.5 QUALITY ASSURANCE

- .1 Perform Work of this Section by single architectural wood casework fabricator with minimum 5 years of current architectural casework production experience and having completed minimum one project in the past 5 years with value within 20% of the cost of the work of this Section.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions 01 61 00 - Common Product Requirements.
- .2 Deliver wood casework only when area of work is enclosed, plaster and concrete work is dry, and area is broom clean and site environmental conditions are acceptable for installation.
- .3 Protect millwork against dampness and damage during and after delivery.
- .4 Store millwork in ventilated areas, protected from extreme changes of temperature and humidity, and within range recommended by AWMAC AWS for location of project.

- .5 Store materials indoors in dry location in clean, dry, well-ventilated area.
- .6 Protect architectural woodwork and hardware from nicks, scratches, and blemishes.
- .7 Replace defective or damaged materials with new.
- .8 Waste Management: for packaging and materials, in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SUSTAINABILITY CHARACTERISTICS

- .1 Lumber, plywood and composite wood products to be CAN/CSA-Z809 or FSC or SFI certified.
- .2 Composite wood products: formaldehyde emissions within the following limits when tested in accordance with ASTM E1333.
 - .1 Hardwood plywood with veneer core (HWPW-VC): 0.05 ppm.
 - .2 Hardwood plywood with composite core (HWPW-CC): 0.05 ppm.
 - .3 Particleboard (PB): 0.09 ppm.
 - .4 Medium density fibreboard (MDF): 0.11 ppm.
 - .5 Thin (less than 8 mm) medium density fibreboard (tMDF): 0.13 ppm.
- .3 Recycled content:
 - .1 Fibreboard must contain less than 10 % roundwood by weight, using weighted average over three month period at manufacturing locations.
- .4 Adhesives: VOC limit 30 g/L maximum to SCAQMD Rule 1168.

2.2 QUALITY GRADE

- .1 Provide all materials and perform all fabrication in accordance with AWMAC AWS Custom Grade.
- .2 In case of conflict between Contract Documents and AWMAC AWS grade requirements, Contract Documents govern.

2.3 LUMBER

- .1 Softwood and Hardwood Lumber: Sound lumber to specified AWMAC AWS quality grade requirements, kiln-dried to moisture content recommended by AWMAC AWS for location of the Work.
- .2 Machine stress-rated lumber is acceptable for all purposes.
- .3 Trim, molding, edge-banding, stiles and rails: maple species, in profiles indicated.

2.4 PANEL MATERIALS

- .1 Interior mat-formed wood particleboard: to ANSI/NPA A208.1, industrial grade M-2 or M-3, medium density (640-800 kg/m³), thickness 15 mm (19mm for shelves) unless indicated otherwise.

- .2 Hardwood plywood: to ANSI/HPVA HP-1.
- .3 Hardboard: To CAN/CGSB-11.3.

2.5 LAMINATED PLASTIC MATERIALS

- .1 Laminated plastic for flatwork: to NEMA LD3.
 - .1 Laminated plastic for cabinets – PL1:
 - .1 Formica 949-SP “White”, with texture oriented vertically
 - .2 Laminated plastic for counter – PL2:
 - .1 Formica 949-58 “Mouse”
 - .3 Laminated plastic for backing sheet:
 - .1 Type: backer.
 - .2 Grade: BKL.
 - .3 Thickness: same thickness as face laminate.
 - .4 Colour: white
 - .4 Thermofused Melamine: to NEMA LD3 Grade LPDL, white.
 - .1 High wear resistant thermofused melamine: equal or exceed 400 cycles (Minimum standard for HPL abrasion test).
 - .5 Surface and edge finishing for semi-exposed shelves (behind cabinet doors):
 - .1 Matching melamine and polyester overlay edge strip with thermoplastic adhesive.
 - .6 Laminated plastic adhesive:
 - .1 Adhesive: Subject to manufacturer’s recommendations.

2.6 CASEWORK FABRICATION - GENERAL

- .1 Fabricate casework of specified core and surface finish materials to specified AWMAC AWS quality grade.
 - .1 Construction type: frameless.
 - .2 Door-cabinet interface: flush overlay.
- .2 Set nails and countersink screws apply stained wood filler to indentations, sand smooth and leave ready to receive finish.
- .3 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.
- .4 Shelving to cabinetwork to be adjustable unless otherwise noted.
- .5 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
- .6 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- .7 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.

2.7 WOOD CASEWORK FABRICATION

- .1 Fabricate casework bodies of specified particleboard panel materials in accordance with AWMAC AWS requirements for grade specified and as follows.
 - .1 Cabinet interiors: melamine.
 - .2 Cabinet edges behind doors and drawers: plastic laminate PL1
 - .3 Toe kick: plastic laminate PL1 covered by resilient coved vinyl base
- .2 Fabricate door and drawer surfaces of specified panel material with plastic laminate on exposed face and all edges
- .3 Drawer construction:
 - .1 Sides: LPDL melamine surface.
 - .2 Bottoms: Tempered hardboard
 - .3 Joinery: Meeting requirements of AWMAC AWS for Grade specified.

2.8 CABINET HARDWARE

- .1 Cabinet hardware: to AWMAC AWS quality grade specified and to ANSI/BHMA A156.9, designated by letter B and numeral identifiers as listed below.
- .2 Finish:
 - .1 Exposed hardware: satin stainless steel.
 - .2 Semi-exposed hardware: Manufacturer's standard finish.
- .3 Casework door hinges: concealed European style Grade II hinges minimum 120° opening.
- .4 Pulls: surface mounted wire D- pull, type B02191, finished to 630, 140mm centres, 8mm dia.
- .5 Shelf brackets and standards: type recessed vertical slotted shelf standard, with shelf brackets.
- .6 Drawer slides:
 - .1 Slide type: side mounted.
 - .2 Extension and capacity: full extension meeting requirements of AWMAC AWS for type and size of drawer.

2.9 CABINET LOCKS

- .1 Do not provide locks

2.10 ACCESSORIES

- .1 Wood screws: stainless steel, type and size to suit application.
- .2 Nails and staples: to CSA B111 and ASTM F1667.
- .3 Splines: wood or metal.
- .4 Sealant: in accordance with Section 07 92 00 - Joint Sealants.

2.11 LAMINATED PLASTIC COUNTERTOPS

- .1 Laminated plastic for flatwork: to NEMA LD3.
 - .1 Formica 949-58 "Mouse"
- .2 Core material: 19 mm exterior grade hardwood plywood with a non-telegraphing grain.
 - .1 Countertops to receive plumbing fixtures: Veneer core plywood with type II adhesive.
- .3 Back splashes: per drawings.
- .4 Front edges: per drawings.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for architectural woodwork installation in accordance with manufacturer's 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 architectural wood casework in accordance with AWMAC AWS grade for respective items.
- .2 In case of conflict between Contract Documents and AWMAC AWS grade requirements, Contract Documents govern.
- .3 Install prefinished millwork at locations shown on drawings.
 - .1 Position accurately, level, plumb straight.
- .4 Fasten and anchor millwork securely.
 - .1 Supply and install heavy duty fixture attachments for wall mounted cabinets.
- .5 Countersink mechanical fasteners at exposed and semi-exposed surfaces, excluding installation attachment screws and screws securing cabinets end to end.
- .6 Use draw bolts in countertop joints.
- .7 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.
- .8 At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant in accordance with Section 07 92 00 - Joint Sealants.
- .9 Apply moisture barrier between wood framing members and masonry or cementitious construction.

- .10 Fit hardware accurately and securely in accordance with manufacturer's written instructions.
- .11 Make cutouts for inset equipment and fixtures using templates provided.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 10 – General Instructions.
 - .1 Clean surfaces of millwork, inside cupboards, and drawers.
 - .2 Remove excess glue, pencil and ink marks from surfaces.
- .3 Waste Management: separate waste materials for recycling and reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.4 PROTECTION

- .1 Protect millwork from damage until final inspection.
- .2 Protect installed products and components from damage during construction.
- .3 Repair damage to adjacent materials caused by architectural woodwork installation.
- .4 Leave work to be site finished ready for finishing by Section 09 91 99 – Painting for Minor Works.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 21 99 - Partitions

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
- .3 Underwriter's Laboratories of Canada (ULC)
 - .1 ULC-S115-11(R2016), Fire Tests of Fire stop Systems.

1.3 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 Tightly Fitted; (ref: NBC Part 3.1.9.1(1) and 9.10.9.6(1)): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
 - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Select fire stop system appropriate to required fire resistance ratings, existing site conditions, and proposed fire stop products.
- .2 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .3 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 in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Shop Drawings:

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- .1 Submit shop drawings to show location, proposed firestop system, material, reinforcement, anchorage, fastenings and method of installation.
 - .2 Proposed fire stop system must be ULC or cUL listed to demonstrate that it is recognized in Canada
 - .3 Construction details shall accurately reflect actual job conditions.
 - .4 Provide Engineering Judgement when a ULC or cUL listed firestop system is not available for, or requires modification to suit, site conditions.
 - .5 Samples:
 - .1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.
 - .6 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
 - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire system with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials and systems 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.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in fire stopping installations approved by manufacturer.
- .2 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with Departmental Representative contractor's representative in accordance with Section 01 00 10 – General Instructions 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 Once during progress of Work at 60% complete.
- .3 Upon completion of Work, after cleaning is carried out.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
 - .1 Store materials in dry location indoors 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 recycling and reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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 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.

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- .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 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 00 10 – General Instructions.
- .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: fire-resistance rating as indicated on plans
 - .2 Top of fire-resistance rated concrete, masonry and gypsum board partitions: fire-resistance rating as indicated on plans.
 - .3 Intersection of fire-resistance rated concrete, masonry and gypsum board partitions: fire-resistance rating as indicated on plans.
 - .4 Control and sway joints in fire-resistance rated concrete, masonry and gypsum board partitions and walls: fire-resistance rating as indicated on plans.
 - .5 Penetrations through fire-resistance rated floor slabs, ceilings and roofs: one hour fire-resistance rating.
 - .6 Openings and sleeves installed for future use through fire separations: floor slabs, ceilings, roofs - 1 hour fire-resistance rating; partitions/walls - fire-resistance rating as indicated on plans
 - .7 Around mechanical and electrical assemblies penetrating fire separations: floor slabs, ceilings, roofs - 1 hour fire-resistance rating; partitions/walls - fire-resistance rating as indicated on plans
 - .8 Rigid ducts: floor slabs, ceilings, roofs - 1 hour fire-resistance rating; partitions/walls - fire-resistance rating as indicated on plans

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 06 40 00 – Architectural Woodwork
- .2 Section 08 11 00 – Metal Doors and Frames
- .3 Section 08 80 50 – Glazing
- .4 Section 09 21 99 – Partitions for Minor Works

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C919-12(2017), Standard Practice for Use of Sealants in Acoustical Applications.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
 - .2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
 - .3 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
 - .4 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
 - .5 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.
- .3 General Services Administration (GSA) - Federal Specifications (FS)
 - .1 FS-SS-S-200-E(2)1993, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.
- .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, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- .1 Caulking compound.
- .2 Primers.
- .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
- .3 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Samples:
 - .1 Submit 2 samples of each type of material and colour.
 - .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
- .4 Manufacturer's Instructions:
 - .1 Submit instructions to include installation instructions for each product used.
- .5 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan and 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 00 10 – General Instructions
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .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 indoors off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect joint sealants from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan and Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.
- .5 Packaging Waste Management: remove for reuse by manufacturer and return of pallets, padding, crates, packaging materials as specified in Waste Reduction Workplan

Construction Waste Management Plan in accordance with Section 01 74 21 -
Construction/Demolition Waste Management and Disposal.

1.6 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Proceed with installation of joint sealants only when:
 - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
 - .2 Joint substrates are dry.
 - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
 - .2 Joint-Width Conditions:
 - .1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.
 - .3 Joint-Substrate Conditions:
 - .1 Proceed with installation of joint sealants only after 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 Health Canada.
- .2 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans. Departmental Representative will arrange for ventilation system to be operated on maximum outdoor air and exhaust during installation of caulking and sealants.

Part 2 Products

2.1 SEALANT MATERIALS

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

- .1 Silicones one part: to CAN/CGSB-19.13.
- .2 Acrylic latex one part: to CAN/CGSB-19.17.
- .3 Acoustical sealant: to ASTM C919.
- .4 Preformed compressible and non-compressible back-up materials:

- .1 Polyethylene, urethane, neoprene or vinyl foam:
 - .1 Extruded open 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/m³ 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 Perimeters of interior frames, as detailed and itemized: sealant type: Acrylic Latex, paintable, Type S, Grade NS, Class 25, Use NT, O
- .2 Perimeter of plumbing fixtures (e.g. sinks): sealant type: Clear Silicone, Type S, Grade NS, Class 25, Use I, O
- .3 Junction of millwork and other surfaces: Clear Silicone, Type S, Grade NS, Class 25, Use O
- .4 Perimeter of non-fire-rated interior partitions: acoustic sealant

2.4 JOINT CLEANER

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.
- .2 Primer: in accordance with sealant manufacturer's written 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 joint sealants 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 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.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 – General Instructions.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean adjacent surfaces immediately.
 - .3 Remove excess and droppings, using recommended cleaners as work progresses.
 - .4 Remove masking tape after initial set of sealant.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 10 – General Instructions.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by joint sealants installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 – Joint Sealants
- .2 Section 08 14 10 – Flush Wood Doors
- .3 Section 08 71 00 – Door Hardware
- .4 Section 08 80 50 – Glazing
- .5 Section 09 21 99 - Partitions
- .6 Section 09 91 99 – Painting for Minor Works

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-17, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM B29-14, Standard Specification for Refined Lead.
 - .3 ASTM B749-14, Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-12.1-2017, Safety Glazing
- .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 Door and Frame Products, 2006.
 - .2 CSDMA, Recommended Selection and Usage Guide for Commercial Steel Door and Frame Products, 2009.
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 80-99, Standard for Fire Doors and Fire Windows.
 - .2 NFPA 252-03, Standard Methods of Fire Tests of Door Assemblies.
- .6 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings.
 - .2 SCAQMD Rule 1168-2017, Adhesives and Sealants Applications.
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701.1-2017, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

- .2 CAN/ULC-S702-14, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
- .3 CAN/ULC-S704-14, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .4 CAN4-S104-10, Standard Method for Fire Tests of Door Assemblies.
- .5 CAN4-S105-09, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.3 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 CAN4-S104 for ratings specified or indicated.
 - .2 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104, ASTM E152 and listed by nationally recognized agency having factory inspection services.
 - .3 All door and frame reinforcement (ie. for hinges, locks, closers, etc.) must be done at factory.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, louvred or glazed, arrangement of hardware fire rating and finishes.
 - .2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings reinforcing fire rating finishes.
 - .3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
 - .4 Submit test and engineering data, and installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Hot dipped galvanized steel sheet: to ASTM A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.
- .2 Reinforcement: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.

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/m³ minimum sanded to required thickness.
- .2 Stiffened: face sheets welded uninsulated honeycomb core.
- .3 Temperature rise rated (TRR): core composition to limit temperature rise on unexposed side of door to 250 degrees C at 60 minutes. Core to be tested as part of a complete door assembly, in accordance with CAN4-S104, covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.

2.3 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
- .2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.
- .3 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 Sections 09 91 99 – Painting for Minor Works. 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 Exterior and interior top and bottom caps: flush steel channels.
- .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 Metallic paste filler: to manufacturer's standard.

- .5 Fire labels: metal riveted.
- .6 Sealant: refer to section 07 92 00 – Joint Sealants.
- .7 Glazing: to CAN/CGSB – 12.1
- .8 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.

2.7 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 specified in Section 08 71 00 – Door Hardware, and for electronic security hardware to be provided by Departmental Representative. Reinforce frames for surface mounted hardware.
- .5 Use templates provided by finish hardware supplier, security hardware suppliers and Departmental Representative.
- .6 Include Conduits for wiring connections to electronic hardware where required.
- .7 Coordinate security hardware requirements with the Departmental Representative prior to fabrication.
- .8 Protect mortised cutouts with steel guard boxes.
- .9 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .10 Manufacturer's nameplates on frames and screens are not permitted.
- .11 Conceal fastenings except where exposed fastenings are indicated.
- .12 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 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 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .3 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.
- .4 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .5 Reinforce doors where required, for surface mounted hardware. Provide flush steel top and bottom channels.
- .6 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .7 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN4-S104 and 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.
- .8 Manufacturer's nameplates on doors are not permitted.
- .9 prepare doors for electronic security hardware to be provided by Departmental Representative. Reinforce doors for surface mounted hardware.
- .10 Provide channel in door for passage of wires from transfer loop to exit device.

2.11 DOORS: HONEYCOMB CORE CONSTRUCTION

- .1 Form face sheets for interior doors from 1.6 mm sheet steel with honeycomb rate core laminate under pressure to face sheets.

2.12 HOLLOW STEEL CONSTRUCTION

- .1 Form face sheets for interior doors from 1.6 sheet steel.
- .2 Reinforce doors with vertical stiffeners, securely welded to face sheets at 150 mm on centre maximum.
- .3 Fill voids between stiffeners of interior doors with honeycomb core.

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.

3.4 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .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 top of carpet 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 frames in accordance with Section 08 80 50 - Glazing.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 08 11 00 – Metal Doors and Frames
- .2 Section 08 71 00 – Door Hardware
- .3 Section 08 80 50 - Glazing

1.2 REFERENCE STANDARDS

- .1 Architectural Woodwork Manufacturers Association of Canada (AWMAC).
 - .1 North American Architectural Woodwork Standards (AWMAC AWS), 2017.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA Certification Program for Windows and Doors 00.
- .3 Environmental Choice Program (ECP).
 - .1 CCD-045-2011, Sealants and Caulking Compounds.
 - .2 CCD-046-2011, Adhesives.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's:
 - .1 For caulking materials during application and curing.
 - .2 For door materials and adhesives.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate door types and cutouts for lights, sizes, core construction, transom panel construction and cutouts.

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit one 300 x 300 mm corner sample of each type wood door.
- .3 Show door construction, core, glazing detail and faces.
- .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Storage and Protection:
 - .1 Protect doors from dampness. Arrange for delivery after work causing abnormal humidity has been completed.
 - .2 Store doors in well ventilated room, off floor, in accordance with manufacturer's recommendations.
 - .3 Protect doors from scratches, handling marks and other damage. Wrap doors.
 - .4 Store doors away from direct sunlight.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Dispose of polystyrene, plastic, or corrugated cardboard packaging material in appropriate on-site bin for recycling in accordance with site waste management program.
- .3 Unused or damaged glazing materials are not recyclable and must not be diverted to municipal recycling programs.
- .4 Divert unused adhesive material from landfill to official hazardous material collections site approved by Departmental Representative.
- .5 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 WOOD FLUSH DOORS

- .1 Construction: particle core, ultra heavy-duty, anti-warping construction:
- .2 Stiles: 3 mm thick veneer, longitudinally laminated by hot pressing with type 1 structural glue, as per ASTM-D5456-93 (LVL FSC), including a 22 mm piece of hardwood, matched with faces, for a total width of 107 mm.
- .3 Top and bottom rails: 3 mm thick veneer, longitudinally laminated by hot pressing with type 1 structural glue, as per ASTM-D5456-93 (LVL FSC), or laminated strand lumber (LSL) for a total width of 85 mm.
- .4 Core: Solid particleboard. Density of 0.45-0.50 metric ton per cubic metre. Complies with CSA-0188 and ANSI A208-1 standards (LD-1/LD-2). Available NAUF/FSC (LD-2).
- .5 Faces: paint grade
- .6 Lock Block: Integrated

-
- .7 Adhesive: Type I PVA Cross-link (NAUF)

2.2 GLAZING

- .1 Glass: In accordance with Section 08 80 50 - Glazing

2.3 FABRICATION

- .1 Vertical edge strips to match face veneer.
- .2 Prepare doors for glazing. Provide glazing stops hardwood maple species with mitred corners.
- .3 Bevel vertical edges of single acting doors 3 mm in 50 mm on lock side and 1.5 mm in 50 mm on hinge side.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSTALLATION

- .1 Unwrap and protect doors in accordance with CAN/CSA-O132.2 Series, Appendix A.
- .2 Install doors and hardware in accordance with manufacturer's printed instructions and CAN/CSA-O132.2 Series, Appendix A.
- .3 Adjust hardware for correct function.
- .4 Install glazing in accordance with Section 08 80 50 - Glazing.

3.3 ADJUSTMENT

- .1 Re-adjust doors and hardware just prior to completion of building to function freely and properly.

3.4 CLEANING

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking; clean doors and frames.
- .3 Clean glass and glazing materials with approved non-abrasive cleaner.
- .4 On completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 08 11 00 – Metal Doors and Frames
- .2 Section 08 14 16 – Flush Wood Doors.
- .3 Section 08 80 50 - Glazing

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1-2006, American National Standard for Butts and Hinges.
 - .2 ANSI/BHMA A156.2-2017, Bored and Preamsembled Locks and Latches.
 - .3 ANSI/BHMA A156.3-2014, Exit Devices.
 - .4 ANSI/BHMA A156.4-2014, Door Controls - Closers.
 - .5 ANSI/BHMA A156.5-2014, Auxiliary Locks and Associated Products.
 - .6 ANSI/BHMA A156.6-2010, Architectural Door Trim.
 - .7 ANSI/BHMA A156.8-2010, Door Controls - Overhead Stops and Holders.
 - .8 ANSI/BHMA A156.12-2013, Interconnected Locks and Latches.
 - .9 ANSI/BHMA A156.13-2017, Mortise Locks and Latches Series 1000.
 - .10 ANSI/BHMA A156.15-2016, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
 - .11 ANSI/BHMA A156.16-2013, Auxiliary Hardware.
 - .12 ANSI/BHMA A156.17-2014, Self-closing Hinges and Pivots.
 - .13 ANSI/BHMA A156.18-2016, Materials and Finishes.
 - .14 ANSI/BHMA A156.19-2013, Power Assist and Low Energy Power - Operated Doors.
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

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 door hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.

- .3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
- .4 After approval samples will be returned for incorporation in Work.
- .4 Hardware List:
 - .1 Submit contract hardware list.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .7 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste management Plan and 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.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial and post consumer content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates required percentage 20% of regional materials and products, showing their cost, distance from project to furthest site of extraction of manufacturer, and total cost of materials for project.

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 door hardware for incorporation into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Tools:
 - .1 Supply 2 sets of wrenches for door closers and locksets

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements:

- .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 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 - 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 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect door hardware from nicks, scratches, and blemishes.
 - .3 Protect prefinished surfaces with wrapping strippable coating.
 - .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 HARDWARE ITEMS

- .1 Use one manufacturer's products only for similar items.

2.2 DOOR HARDWARE

- .1 Locks and latches:
 - .1 Mortise locks and latches: to ANSI/BHMA A156.13, series 1000 mortise lock, grade 1, designed for function and keyed as stated in Hardware Schedule.
 - .2 Lever handles
 - .3 Roses: round.
 - .4 Normal strikes: box type, lip projection not beyond jamb.
 - .5 Cylinders: key into keying system as noted.
 - .6 Finished as indicated in Hardware Schedule.
- .2 Butts and hinges:
 - .1 Butts and hinges: to ANSI/BHMA A156.1, designated by letter A and numeral identifiers, followed by size and finish, listed in Hardware Schedule.
- .3 Door Closers and Accessories:
 - .1 Door controls (closers): to ANSI/BHMA A156.4, designated by letter C and numeral identifiers listed in Hardware Schedule, size in accordance with ANSI/BHMA A156.4, table A1, finished to 630

- .4 Architectural door trim: to ANSI/BHMA A156.6, designated by letter J and numeral identifiers as listed in Hardware Schedule. Finished as listed in Hardware Schedule.
 - .1 Door protection plates: 1.27 mm thick stainless steel finished to 630.

2.3 FASTENINGS

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

2.4 KEYING

- .1 Doors to be keyed as directed by Departmental Representative.
- .2 Supply keys in duplicate for every lock in this Contract.
- .3 Supply 3 master keys for each master key or grand master key group.
- .4 Stamp keying code numbers on keys and cylinders.
- .5 Supply construction cores.
- .6 Hand over permanent cores and keys to Departmental Representative.

Part 3 Execution

3.1 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 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.
- .4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Use only manufacturer's supplied fasteners.
 - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .7 Remove construction cores locks when directed by Departmental Representative.

- .1 Install permanent cores and ensure locks operate correctly.

3.2 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 – General Instructions.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
 - .3 Remove protective material from hardware items where present.
 - .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 10 – General Instructions.
- .2 Waste Management: separate waste materials for recycling reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 DEMONSTRATION

- .1 Maintenance Staff Briefing:
 - .1 Brief maintenance staff regarding:
 - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
 - .2 Description, use, handling, and storage of keys.
 - .3 Use, application and storage of wrenches for door closers and fire exit hardware locksets.
- .2 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by door hardware installation.

3.6 SCHEDULE

Group – 001, Existing Doors

Door # – 3113.1, 3114.1, 3105.1, 3104.1, 3104.2, 3116.1, 3120.1, 1104.1, 1106.1, 1110.1, 1140.1, 3121.1, 3104B.1, 3118.1, 3119.1, 1160.1

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
1	Existing Hardware to remain. Replace/make good as required for door to be fully functional		Contractor, as required

Group – 002, lab, offices

Door # – 3108.1, 3108.2, 3107.1, 3107.2, 3104A.1, 3101A.1, 3102.1

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
3	Hinges: A5111 - 114 x 114 x NRP		Contractor
1	Mortise lockset: F13 Schlage L9456 17 626		Supplied by Departmental Representative, installed by Contractor
1	Door Closer: LCN 4040XP		
2	Kick Plate:		Contractor
1	Door Stop:		Contractor

Group – 003, Egress Door from HC Lab, Security Door Type B, 45 Minute Fire-Rated

Door # - 3111.1

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
3	Hinges: A5111 - 114 x 114 x NRP		
1	Vonduprin CX98-EO exit only crash bar with no trim		Supplied by Departmental Representative, installed by Contractor
1	Door Closer: LCN 4040XP		
1	Kick Plate:		Contractor
1	Door Stop:		Contractor
1	Door Contact:		Departmental Representative

Group – 004, Stairwall Door, Security Door Type E2, 45 minute fire-rated

Door # - 3110.1

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
3	Hinges: A5111 - 114 x 114 x NRP		Contractor
1	Vonduprin QEL98LF-RX panic bar		Supplied by Departmental Representative, installed by Contractor
1	Door Closer: LCN 4040XP		
1	Vonduprin PS904-FA-BB Power supply with battery backup and fire alarm relay.		Contractor
1	Vonduprin 996NL Handle assembly		Contractor
1	Abloy EA 280 wire transfer (Securitron EPT is also acceptable)		Contractor
1	Donjo EF 86 Mortise blank cover		Supplied by Departmental Representative, installed by Contractor
1	Kick Plate:		Contractor
1	Door Stop:		Contractor
1	Door Contact:		Departmental Representative
1	Card Access		Departmental Representative
1	Keypad		Departmental Representative

Group – 005, Storage Room Door, Security Door Type D

Door # - 1112.1

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
3	Hinges: A5111 - 114 x 114 x NRP		Contractor
1	Mortise lockset: F13 Schlage L9456 17 626		Supplied by Departmental Representative, installed by Contractor
1	Door Closer: LCN 4040XP		

1	Kick Plate:		Contractor
1	Door Stop:		Contractor
1	Door Contact:		Departmental Representative
1	Keypad		Departmental Representative

Group – 006, VC Room doors

Door # - 3103.1, 3115.1

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
3	Hinges: A5111 - 114 x 114 x NRP		Contractor
1	Mortise lockset: F13 Schlage L9456 17 626		Supplied by Departmental Representative, installed by Contractor
1	Door Closer: LCN 4040XP		
1	Kick Plate:		Contractor
1	Door Stop:		Contractor
1	Concealed Mortised Automatic Door Bottom:		Contractor
1	Set of jamb and head acoustic weatherstripping		Contractor

Group – 007, EM Lab, 45 Minute Fire Rating

Door # - 3116.2, 3117.1

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
3	Hinges: A5111 - 114 x 114 x NRP		Contractor
1	Mortise lockset: F13 Schlage L9456 17 626		Supplied by Departmental Representative, installed by Contractor
1	Door Closer: LCN 4040XP		
1	Kick Plate:		Contractor
1	Door Stop:		Contractor
1	Door Contact:		Provided by

			Departmental Representative
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Group – 008, New Entrance Doors, Security Door Type EE2, 45 minute fire-rated

Door # - 3100.1

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
1	Card Access		Departmental Representative
1	Keypad		Departmental Representative
1	Vonduprin KR1654 Key removable mullion or equivalent. Both doors need to latch on this mullion		Contractor
	Right-Hand door		
3	Hinges: A5111 - 114 x 114 x NRP		Contractor
1	Vonduprin QEL98LF-RX panic bar		Supplied by Departmental Representative, installed by Contractor
1	Vonduprin PS914-FA-BB Power supply with battery backup and fire alarm relay.		
1	Vonduprin 996NL Handle assembly		
1	Abloy EA 280 wire transfer (Securitron EPT is also acceptable)		
1	LCN 4040XP door closer		
1	Kick Plate:		Contractor
1	Door Stop:		Contractor
	Left-Hand door		
3	Hinges: A5111 - 114 x 114 x NRP		Contractor
1	Vonduprin CX98-EO exit only crash bar with no trim		Supplied by Departmental Representative, installed by Contractor
1	Door Contact:		Departmental Representative
1	LCN 4040XP door closer		Supplied by Departmental Representative, installed by Contractor
1	Kick Plate:		Contractor

1	Door Stop:		Contractor
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Group – 009, New Entrance Door, Security Door Type E, 45 minute fire-rated

Door # - 3100.2

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
3	Hinges: A5111 - 114 x 114 x NRP		Contractor
1	Vonduprin QEL98LF-RX panic bar		Supplied by Departmental Representative, installed by Contractor
1	Vonduprin PS904-FA-BB Power supply with battery backup and fire alarm relay.		
	Vonduprin 996NL Handle assembly		
1	Abloy EA 280 wire transfer (Securitron EPT is also acceptable)		
1	LCN 4040XP door closer		
1	Kick Plate:		Contractor
1	Door Stop:		Contractor
1	Door Contact:		Departmental Representative
1	Card Access		Departmental Representative
1	Keypad		Departmental Representative

Group – 010, Server Room, Security Door Type D

Door # - 3120.2

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
3	Hinges: A5111 - 114 x 114 x NRP		Contractor
1	Mortise lockset: F15 Schlage L9480 17 626		Supplied by Departmental Representative, installed by Contractor
1	Door Closer: LCN 4040XP		
1	Kick Plate:		Contractor
1	Door Stop:		Contractor

1	Door Contact:		Departmental Representative
1	Keypad		Departmental Representative

Group – 011, Existing Cooler, Security Door Type D3 Non-Standard

Door # - 3112.1

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
3	Hinges: A5111 - 114 x 114 x NRP		Contractor
1	Mortise lockset: F13 F13 Schlage L9456 17 626		Supplied by Departmental Representative, installed by Contractor
1	Door Closer: LCN 4040XP		
1	Kick Plate:		Contractor
1	Door Stop:		Contractor
1	Door Contact:		Departmental Representative
1	Keypad		Departmental Representative

Group – 012, Existing Shaft Access Doors, Security Door Type B

Door # - 3100.3, 3109.1, 3109.2

QTY	DESCRIPTION	FINISH	RESPONSIBILITY
1	Door Contact:		Departmental Representative
1	Door Closer: LCN 4040XP		Supplied by Departmental Representative, installed by Contractor
1	Mortise lockset: F13 Schlage L9456 17 626		

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 08 11 00 – Metal Doors and Frames.
- .2 Section 08 14 16 – Flush Wood Doors

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C542- 05,(2017), Standard Specification for Lock-Strip Gaskets.
 - .2 ASTM D790-07, 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 D1929-16, Standard Test Method for Determining Ignition Temperature of Plastics.
 - .5 ASTM D2240-15e1, Standard Test Method for Rubber Property - Durometer Hardness.
 - .6 ASTM E84-17a, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .7 ASTM F1233-08, (2013) Standard Test Method for Security Glazing Materials and Systems.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-12.1-2017, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB-12.2-M91, R2017 Flat, Clear Sheet Glass.
 - .3 CAN/CGSB-12.3-M91, R2017 Flat, Clear Float Glass.
- .3 Glass Association of North American (GANA)
 - .1 GANA Glazing Manual - 2008.
 - .2 GANA Laminated Glazing Reference Manual - 2009.
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-A2017, Adhesives and Sealants Applications.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with Departmental Representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.

- .4 Review manufacturer's written installation instructions and warranty requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
 - .1 Submit shop inspection for glass.
- .5 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Reduction Workplan and Waste Management Plan 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.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Low-Emitting Materials:
 - .1 Submit listing of adhesives and sealants used in building, showing compliance with VOC and chemical component limits or restrictions requirements.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for 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 with manufacturer's written instructions and 01 61 00 - Common Product Requirements.

- .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 in dry location 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 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 Limit glass deflection to flexural limit of glass 1/200 with full recovery of glazing materials.
- .2 Flat Glass:
 - .1 Safety glass: to CAN/CGSB-12.1, transparent, 6 mm thick minimum but thicker if required for opening
 - .1 Type 2-tempered.
 - .2 Class B-float.
 - .3 Category 11 1 (cat 1 is of glass < 9ftsq, cat 11 is >9ftsq.)

2.2 ACCESSORIES

- .1 Setting blocks: Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.
- .2 Spacer shims: silicone neoprene, 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 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; black colour.
- .4 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 - DRY METHOD (TAPE AND TAPE)

- .1 Perform work in accordance with GANA Glazing Manual GANA Laminated Glazing Reference Manual for glazing installation methods.
- .2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.
- .3 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.
- .4 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.
- .5 Place glazing tape on free perimeter of glazing in same manner described.
- .6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- .7 Knife trim protruding tape.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 – General Instructions.
 - .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.

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- .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 00 10 – General Instructions.
 - .2 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 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.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 08 11 00 – Metal Doors and Frames
- .2 Section 09 91 99 – Painting for Minor Works.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C1396/C1396M-17, Standard Specification for Gypsum Wallboard.
 - .2 ASTM C475/C475M-17, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .3 ASTM C514-04 (2014), Standard Specification for Nails for the Application of Gypsum Board.
 - .4 ASTM C645-14e1, Standard Specification for Nonstructural Steel Framing Members.
 - .5 ASTM C754-17, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - .6 ASTM C840-17a, Standard Specification for Application and Finishing of Gypsum Board.
 - .7 ASTM C954-15, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.122 in. (2.84 mm) in Thickness.
 - .8 ASTM C1002-16, 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.
 - .9 ASTM C1047-14a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .2 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-2017, Adhesives and Sealants Applications.
- .3 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by a professional engineer licenced in the Province of Ontario, Canada.

- .2 For partitions that terminate at the existing suspended ceilings show lateral support framing required to support partitions independent of existing suspended ceiling system, to which the partition assembly shall not be fastened. Indicate member design thickness exclusive of coatings, connections and bracing details, screw sizing and spacing, and anchors.
- .3 Indicate locations, dimensions, openings and requirements of related work including required blocking and backup to support cabinets.
- .3 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum, framing, sealants and include product characteristics, performance criteria, physical size, finish and limitations.
- .4 Test and Evaluation Reports: submit test reports in accordance with Section 01 45 00 - Quality Control, from approved independent testing laboratory, certifying partition system complies with sound transmission rating, fire-resistance rating as specified.
- .5 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan and 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.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates required percentage 20 % of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
 - .4 Low-Emitting Materials:
 - .1 Submit listing of sealants used in building, comply with VOC and chemical component limits or restriction 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 in dry location indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store materials inside, level, under cover. Protect from weather, damage from construction operations and other causes, in accordance with manufacturer's printed instructions.
- .3 Handle materials to prevent damage to edges or surfaces. Protect metal accessories and trim from being bent or damaged.
- .4 Store and protect partition materials from nicks, scratches, and blemishes.
- .5 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan and Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse by manufacturer and return of padding, crates, packaging materials pallets, as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Performance/Design Criteria:
 - .1 Partition assembly to be non-combustible construction. Ceiling/top/deflection tracks to allow minimum 25mm deflection space.
 - .2 Non-structural Metal Framing (except for Partition P5, for which refer to Article 3.8 APPENDIX – SECURE DEMISING WALL CONSTRUCTION SPECIFICATIONS):
 - .1 Non-load bearing channel stud framing: to ASTM C645, 92 mm stud size unless otherwise indicated, roll formed from hot dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres. Thickness to be determined by engineered shop drawings.
 - .2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 32 mm flange height.
 - .3 Metal channel stiffener: 19 x 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.
 - .4 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, and as follows:
 - .1 Slotted Deflection Track for Fire Separations: Premanufactured slotted top runner with 63 mm down standing legs and having 6 mm wide x 38 mm high slots spaced as 25 mm on center along length of runner; tested and certified for use in fire rated wall construction.
 - .3 Gypsum Board:
 - .1 Recycled content: Post-consumer 20% and Post-Industrial 20% minimum.
 - .2 Standard board: to ASTM C1396/C1396M Type X, 15mm thick, 1200 mm wide x maximum practical length, ends square cut, edges tapered.
 - .3 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
 - .4 Steel tapping screws: to ASTM C1002.

- .5 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, metal, zinc-coated by hot-dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.

2.2 ACCESSORIES

- .1 Sealants: in accordance with Section to ASTM C475 07 92 00 - Joint Sealants.
 - .1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.
- .2 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.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions prior to partition installation.
 - .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 OF FRAMING

- .1 For erection of Partition P5 refer also to Article 3.8 APPENDIX – SECURE DEMISING WALL CONSTRUCTION SPECIFICATIONS. In the case of discrepancies, Appendix governs.
- .2 Install steel framing members to receive screw-attached gypsum board in accordance with ASTM C754 except where specified otherwise.
- .3 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
- .4 Place studs vertically at 400 mm on centre and maximum of 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 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .7 Include 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.
- .8 Install heavy gauge single jamb studs at openings.

- .9 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .10 Include 40 mm stud or furring channel secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .11 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .12 Extend partitions to ceiling height except where indicated.
- .13 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use double track slip joint.
- .14 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .15 Install insulating strip under studs and tracks around perimeter of sound control partitions.

3.3 ERECTION OF GYPSUM BOARD AND ACCESSORIES

- .1 Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.
- .2 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840 except where specified otherwise.
- .3 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .4 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
- .5 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.
- .6 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .7 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .8 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.
- .9 Install acoustical sealant insulation in sound rated partitions to correspond with tested assembly.
- .10 Install gypsum boards in direction that will minimize number of end-butt joints. Stagger end joints 250 mm minimum.

3.4 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.

-
- .2 Apply single layer gypsum board to metal furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.

3.5 INSTALLATION

- .1 For installation of Partition P5 refer also to Article 3.8 APPENDIX – SECURE DEMISING WALL CONSTRUCTION SPECIFICATIONS. In the case of discrepancies, Appendix governs.
- .2 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 using contact adhesive for full length at 150 mm on centre.
- .3 Install casing beads around perimeter of suspended ceilings.
- .4 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .5 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .6 Install access doors to electrical and mechanical fixtures specified in respective sections.
 - .1 Rigidly secure frames to furring or framing systems.
- .7 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.
- .8 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.
- .9 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.
- .10 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 10 – General Instructions.
- .3 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by partition installation.

3.8 APPENDIX – SECURE DEMISING WALL CONSTRUCTION SPECIFICATIONS

- .1 Appendix follows.

END OF SECTION

Secure Demising Wall Construction Specifications

Wall Framing (Figure 1)

Slab-to-Slab

Walls must be slab-to-slab (from the finished floor to the underside of structural concrete roof or floor) or continue across the ceiling to form a continuous secure enclosure (Secure Ceiling). Where the space above the Secure Ceiling (measured to the underside of the limiting structural component) exceeds 6 inches, the space should be closed and secured or electronically monitored.

Top and Bottom Tracks:

SSMA standard: 1- 5/8" x 6", 18ga (600T162-43); OR

Preferred: 2" x 6", 18ga (600T200-43)

Secure top and bottom steel stud track to both slabs at 300mm oc using any expanding (preferably double expanding) mechanical fastener. Non-expanding (e.g. "Tapcon") screws are not acceptable.

Studs:

SSMA standard: 1- 5/8" x 6", 18ga (600S162-43: 33ksi); OR

Preferred: 2" x 6", 18ga (600S200-43: 33ksi)

Space studs at 300 mm oc and secure to the top and bottom tracks with welds or rivets (not screws).

Install double (jamb) studs at the door frame opening. Install the door frame as per HMMA 840-07, part 3 A, B, C, D and E (except that screws shall be replaced with steel rivets).

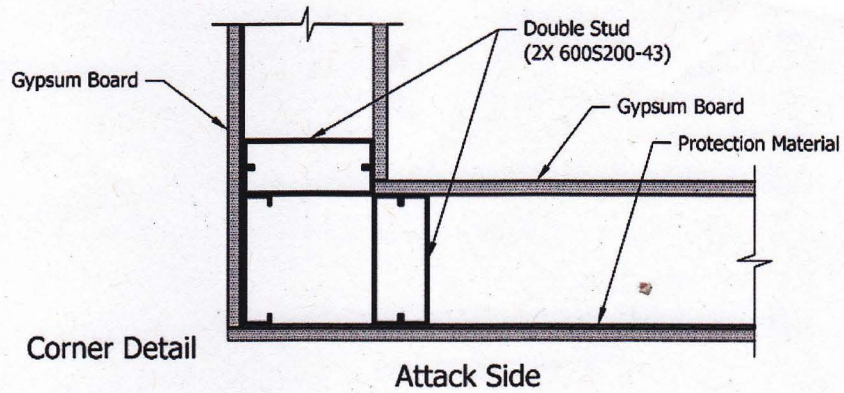
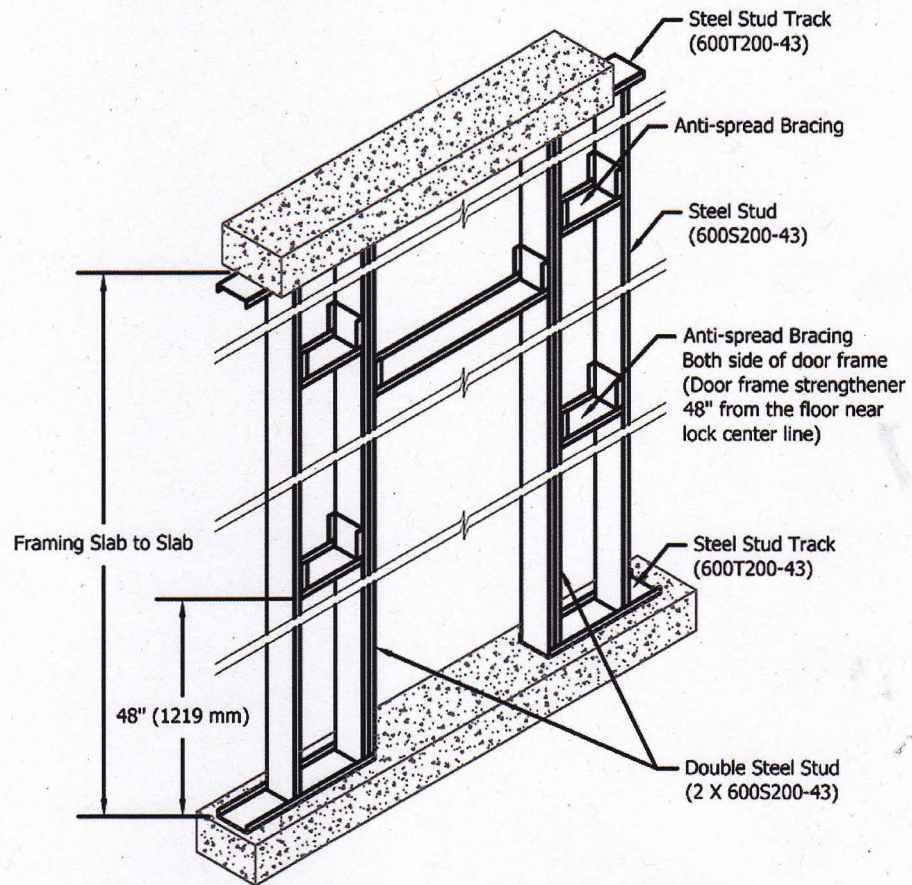
Install anti-spread bracing **approximately** 48" from the bottom of the wall between the door frame double stud and the adjacent stud on both sides of the frame. Bracing to be installed within 6" (vertical) of centreline of locking hardware.

Construct wall corners with double studs.

Notes:

1. Leaving a small gap and using drywall sheets to brace frame sections during wall erections is permitted provided steel sheets on the attack side are continuous over all gaps.
2. Drawings of doubled studs are representative. Connect and orient doubled studs as per standard industry practice.

Figure 1: Wall Framing Detail



Wall Protection Material (Figures 2 to 5)

Wall protection material may be one of two options:

Flattened Metal Mesh: To EMMA 557-99. Style 3/4-9F: nominal strand thickness of 0.120" (0.108" to 0.132"). Diamond opening of 0.563" x 1.688".

OR

Sheet Steel: 16 Ga, A1008 / A1008M (cold rolled) or A1011/ A1011M (hot rolled) or equivalent.

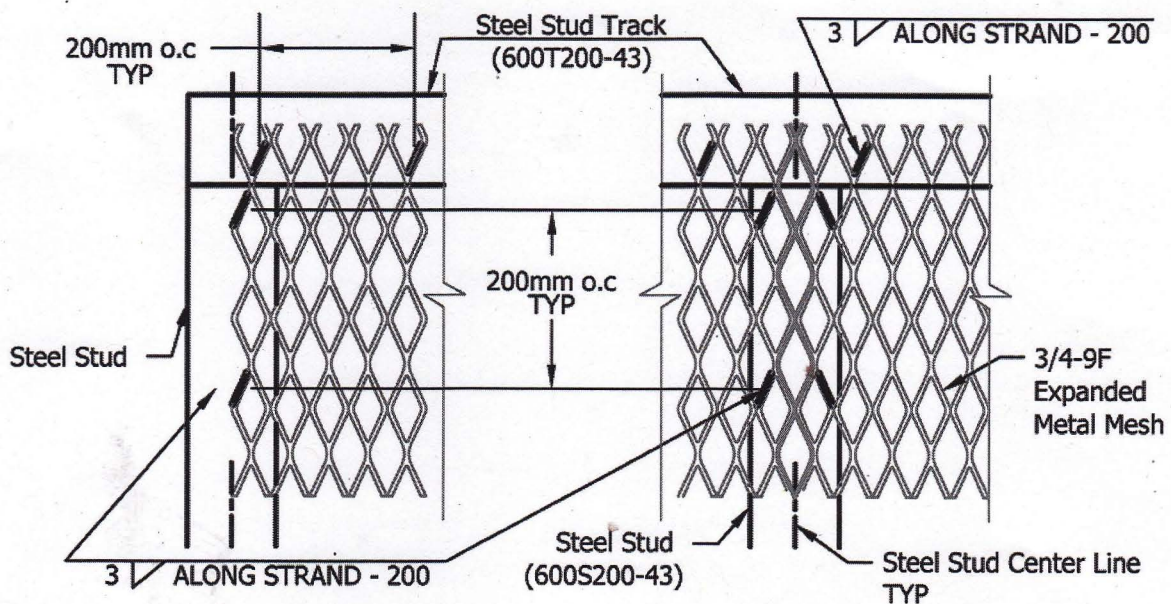
Mount on the outside (attack side) of the room. Support all edges by anti-spread bracing, studs or corners. Align the sheet edges at every vertical and horizontal seam on the centre line of the steel stud or anti-spread bracing and secure all sheets with welds or rivets.

Note: Screws (including "security screws") are **NOT** acceptable for permanently attaching the protection material (steel or steel mesh). Screws may be used to "tack" the sheets in place pending riveting or welding. Temporary screws do not need to be removed.

Welding (Permitted Method)

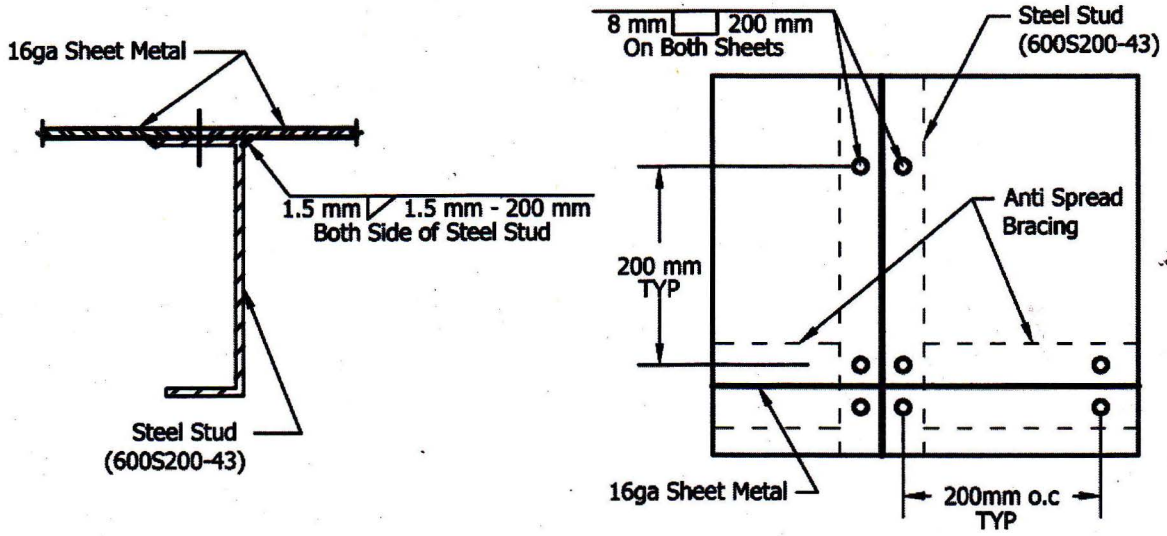
Steel mesh (Figure 2): 3mm fillet weld along the strand at 200mm oc

Figure 2: Welding Steel Mesh



Steel Sheet (Figure 3): 1.5mm fillet weld 15mm long at 200mm oc **OR** 8mm plug weld at 200mm oc

Figure 3: Welding Sheet Steel



Rivets (Preferred Method) (Figure 4):

Steel sheet: 3/16" steel rivets at 200mm o.c.

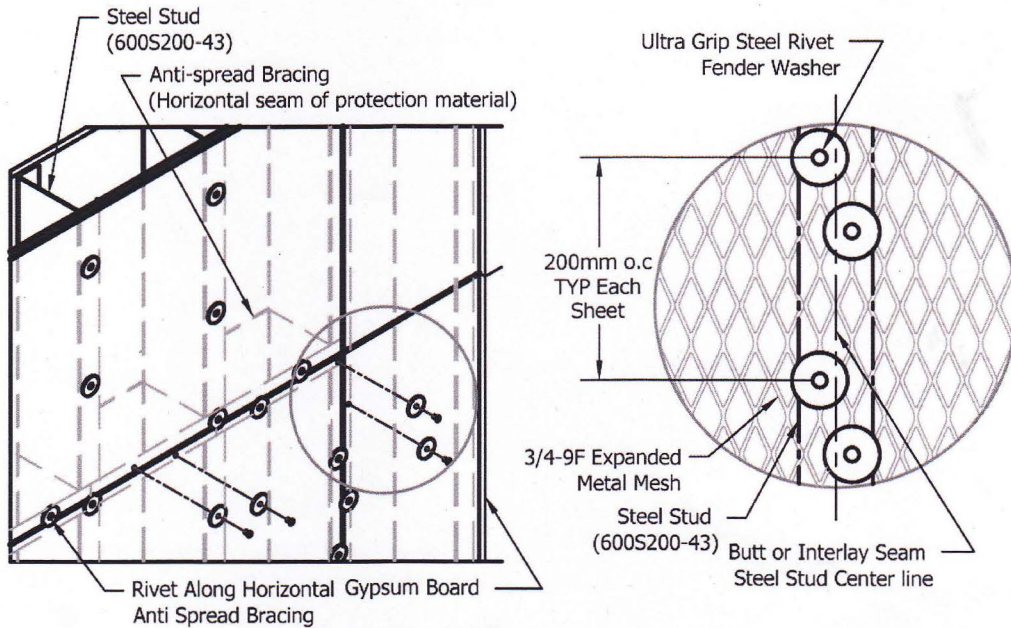
Steel mesh: 3/16" steel rivets and "fender" washer (1 1/2" OD, 3/16" ID) at 200mm o.c.

Suggested material:

Rivets: 3/16" steel pop rivet: Speaneur part #301-440

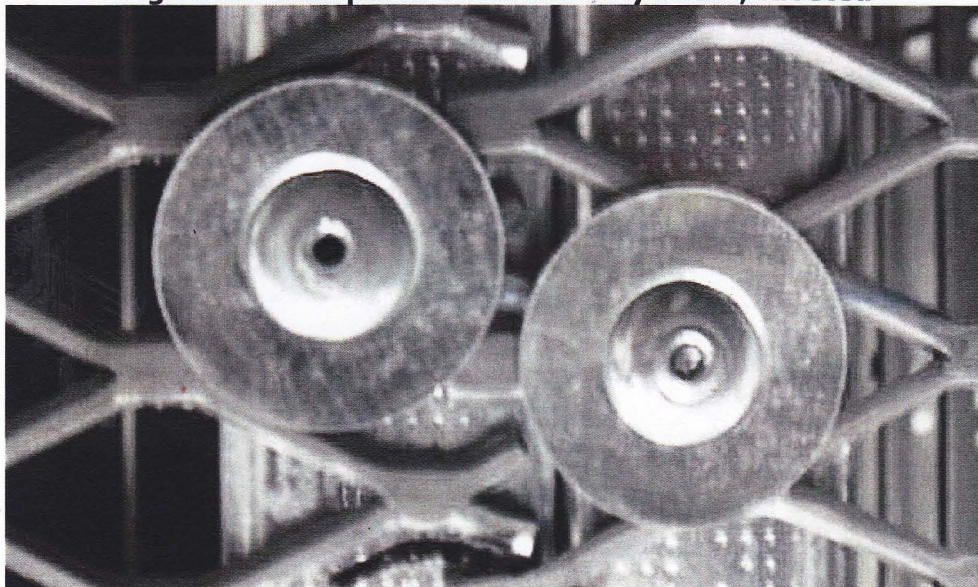
Washers: 1 1/2" OD, 3/16" ID "fender" washer: Fastenal part #1133204

Figure 4: Riveting Sheet or Mesh



Steelmesh Interlay Seam (Figure 5):

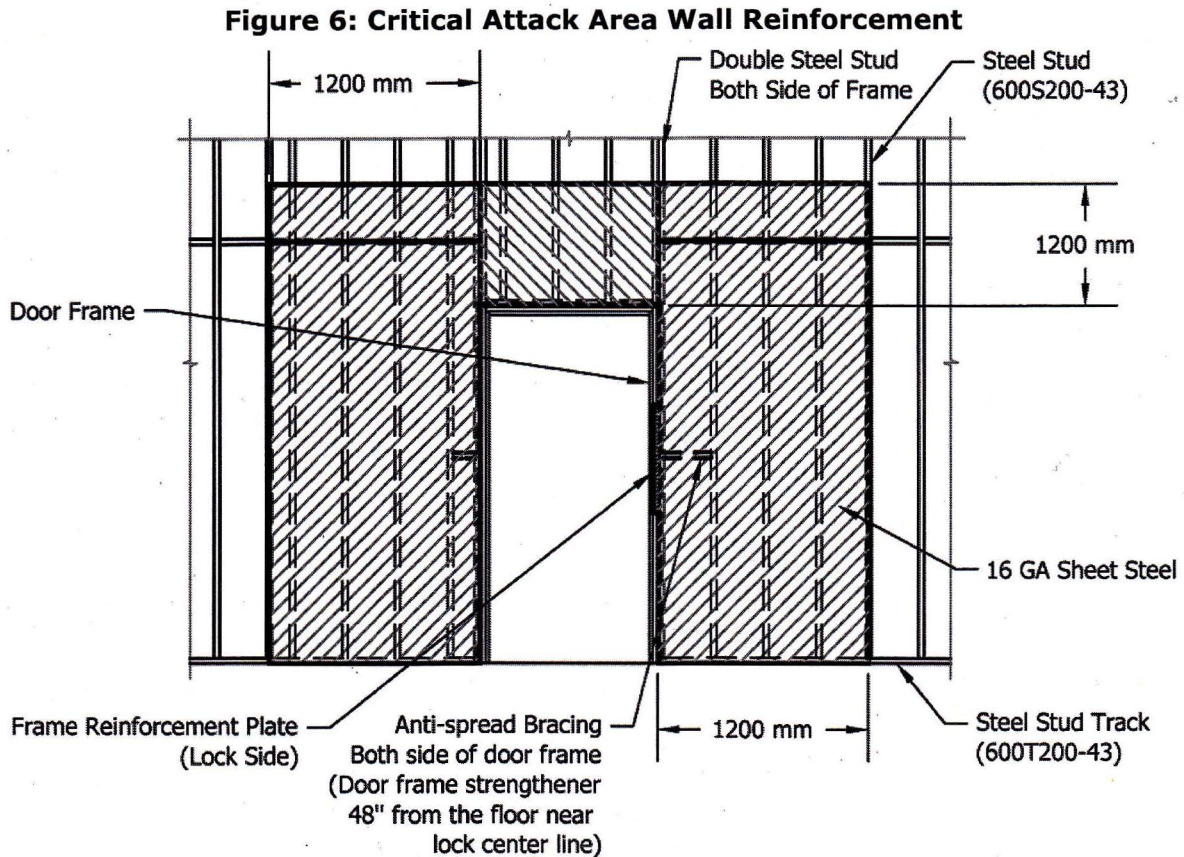
Figure 5: Example of Mesh Interlay Seam, Riveted



Critical Attack Area (Figure 6)

16 ga. (1.6 mm) steel sheet, HR Commercial quality, ASTM A366, matte finish, shall extend 1200mm around the door frame on the inside of the secure storage room and be attached as per selected rivet or welding requirements for protection material.

Note: Perforations for services, conduits or ducts are not permitted in the Critical Attack Area.



Wall Finishing Details

Install 16mm gypsum wall boards on both sides of the wall (interior is optional). Standard drywall screws are acceptable for attaching the drywall.

Apply continuous bead of fire-rated acoustic sealing on both sides of the top and bottom tracks minimum of 7mm, maximum of 16mm. ASTM E814 (UL1479), ASTM E1966 (UL 2079) or CAN/ ULC S115 test standards with a fire/ smoke rating acceptable to the Authority Having Jurisdiction (AHJ).

Paint exterior surface of wall with one coat primer/sealer and one coat of gloss enamel. Primer/sealer must extend above drop ceilings to the bottom of structural ceiling. Paint

must be uniform and without blemishes. Joints must not be visible. Custom colors should be considered.

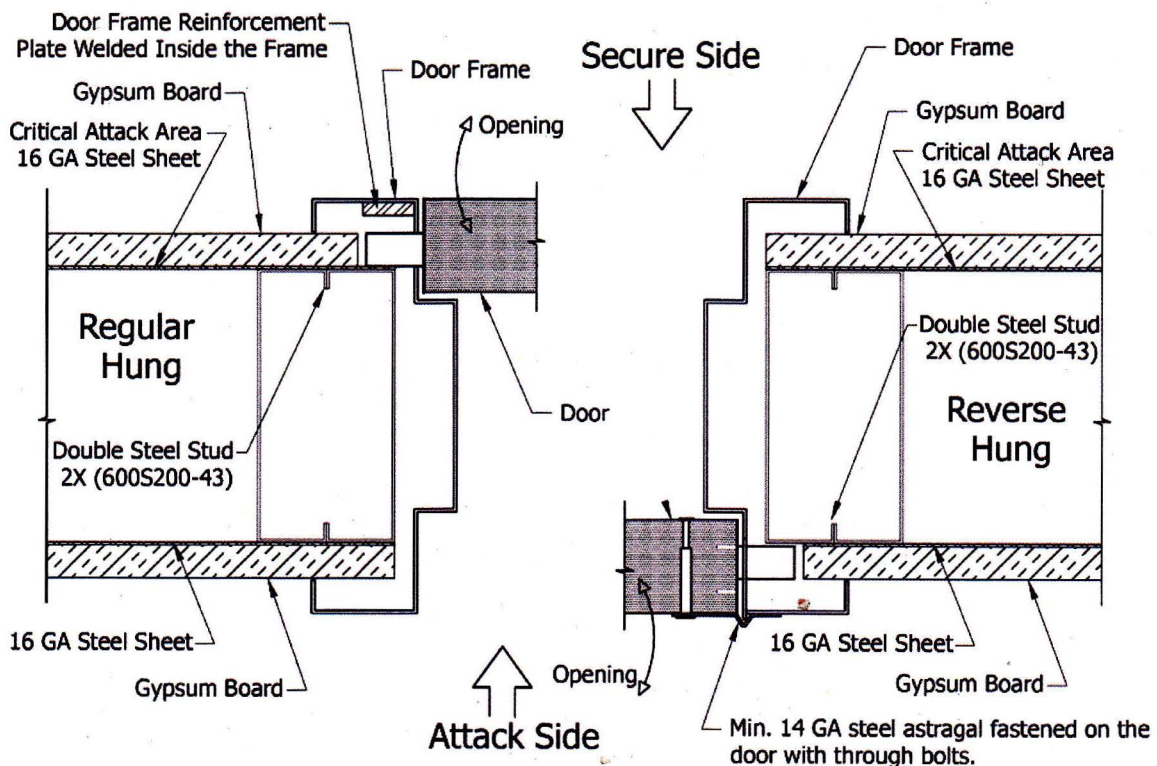
Frame reinforcement at the lock area (Figure 7):

Secure a 6.4mm x 25mm x 610mm steel plate inside the frame using tack welds on every edge. Align the centre of the plate with the lock bolt.

For reverse hung doors, install a steel astragal covering the entire lock edge of the door AND the unmodified strike plate. The astragal should be at least 14 ga (2 mm) thick, should overlap the door frame by at least 25mm. Attach with minimum 6mm (1/4") diameter steel carriage bolts spaced at 250mm oc and at least 25mm from mortise lock pocket. Carriage bolt heads must be on the attack side.

Suggested product: Zero International #43STST

Figure 7: Frame Reinforcement at Door



Plumbing and Electrical Pass-through Construction

Minimize plumbing and electrical pass-throughs in walls where possible. Do not locate pass-throughs in the Critical Attack Area. Where pass-throughs are required, frame openings within 1 inch (25mm) of the pipe/conduit and secure to the stud framing at minimum two places. Extend the wall protection material to within $\frac{3}{4}$ " (20 mm) of the edge of the opening. Extend gypsum wall board to within $\frac{1}{4}$ " of the edge of the pipe or conduit. Seal all gaps with fire rated or acoustic sealant. Recommended product standard: ASTM E 814 (UL 1479) or CAN/ULC S115, or as required by the AHJ.

Where necessary to accommodate pipe or conduit movement or expansion, pipes and conduit may be enclosed in a close-fitting sheet metal sleeve and the sleeve mechanically fastened to the stud framing at two places (minimum). Clearance between the sleeve and pipe or conduit should be kept to a minimum and not exceed $\frac{1}{4}$ ".

Sound Reduction

The following assembly will provide an STC rating of approximately 54-55:

- Two layers of 16 mm fire-rated gypsum board
- One layer of sheet or expanded mesh steel
- Steel studs spaced 300 mm oc
- 150 mm thick mineral wool batts between studs
- Resilient metal channels spaced 400 mm apart
- One layer of 16 mm fire-rated gypsum board

This rating is for the wall assembly without pass-throughs or gaps. Acoustic caulking must be applied between the gypsum board and all adjacent surfaces to prevent sound leakage through spaces and gaps.

Electrical boxes shall not be installed back to back.

Approved: 2018-07-23

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 21 99 – Partitions for Minor Works.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C423-09, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - .2 ASTM E580/E580M-14 Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
 - .3 ASTM C635/C635M-13a, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
 - .4 ASTM C636/C636M-08, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - .5 ASTM E1264-14, Standard Classification for Acoustical Ceiling Products.
 - .6 ASTM E1414/E1414M 11ae1 Standard Test Method for Sound Attenuation between Rooms Sharing a Common Ceiling Plenum.
 - .7 ASTM E1477-98a(2013), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
 - .8 ASTM F1667-15 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction and Amendment No. 1 1988.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .4 Underwriter s Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-2003, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 COORDINATION

- .1 Do not begin erection of ceiling suspension system until work above ceiling has been inspected by Departmental Representative.

1.4 PRE-INSTALLATION MEETING

- .1 Convene pre-installation meeting one week prior to beginning work of this Section with Departmental Representative, other affected trades, contractor's representative in accordance with Section 01 00 10 – General Instructions to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with work of other sections.
 - .4 Review manufacturer s installation instructions and warranty requirements.
 - .5 Review accepted shop drawings for installation requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer s instructions, printed product literature and data sheets for acoustical suspension, acoustic panels, acoustic tiles, and system accessories. Include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit reflected ceiling plans for special grid patterns as indicated.
 - .2 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 lateral bracing and accessories.
- .4 Delegated Design Submittals:
 - .1 Submit delegated design shop drawings stamped and signed by professional engineer registered or licensed in Territory Province of Ontario.
 - .2 Include supporting details, treatment of cross runners, main runners, and wall closures at terminal ends, suspension wire, lateral force bracing, light fixtures and services within the ceiling, seismic isolation joints and partition bracing.
- .5 Samples:
 - .1 Submit for review and acceptance of each component specified or necessary for complete installation. Include technical descriptive data.
 - .2 Submit duplicate samples of each component proposed for use in each type of ceiling suspension system.
 - .3 Submit duplicate 150 mm x 100 mm full size samples of each type of acoustical unit.
- .6 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan and 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.
- .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial post-consumer content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates required percentage 20% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
 - .4 Low-Emitting Materials:
 - .1 Submit listing of adhesives and sealants paints and coatings used in building, showing compliance with VOC and chemical component limits or restriction requirements.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 00 10 – General Instructions.
- .2 Submit operation and maintenance data for acoustical suspension for incorporation into manual.
- .3 Submit final certificate from design professional responsible for delegated detail design of ceiling indicating conformity with accepted shop drawings.

1.7 MAINTENANCE MATERIALS

- .1 Provide extra acoustical units in accordance with Section 01 00 10 – General Instructions.
- .2 Provide acoustical units amounting to 2 % of gross ceiling area for each pattern and type of acoustical panel or tile, suspension system and trim required for project, minimum 1 complete factory-sealed package of each.
- .3 Ensure extra materials are from same production run as installed materials.
- .4 Deliver extra materials for each type of acoustical unit in original unopened packages clearly identified, including colour and texture.
- .5 Deliver to Departmental Representative, upon completion of the work of this section.

1.8 CERTIFICATIONS

- .1 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements. Include certification of sustainable requirements.

1.9 MOCK-UPS

- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
- .2 Construct mock-up 10 m²minimum of each type acoustical ceiling assembly including one outside corner one inside corner. Ceiling system mock-up to show basic construction

and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation, seismic reinforcing.

- .3 Construct mock-up where directed.
- .4 Allow 2 working days for inspection of mock-up by Departmental Representative before proceeding with ceiling work.
- .5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of the finished work.

1.10 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer s written instructions and 01 61 00 - Common Product Requirements.
- .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 flat, indoors in dry location off ground and in accordance with manufacturer s recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect acoustical ceiling, tiles suspension grid components from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .4 Store extra materials required for maintenance, where directed by Departmental Representative.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse recycling or disposal in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

1.11 ENVIRONMENTAL REQUIREMENTS

- .1 Permit wet work to dry before beginning to install.
- .2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20 % before and during installation.40
- .3 Store materials in work area 48 hours prior to installation.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Design Requirements:
 - .1 Intermediate duty system to ASTM C 635/ASTM C635M.
 - .2 Maximum deflection: 1/360th of span to ASTM C 635/ASTM C635M deflection test.
- .2 The suspension system must be capable of safely supporting the weight of all items which are designed to be supported by it, including, but not limited to:

- .1 Light fixtures
- .2 Diffusers
- .3 Other items supported by the ceiling system
- .3 Design the suspension system to withstand normal and seismic loads.

2.2 ACOUSTICAL CEILING SUSPENSION

- .1 Acoustical Ceiling Suspension system: non fire rated, made up as follows:
 - .1 exposed tee bar grid to match existing ceiling grid profile.
- .2 Basic materials for suspension system: commercial quality cold rolled steel mill finished.
- .3 Exposed tee bar grid components: white colour shop painted satin sheen. 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.
- .4 Hanger wire: galvanized soft annealed steel wire:
 - .1 3.6 mm diameter for access tile ceilings.
- .5 Hanger inserts: purpose made.
- .6 Accessories: splices, clips, wire ties, retainers and wall moulding reveal flush, to complement suspension system components, as recommended by system manufacturer.
- .7 Seismic components and accessories: in accordance with accepted shop drawings.

2.3 ACOUSTICAL CEILING PANELS

- .1 Acoustical Panel: to match existing – Armstrong 703B, 610 x 1220 mm

Part 3 Execution

3.1 EXAMINATION

- .1 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 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INTERFACE WITH OTHER WORK

- .1 Coordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

3.3 SUSPENSION SYSTEM INSTALLATION

- .1 Comply with manufacturer s written installation instructions and recommendations, including product technical bulletins, product carton installation instructions, and data sheets.
- .2 Install suspension system in accordance with accepted shop drawings, Certification Organizations tested design requirements and ASTM C636/C636M except where specified otherwise.
- .3 Lay out system according to reflected ceiling plan.
- .4 Finished ceiling system to be square with adjoining walls and level within 1:1000.
- .5 Secure hangers to overhead structure using attachment methods as indicated acceptable to Departmental Representative.
- .6 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
- .7 Ensure suspension system is coordinated with location of related components. Provide carrying channels as necessary to bridge at unavoidable interference between suspension system and other work above ceiling.
- .8 Install wall moulding to provide correct ceiling height.
- .9 Completed suspension system to support super-imposed loads, such as grilles lighting fixtures diffusers and speakers.
- .10 Support at light fixtures diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 610 mm around perimeter of fixture.
- .11 Attach Interlock cross member to main runner to provide rigid assembly.
- .12 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.
- .13 Install access splines to provide 50 % ceiling access.
- .14 Expansion joints:
 - .1 Erect two main runners parallel, 25 mm apart, on building expansion joint line. Lay in strip of acoustic tile/board, painted black, 25% narrower than space between 2 T bars.
 - .2 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.
- .15 Install perimeter trim at floating installations securely anchored to suspension system, in accurate alignment with adjacent assemblies. Install curved trim members in smooth curves to radius indicated.

3.4 ACOUSTICAL CEILING PANEL INSTALLATION

- .1 Install lay-in acoustical panels in ceiling suspension system in accordance with manufacturer's instructions and as indicated.

-
- .2 Install fibrous acoustical media and spacers over entire area above suspended metal panels.

3.5 SITE QUALITY CONTROL

- .1 Arrange for periodic site visits by design professional responsible for delegated ceiling design work to review installed work for conformity to design.
- .2 Arrange for periodic site visits by manufacturer's representative to review installed work for conformity to manufacturer's installation instructions and recommendations.
- .3 Submit written site reports by designer to Departmental Representative within 3 days of visit.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 10 – General Instructions.
 - .1 Touch up scratches, abrasions, voids and other defects in painted surfaces.
- .3 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 74 21- Construction/Demolition Waste Management and Disposal.

3.7 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 09 21 99 - Partitions
- .2 Section 09 68 13 – Tile Carpeting

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM F1303-04 (2014), Standard Specification for Sheet Vinyl Floor Covering with Backing.
- .2 South Coast Air Quality Management District (SCAQMD)
 - .1 SCAQMD Rule 1113-2016, Architectural Coatings.
 - .2 SCAQMD Rule 1168-2017, 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 linoleum 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 and 300 mm long edge strips.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Reduction Workplan and Waste Management Plan 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.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence that project incorporates required percentage 20 % of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
 - .4 Low-Emitting Materials:

- .1 Submit listing of adhesives and sealants used in building, showing compliance with VOC and chemical component limits or restriction requirements.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide extra materials of resilient sheet flooring and adhesives in accordance with Section 01 00 10 – General Instructions.
 - .2 Provide 2 m² of each colour, pattern and type flooring material required 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 Deliver to Departmental Representative, upon completion of the work of this section.
 - .6 Store where directed by Departmental Representative.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors off ground 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.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of crates, padding, packaging materials pallets, as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 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 Linoleum sheet flooring – thickness 2.5 mm
 - .1 In Kitchen 3118 - Armstrong Marmorette, Charcoal Grey LP059

- .2 In Labs and Corridors – Armstrong Marmorette, colour to be chosen by Departmental Representative
- .3 Accent insets in corridors – product and colour to be chosen by Departmental Representative
- .2 Linoleum base: Sheet flooring to be carried up wall to form integral base.
 - .1 Height: 100mm
- .3 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
 - .1 Cove base adhesives:
 - .1 Adhesive: maximum VOC limit 50 g/L to SCAQMD Rule 1168.
- .4 Sub-floor filler and leveller: as recommended by flooring manufacturer for use with their product.
- .5 Metal edge and transition strips:
 - .1 Brushed solid stainless steel with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.
 - .2 Brushed solid stainless steel transition strips suitable for transitioning from new marmoleum to existing adjacent finishes
- .6 External corner protectors: stainless steel, type recommended by flooring manufacturer.
- .7 Edging to floor penetrations: stainless steel type recommended by flooring manufacturer.
- .8 Sealer and wax: type recommended by resilient flooring material manufacturer for material type and location.
 - .1 Sealer: maximum VOC limit 100 g/L to SCAQMD Rule 1113.

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 Follow manufacturer's recommendations in addition to instructions below. In the case of discrepancy notify Departmental Representative.
- .2 Remove existing resilient and other flooring.
- .3 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.
- .4 Clean floor and apply filler as recommended by flooring supplier; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .5 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .6 Prime concrete slab to resilient flooring manufacturer's printed instructions.

3.4 APPLICATION: FLOORING

- .1 Follow manufacturer's recommendations in addition to instructions below. In the case of discrepancy notify Departmental Representative.
- .2 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 1 month following building occupation.
- .3 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .4 Lay flooring with seams parallel to building lines to produce a minimum number of seams. Border widths minimum 1/3 width of full material.
- .5 Run sheets in direction of traffic. heat weld and continuously seal Double cut sheet joints according to manufacturer's printed instructions.
- .6 Heat weld seams of linoleum sheet flooring in accordance with manufacturer's printed instructions.
- .7 As installation progresses, and after installation roll flooring with 45 kg minimum roller to ensure full adhesion.
- .8 Cut flooring around fixed objects.
- .9 Install feature strips and floor markings where indicated. Fit joints tightly.
- .10 Install flooring in pan type floor access covers. Maintain floor pattern.
- .11 Continue flooring over areas which will be under built-in furniture or benchwork.
- .12 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.
- .13 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.5 APPLICATION: BASE

- .1 Sheet flooring to be carried up wall to form integral base.
- .2 Clean substrate and prime with one coat of adhesive.

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- .3 Apply adhesive to back of base.
 - .4 Install straight and level to variation of 1:1000.
 - .5 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
 - .6 Cope internal corners and for right angle external corners.
 - .7 Heat weld base in accordance with manufacturer's printed instructions.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 10 – General Instructions.
 - .1 Clean flooring surfaces to flooring manufacturer's printed instructions.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 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 Use only water-based coating for linoleum.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 65 16 – Resilient Sheet Flooring

1.2 REFERENCE STANDARDS

- .1 American Association of Textile Chemists and Colorists (AATCC)
- .1 AATCC Test Method 16.2-2012(R2014) , Colorfastness to Light: Carbon-Arc.
- .2 AATCC Test Method 16.3-2012(R2014) , Colorfastness to Light: Xenon-Arc
- .3 AATCC Test Method 134-2013(2016) , Electrostatic Propensity of Carpets.
- .4 AATCC Test Method 171-2014 , Carpets: Cleaning of; Hot Water Extraction Method .
- .5 AATCC Test Method 175-2013 , Stain Resistance: Pile Floor Coverings.
- .6 AATCC Test Method 189-2012 , Fluorine Content of Carpet Fibers.
- .2 ASTM International (ASTM)
- .1 ASTM D297-15 , 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 D 1667-05(R2011) , Standard Specification for Flexible Cellular Materials-Poly (Vinyl Chloride) Foam (Closed-Cell).
- .4 ASTM D3574-11 , Standard Test Methods for Flexible Cellular Materials - Slab, Bonded, and Molded Urethane Foams.
- .5 ASTM D3936-12 , Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering.
- .6 ASTM D 5116-10 , Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
- .3 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-4.2 No. 22-2004(2013) , Textile Test Methods - Colourfastness to Rubbing (Crocking).
- .2 CAN/CGSB-4.2 No.27.6–M91-(R2013) , Textile Test Methods - Flame Resistance - Methemine Tablet Test for Textile Floor Coverings.
- .3 CAN/CGSB-4.2 No. 76-94/ISO 2551: 1981 IDT (R2013) , 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: 1978 (R2012) , Textile Test Methods - Carpets - Determination of Tuft Withdrawal Force.
- .4 Carpet and Rug Institute (CRI)
- .1 CRI 104 Standard for Installation of Commercial Carpet 2015 .

- .2 CRI Green Label Plus Indoor Air Quality Testing Program.
- .5 Environmental Choice Program (ECP)
 - .1 CCD-152- 2009 , Flooring Products, Commercial Non-modular Textile Flooring.
- .6 Health Canada
 - .1 C.R.C., c.923-10 , Hazardous Products Act - Carpet Regulations, Part II of Schedule 1.
- .7 National Floor Covering Association (NFCA)
 - .1 National Floor Covering Specification Manual 2007 .
- .8 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2016 , Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005 , Adhesives and Sealants Applications.
- .9 ULC Standards(ULC)
 - .1 CAN/ULC-S102-11 , Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S102.2-88 , Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section on-site installation, with Contractor's Representative and Departmental Representative in accordance with Section 01 00 10 – General Instructions 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: sequence with other work in accordance with Section 01 00 10 – General Instructions.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for each adhesive carpet protection subfloor patching compound and include product characteristics, performance criteria, physical size, finish and limitations.

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- .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06-Health and Safety Requirements.
 - .3 Shop Drawings:
 - .1 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 2 samples for review and acceptance of each accessory.
 - .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 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating 75 % of construction wastes recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .3 Regional Materials: submit evidence project incorporates required percentage 20% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
 - .4 Low-Emitting Materials:
 - .1 Submit listing of adhesives and coatings used in building, showing compliance with VOC and chemical component limits or restriction requirements.

- .2 Submit listing of carpet, carpet backer and adhesive used in building, showing compliance with CRI Green Label Plus Indoor Air Quality Test Program. ASTM D 5116
- .10 Qualification Statements:
 - .1 Compliance: to CAN/ULC-S102.2 .
 - .2 Testing: passes Green Label Plus 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 .

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 00 10 – General Instructions.
- .2 Operation and Maintenance Data: submit operation and maintenance data for installed products for incorporation into manual.
- .3 Warranty Documentation: submit warranty documents specified.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra stock materials in accordance with Section.
 - .1 Quantity: provide minimum 5%
 - .1 Adhesives: 2% of total requirement
 - .2 Delivery, storage and protection: comply with Departmental Representative's requirements for delivery and storage of extra materials.

1.7 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00- Quality Control.
- .2 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 .
- .3 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 No sub-contract labour without written approval of Departmental Representative.
 - .3 Responsible for proper product installation, including floor testing and preparation as specified and in accordance with carpet manufacturer's written instructions.

1.8 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 in dry location 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 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.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

1.9 SITE CONDITIONS

- .1 Moisture: substrate within moisture limits and alkalinity limits recommended by manufacturer. Prepare moisture testing and provide report to Departmental Representative.
- .2 Temperature: maintain ambient temperature of minimum 18 degrees C from 48 hours before installation to minimum 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 Departmental Representative will co-ordinate operation of ventilation system during installation of carpet. Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.
 - .2 Ventilate enclosed spaces. 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:
 - .1 Wet-work in space completed and nominally dry.
 - .2 Work above ceilings complete.

1.10 WARRANTY

- .1 Manufacturer's warranty: submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty in addition to and not limit other rights Departmental Representative may have under Contract Documents.

Part 2 Products

2.1 MATERIALS

- .1 Description:
 - .1 Carpet Tiles: Field Tile
 - .1 Manufacturer: Tarkett
 - .2 Style: Trajectory 03913
 - .3 Colour: Merino 23504
 - .2 Adhesives: Maximum VOC limit 50 g/L to SCAQMD Rule 1168.
 - .3 Primer/Sealer: in accordance with manufacturer's recommendations for surface conditions:
 - .1 VOC limit: maximum 100 g/L to SCAQMD Rule 1113
 - .4 Carpet and Accessories:
 - .1 Green Label Plus certified.
 - .2 20% Post-industrial Post-consumer recycled content.

2.2 ACCESSORIES

- .1 Base:
 - .1 Resilient Base:
 - .1 Type: Johnsonite
 - .2 Style: toe-less in carpet areas, coved in areas with resilient flooring where used to cover benchwork toe-kicks.
 - .3 Thickness: 3.17 mm
 - .4 Height: 102 mm
 - .5 Lengths: cut lengths minimum 1200 mm
 - .6 Colour: 20 - charcoal.
 - .2 Binder Bars: As recommended by manufacturer.

- .3 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.
 - .4 Adhesive:
 - .1 Multi-purpose Adhesive Type: water based resealable adhesive as recommended by carpet tile manufacturer for direct glue down installation.
 - .2 Pressure Sensitive Type: recommended by carpet tile manufacturer for direct glue down installation of speciality backed carpet tiles.
 - .3 Mill-applied Adhesive Type: fully cured. Combination of pre-applied adhesive and tile to meet carpet only VOC emissions criteria of Carpet and Rug Institute Green Label Plus Indoor Air Quality Certification Program.
 - .4 On site application VOC limit: 50 g/L maximum to SCAQMD Rule 1168.
 - .5 Adhesive in compliance with CCD-152.
 - .5 Transition Mouldings:
 - .1 Carpet edge / reducer strip.
 - .6 Carpet protection: non-staining heavy duty kraft paper.
 - .7 Concrete floor sealer primer:
 - .1 VOC limit: 100 g/L maximum to SCAQMD Rule 1113.
 - .8 Subfloor patching compound: Portland cement base filler, mix with latex water to form cementitious paste as recommended by carpet manufacturer.

Part 3 Execution

3.1 INSTALLERS

- .1 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 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 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 suitable for carpet installation.
 - .2 Fill and level cracks 3 mm wide or protrusions over 0.8 mm with appropriate and compatible latex polymer fortified patching compound to suit manufacturer's written recommendations.
 - .3 Comply with manufacturer's written recommendations for maximum patch thickness.
 - .4 Prime large patch areas with compatible primer.
 - .5 Ensure concrete substrates cured, clean and dry.
 - .6 Ensure concrete substrates free of paint, dirt, grease, oil, curing or parting agents, and other contaminants, including sealers, that interfere with bonding of adhesive.
 - .7 Where powdery or porous concrete surface encountered, apply primer compatible with adhesive to provide 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 installed.
- .4 Install carpet tile in accordance with 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 compliance with manufacturer specifications.
 - .2 Trapping yarn between carpet tiles is prohibited.
- .6 Apply thin film of pressure-sensitive adhesive according to manufacturer's recommendations.
- .7 Finished installation to present smooth wearing surface free from conspicuous seams, burring and other faults.

- .8 Use material from same dye lot.
 - .1 Colour, pattern and texture to match within visual areas.
 - .2 Maintain constant pile direction.
- .9 Fit around architectural, mechanical, electrical and telephone outlets, and furniture fittings, around perimeter of rooms into recesses, and around projections.
- .10 Install carpet tiles to underfloor duct system access covers.
- .11 Install carpeting in pan type floor access covers.
- .12 Extend carpet tiles into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- .13 Install carpet tiles smooth and free from bubbles, puckers, and other defects.
- .14 Protect exposed carpet tile edges at transition to other flooring materials with suitable transition strips.
- .15 Base Installation: Install base as described and indicated in the drawings. Install resilient base with adhesive to all areas where existing resilient base is located.

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 Work of this Section depends, complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning 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 00 10 – General Instructions.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 10 – General Instructions.

- .1 Vacuum carpets clean immediately after completion of installation.
- .2 Waste Management: separate waste materials for reuse/recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Prohibit traffic on carpet for minimum period of 24 hours after installation and until adhesive is cured.
- .3 Install carpet protection as directed by Departmental Representative.
- .4 Repair damage to adjacent materials caused by tile carpeting installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 21 99 - Partitions for Minor Works

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .2 Maintenance Repainting Manual - current edition.
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2016, Architectural Coatings.

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 paint and coating products and include product characteristics, performance criteria, physical size, finish and limitations. For each paint and coating product. Indicate each product's MPI product number and label and organize each product by the MPI painting/repainting system to which it belongs
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit 200 x 300 duplicate mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards.
- .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan and 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.
- .2 Regional Materials: submit evidence that project incorporates required percentage 20 % of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
- .3 Low-Emitting Materials:
 - .1 Submit listing of paints and coatings used in building, comply with VOC and chemical component limits or restriction 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 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store painting materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.
- .4 Fire Safety Requirements:
 - .1 Supply fire extinguisher adjacent to storage area, type as recommended by paint manufacturer.
 - .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 National Fire Code of Canada (NFC) requirements.
- .5 Develop Waste Reduction Workplan and Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 75 21 – Construction/Demolition Waste Management and Disposal.
- .6 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, padding, packaging materials crates, as specified in Waste Reduction Workplan Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces in accordance with Section 01 51 00- Temporary Utilities.
 - .2 Co-ordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.

- .3 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
 - .2 Test concrete, masonry and plaster surfaces for alkalinity as required.
 - .3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.
- .3 Additional application requirements:
 - .1 Apply paint finish 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.

Part 2 Products

2.1 MATERIALS

- .1 Supply paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.
- .3 Materials in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual "Approved Product" listing.
 - .1 Use MPI listed materials having E3 or E2 rating where indoor air quality requirements exist.
- .4 Colours:
 - .1 All colours listed below are simply for matching colour. Specific paint products must comply with MPI paint systems described below.
 - .1 PT1, main wall and ceiling colour: to match Sico Drum Skin (white), 6210-11
 - .2 PT2, accent wall colour: to match Benjamin Moore Deep Rose (red), 2004-10
 - .3 PT3, doors/frames and the wall behind kitchen millwork: to match Benjamin Moore Whale Gray, 2134-40, modified as required to match counter top laminate exactly
 - .4 PT4, accent wall colour: to match Sico Arctic Hare (light grey), 6209-31
 - .5 PT 5, accent wall colour: to match Sherwin Williams Down Pour (blue), SW6516
 - .6 PT6, accent wall colour: to match Benjamin Moore Killarney (green), CC 698
- .5 Mixing and tinting:
 - .1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from Departmental Representative for tinting of painting materials.

- .2 Use and add thinner in accordance with paint manufacturer's recommendations.
 - .1 Do not use kerosene or similar organic solvents to thin water-based paints.
- .3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.
- .4 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.
- .6 Gloss/sheen ratings:
 - .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss Level-Category	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish	Max. 5	Max. 10
Gloss Level 2 - Velvet	Max.10	10 to 35
Gloss Level 3 - Eggshell	10 to 25	10 to 35
Gloss Level 4 - Satin	20 to 35	min. 35
Gloss Level 5 - Semi-Gloss	35 to 70	
Gloss Level 6 - Gloss	70 to 85	
Gloss Level 7 - High Gloss	More than 85	

- .2 Gloss level ratings of painted surfaces as noted on Finish Schedule as indicated.
- .7 Interior painting:
 - .1 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 INT 5.3M – High performance architectural latex (over W.B. galvanized primer), Premium Grade, G5 finish.
 - .2 Dressed Lumber: doors, door and window frames, casings, mouldings, etc.:
 - .1 High performance architectural latex, Premium Grade, G5 finish.
 - .3 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock" type material, etc.
 - .1 INT 9.2B - High performance architectural latex (over latex primer/sealer), Premium Grade, G3 finish.
- .8 Interior re-painting:
 - .1 Concrete Vertical Surfaces
 - .1 RIN 3.1J – High Performance Architectural Latex (over w.b. alkali-resistant primer), Premium Grade, G3 finish
 - .2 Galvanized Metal: (doors, frames, railings and handrails, etc.).
 - .1 RIN 5.3J - High Performance Architectural Latex, Premium Grade, G5 finish
 - .1 When painting over existing alkyd paint, modify system to use MPI 17as full primer coat - clean and de-gloss existing surface prior to application. Allow 24 hours minimum drying time after application of primer coat
 - .3 Dressed Lumber: (Including Doors).
 - .1 High performance architectural latex, Premium Grade, G5 finish

- .4 Plaster and Gypsum Board: gypsum wallboard, drywall, "sheet rock" type material, etc.
 - .1 RIN 9.2B – High Performance Architectural Latex, Premium Grade, G3 finish.

Part 3 Execution

3.1 GENERAL

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.
- .2 Perform preparation and operations for interior painting in accordance with MPI - Maintenance Repainting Manual and MPI - Architectural Painting Specifications Manual except where specified otherwise.

3.2 EXAMINATION

- .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 properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

3.3 CONDITION OF SURFACES

- .1 Assess the degree of surface deterioration (DSD) prior to commencement of painting using the assessment criteria indicated in the MPI Maintenance Repainting Manual and repaint accordingly per MPI.
- .2 No repainting work shall commence until all DSD-4 adverse conditions and defects have been corrected and surfaces and conditions are acceptable.

3.4 PREPARATION

- .1 Protection of in-place conditions:
 - .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 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.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to

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- undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
 - .4 Clean and prepare surfaces in accordance with MPI - Maintenance Repainting Manual and MPI - Architectural Painting Specification Manual specific requirements and coating manufacturer's recommendations.
 - .5 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.
 - .6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.
 - .7 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.
 - .8 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.
 - .9 Touch up of shop primers with primer as specified.
 - .10 Test all existing paint surfaces to determine if latex or alkyd prior to application.

3.5

APPLICATION

- .1 Paint only after prepared surfaces have been accepted by Departmental Representative.
- .2 Use method of application approved by Departmental Representative.
 - .1 Conform to manufacturer's application recommendations.
- .3 Apply coats of paint in continuous film of uniform thickness.
 - .1 Repaint thin spots or bare areas before next coat of paint is applied.
- .4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .5 Sand and dust between coats to remove visible defects.
- .6 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.
- .7 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .8 Finish closets and alcoves as specified for adjoining rooms.
- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .10 Mechanical/Electrical Equipment:

- .1 Paint conduits, piping, hangers, ductwork and other mechanical and electrical equipment exposed in finished areas, to match adjacent surfaces, except as indicated.
- .2 Do not paint over nameplates.
- .3 Keep sprinkler heads free of paint.
- .4 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 10 – General Instructions.
- .3 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .4 Place primer, stains and paint defined as hazardous or toxic waste, including tubes and containers, in containers or areas designated for hazardous waste.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 21 99 – Partitions for Minor Works
- .2 Section 09 68 13 – Tile Carpeting
- .3 Section 12 35 53.14 – Storage Cabinets

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI A208.1-2009, Particleboard.
- .2 ASTM International
 - .1 ASTM A167-99 (2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM A240/A240M-11b, 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.
 - .4 ASTM B117-11, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - .5 ASTM B456-11e1, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - .6 ASTM E54-80 (1996), Standard Test Methods for Chemical Analysis of Special Brasses and Bronzes.
 - .7 ASTM E478-08, Standard Test Methods for Chemical Analysis of Copper Alloys.
- .3 CSA International
 - .1 CSA O112.10-08, Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure).
- .4 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
- .5 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA LD 3-2005, High-Pressure Decorative Laminates (HPDL).
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards.
 - .1 SCAQMD Rule 1113-A2011, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

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- .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 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.
 - .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.
 - .6 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Reduction Workplan and Waste Management Plan 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.
 - .3 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages of recycled content materials and products, showing their costs and percentages of post-consumer and post-industrial content, and total cost of materials for project.
 - .2 Submit evidence, when Supplementary Cementing Materials (SCMs) are used, to certify reduction in cement from Base Mix to Actual SCMs Mix, as percentage.
 - .4 Regional Materials: submit evidence that project incorporates required percentage 20 % of regional materials and products, showing their cost,

distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

- .5 Low-Emitting Materials:
 - .1 Submit listing of carpet paints and coatings adhesives and sealants used in building, showing compliance with VOC and chemical component limits or restriction requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location off ground indoors 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 Develop Waste Reduction Workplan Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .5 Packaging Waste Management: remove for reuse by manufacturer and return of padding, packaging materials pallets, crates, as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 QUALIFICATIONS

- .1 The sub-contractor must be a recognized laboratory furniture manufacturer with a minimum of 5 years experience in the industry. They shall also have ISO-9001-2000 accreditation and their products must meet all recommended practices of the "Scientific Equipment & Furniture Association" (SEFA).
- .2 The Contractor must demonstrate and prove its ability to produce and install projects of similar sizes and complexity.

Part 2 Products

2.1 MATERIALS

- .1 Commercial Quality Cold Rolled Steel sheets as per ASTM A366-85, class 1.
- .2 Stainless Steel sheets, type 316 with # 4 satin finish, as per ASTM A167-96.
- .3 Polished glass as per CAN/CGBS-12.3, 6 mm thickness
- .4 Polished laminated glass as per CAN/CGSB.12.1, first quality, 6 mm total thickness.

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- .5 Silicone sealant for moisture resistance, Dow Corning # 786, black, clear or white and / or black chemical resistant sealant Dow Corning # 999 according to needs.

2.2 CABINETS

- .1 The laboratory furniture shall be constructed as per Bedcolab's Forte Inset Casework System.
- .2 The minimum metal gauges used in the fabrication of the casework shall be the following as recognized per North American standards:
 - .1 3.2 mm, for top front rails of the cabinets
 - .2 1.7 mm, for all leveling devices & drawer suspension tracks.
 - .3 1.0 mm, for all drawer boxes, drawer front's interior and exterior panels and the door's interior panels.
 - .4 1.2 mm, for all the other cabinet's component including cabinet frames, doors and shelves.
- .3 The cabinets shall have successfully passed all required physical and chemical resistance testing per SEFA 8M-2010 specifications. Contractor shall supply proof of test results.
- .4 Casework shall feature all welded construction. All cases shall be rigid and self-supporting and fabricated to allow individual unit relocation at any time. Screws and bolts are acceptable only if they are to be used on removable pieces.
- .5 All welds shall be ground smooth. Spotweld will not be noticeable.
- .6 Each unit shall have non-exposed top front and bottom rails to assure the rigidity of the cabinet. The vertical posts and the horizontal rails must form a rigid, square assembly to house the doors and drawers. The fit of the doors and drawers will be such to prevent a sight line within the cabinet and to prevent dust penetration.
- .7 The side panels of the cabinet including front and back vertical rails must be formed in one piece. All front vertical posts shall be pre-punched to accommodate left or right door hinging as well as any combination of drawers, doors and shelves. In addition, front vertical rails shall be reinforced with a U shaped channel for added strength. All rear vertical posts shall be pre-punched to received drawer suspension tracks and shelf clips.
- .8 All parts and sub assemblies including the doors, drawers, drawer suspension tracks, front center posts and removable back panels, shall be interchangeable in the field without requiring special tools.
- .9 Each corner under the cabinet floor shall be provided with a 8 mm diameter steel threaded bolt type leveling device adjustable by a slot screwdriver from inside the cabinet. Black nylon caps shall be supplied to cover holes after installation. In order to properly support the weight that will be placed on the leveler, a full depth formed box shall be spot welded to the side wall as well as the bottom of the cabinet.
- .10 All double door cabinets must be free of a center post, to permit full access to the storage area. The cabinet shall be constructed in such a way as to allow the retrofitting of a center post so that different door and drawer combinations can be installed.
- .11 All base cabinets shall be provided with a continuous 102 mm high by 51 mm deep toe space along the entire working area.

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- .12 The front top portion of the side panels shall be welded to an 11 gauge "u" shaped channel to form a rigid square assembly to properly support the counter top.
 - .13 No exposed horizontal structural members between doors and drawers shall be accepted.
 - .14 Perforations or mechanical fixations are not permitted on visible cabinet sides.
 - .15 All base cabinets, with the exception of the drawer units, shall be supplied with a back panel which shall be removable, without the use of tools. Back panels shall extend full height and width between the structures of the cabinet. Sink cabinets shall have a partial back panel, 227 mm high, to accommodate plumbing requirements.
 - .16 All cabinet boxes must be fabricated to permit any future arrangement of doors and drawers. Front center posts or any other separator must be removable or can be added at any time, without having to make additional perforations or modifications to the cabinet.
 - .17 Shelving :
 - .1 Shelving shall be Cold Rolled Steel. Edges shall be turned down on all four sides 19 mm and shall return under on front and back 19 mm.
 - .2 Shelves shall be adjustable on 13 mm increments and shall be full depth and width of the interior.
 - .3 Each shelf shall be supported by four zinc plated shelf clips.
 - .18 Doors :
 - .1 Hinged metal doors shall consist of an inner and outer panel (painted inside and out) with sound deadening material covering the entire inside surface of the door.
 - .2 The two top corners of the doors must be welded the full thickness of the doors and ground smooth.
 - .3 The inside panel shall be removable and be mechanically fastened to the front panel by two fasteners at the bottom of the door to form a rigid 19 mm thick door with no vibrations during the opening and the closing of the door.
 - .4 Hinged side shall be reinforced adequately to ensure firm fastening and prevent sagging.
 - .5 Recessed black PVC or aluminum handles or wire pulls must be installed in the upper section of the door opposite the hinges, to permit an easy and natural opening.
 - .19 Drawers :
 - .1 The drawer bottom flanges shall be bent upward on four sides for easier cleaning.
 - .2 Drawer fronts shall consist of an inner and outer panel (painted inside and out) with a sound deadening material covering the entire inside surface of the drawer front.
 - .3 The outside panel shall be removable and be mechanically fastened to the front panel to form a rigid 19 mm thick door.
 - .4 Drawer sides shall be structurally reinforced around the top edge by a 19 mm return flange with a 6 mm seam bend to the inside. The front and back drawer panels shall be reinforced by a 19 mm flange all around and shall be welded to the sides to form a rigid drawer unit.

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- .5 Drawers shall operate on 25 mm diameter nylon wheels with steel ball bearings. One such wheel shall be on each drawer slide and one on each drawer suspension track.
 - .6 Drawer tracks shall be designed to prevent metal to metal contact and shall incorporate a self closing action for at least the last 178 mm of drawer travel.
 - .7 The drawer slides shall have built-in stops to prevent inadvertent removal of the drawers and shall be designed so that the drawers can be removed from full open position by lifting the front of the drawers and pulling out. The closing action of the drawers shall be cushioned by two rubber bumpers and the drawers shall be so designed as to operate freely and quietly even when loaded.
 - .8 One recessed black PVC or aluminum handle or a wire pull shall be supplied in the center of the front of each drawer, except for drawers 762 mm or wider which require two pulls.
 - .9 The cabinets must be designed to permit the addition of full extension drawer tracks in replacement of the self closing tracks, without any modifications to the cabinets. This addition must be possible after the installation.
- .20 Filler Panels
- .1 All filler panels between cabinets or walls shall be fabricated with the same material and finish as the cabinets.
 - .2 Filler panels shall be flanged 25 mm on one side and flat on the other, to be cut on job site to suit wall conditions, and shall fit into double angles secured to the wall. No visible mounting screws permitted.
 - .3 Corner filler panels shall be a two piece construction, one fixed panel and the other a floating panel to accommodate room dimensions. Each shall have return flanges and an integral 76 mm x 102 mm toe space filler to interlock with the adjacent cabinet.
 - .4 Front filler panels shall be fabricated complete with return flanges on both sides and a 76 mm x 102 mm toe space along the working face.
- .21 Knee space Assembly :
- .1 The knee space between two cabinets shall consist of a channel shaped metal skirt 102 mm high supporting the counter top and a full width service cover panel to enclose the pipe space.
 - .2 If a knee space drawer is required it will consist of a 102 mm all welded construction skirting panel. The drawer shall use the same drawer tracks as the standard base cabinets.
 - .3 The service cover panel shall be designed in three sections. The lower and upper sections shall be fixed in place on each side to the back of the base cabinets. The middle section shall be fitted between the base cabinets and hanged from the upper section and kept in place with a magnet strip on the lower section.
- .22 Gable Legs :
- .1 Gables may be used in lieu of base cabinets to support counter tops. They shall consist of an inner and outer panel formed and welded to provide a strong rigid unit.

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- .2 All gables shall be 31 mm thick with a 76 mm x 102 mm toe space and equipped with two 8 mm diameter threaded bolt type steel levelers as in standard base cabinets.
- .23 Leg Sets :
- .1 Leg Sets may be used in lieu of base cabinets to support counter tops. They consist of two 51 mm square metal tubular legs, a steel channel shaped skirting panel 102 mm high on top as well as a 25 mm x 51 mm steel tube centered 204 mm up from the bottom of leg. All components are welded together to form a strong rigid unit.
 - .2 The leg sets are equipped with two 8 mm diameter threaded bolt type steel levelers as in standard base cabinets.
- .24 Wall Storage Cabinets :
- .1 All wall storage cabinets shall be made of Cold Rolled Steel and built using the same construction as the standard base cabinets.
 - .2 Cabinet sides, bottom and top shall be 1.2 mm steel panels with the same construction detail on the front edge as the standard base cabinets.
 - .3 Back panel shall be flanged 13 mm on all four sides and spot welded to cabinet sides, bottom and top. Back panel shall be reinforced with two hat section channels welded vertically at 125 mm from each side and have two vertical rows of holes at 12mm increments for shelf support clips.
 - .4 The cabinet floor shall cover the full interior width and depth with return flanges turned down on all four sides. This panel shall be removable for easy access to wall fastenings.
 - .5 Shelves shall be Cold Rolled Steel 19 mm thick with all four sides turned down and shall have a 19 mm return flange on the front and back. Shelves shall be adjustable at 13 mm increments and shall be full depth and width of interior. Four zinc plated clips per shelf shall be provided.
 - .6 The wall storage cabinets should permit the addition of all of the following kinds of door arrangements without any modifications to the cabinet. Cabinets can be supplied open on the front or with the following types of doors:
 - .1 Sliding glass doors shall be 6 mm glass fitted to a "W" shaped extruded aluminum shoe running the full width of door bottom. Shoe shall be provided with two nylon wheel assemblies. The door assembly shall run on an inverted "W" shaped extruded aluminum track. One finger pull 16 mm x 76 mm per door shall be ground into glass on side of door.
 - .2 Sliding metal doors shall be the same construction as the doors on the standard base cabinets but shall be guided at the bottom with a full width aluminum track and a black nylon track on top.
 - .3 Hinged metal doors shall be the same construction as the doors on the standard base cabinets.
 - .4 Hinged glass doors shall be 6 mm glass with a 51 mm x 19 mm metal frame all around the glass.
- .25 Steel Furniture Finish:

- .1 When fabrication of unit is completed, all surfaces shall be free of scratches, spot weld marks or material imperfections. Welds will be ground smooth where necessary. The unit will be washed using a three stage iron phosphate process for proper surface preparation, and subsequently dried in a dry off oven to remove all traces of humidity.
- .2 A high quality chemical resistant polyurethane paint will then be applied to all surfaces including the interior of door and drawer panels using an electrostatic spray process. The parts will pass through a baking oven for the duration and temperature as recommended by the paint manufacturer. Painted surfaces shall conform to A.A.M.A. 2603.
- .3 The painted surfaces shall meet or exceed the SEFA 8 specification for chemical resistance as specified by the "Scientific Equipment and Furniture Association" and shall contribute to LEED credits.
- .4 Technical Performance :
 - .1 Adhesion to substrate: 100% 5B (ASTM D3359)
 - .2 Hardness: 3H (ASTM D3363)
 - .3 Gloss: 60 +/- 5 units on 60°
 - .4 Flexibility: ¼" Conical Mandrel (ASTM D522)
 - .5 Impact resistance: 100 in-lb direct: 100 in-lb reverse (ASTM D2794)
 - .6 Corrosion resistance: 1000 hrs less 1/16" in creepage over B-1000 treated test panels (ASTM B117)
 - .7 Humidity resistances: 1000 hrs no blistering over B-1000 treated test panels (ASTM D2247)
- .5 Colors: Bedcolab BL400 Dark Grey

2.3 COUNTERTOPS

- .1 Solid epoxy resin, by Durcon, radius top edge, 25mm thick
- .2 Colour to be Black Onyx
- .3 Backsplash: Materials shall be 25mm thick. Supply loose for field application in same material as countertops. Curbs as installed shall be 4 inches 102mm high, unless otherwise indicated on drawings. Curbs will be bonded to the tops at the jobsite. Include top mounted end curb where work surfaces abut walls, fume hoods, and locations detailed on drawings.
- .4 Provide black plastic cable entry plugs with covers, 72mm dia.

2.4 COUNTERTOP FABRICATION

- .1 Fabricate laboratory counter tops splashbacks as indicated.
- .2 Use specified materials in designated locations as follows:
- .3 Fabricate counter top and splashback sections in as long a length as practicable.
- .4 Cut holes for fittings, accessories, and equipment.
- .5 Round exposed edges and corners of cutouts.

2.5 CABINET HARDWARE

- .1 Cabinet pulls: Extruded aluminum 4" (102 mm) long set flush within thickness on door and drawer front panels.
- .2 Drawer tracks: shall be 75% opening self closing Bedcolab model # DT002 with 178 mm self- closing feature - 150 lbs capacity
- .3 Cabinet hinges: 1.9 mm steel, five knuckle type screwed into door and fastened to cabinet side with two counter sunk 8-32 stainless steel screws. Hinges shall be stainless steel.
- .4 Door catches: Shall be adjustable zinc plated steel spring loaded, nylon roller, and model number 950 by Canaropa.
- .5 Strike plates: shall be made of steel and part of the structure of the cabinet.
- .6 Locks: do not provide locks
- .7 Levelers: Levelers at the four cabinet corners shall be cadmium plated hex head 5/16" (8 mm) machine screws 1 1/2" (38 mm) long slotted on threaded end for screwdriver adjustment. Levelers can be supplied, as an option, with white nylon glide caps. Cluthe # 805
- .8 Press plugs: Press plugs for cabinet floors shall be black nylon, Cords # DP875.
- .9 Shelf clips: Shelf clips shall be Roll-It # 101 with a zinc finish
- .10 Drawer and hinged door bumpers: Drawer and hinged door bumpers shall be black rubber, tongue type press fit bumper. Two bumpers per door or drawer. 3M # SJ- 5003.

2.6 EPOXY SINKS

- .1 Description: integrally molded from modified thermosetting epoxy resin, and oven cured. Nominal wall thickness 12mm with all interior corners coved to a 36mm radius and bottoms pitched to the outlet opening.
- .2 Drop-in Sinks: provide as shown on drawings:
 - .1 Sink shall be installed such that the top edge of the sink is positioned 3mm below the work surface with a 45 degree slope from the top of the worksurface to the top of the sink lip. The sink joint shall not exceed 3mm plus or minus 1.5mm.
 - .2 Sealant: join work surface and sinks with a 2 part epoxy grout having similar chemical resistance and strength properties as the work surface itself.
 - .3 Sink drains will be positioned per manufacturer's drawings
 - .4 Sink installation by Div. 15
- .3 Sink colour: black to match counter
- .4 Sink outlets:
 - .1 sink outlets shall accommodate a plastic disc strainer. Provide outlet with 50mm opening and open-end overflow standpipe. Outlet flange to be sloped and radiused to the opening for proper outlet drainage. Overflow to be at least 50mm shorter than depth of sink. Installation and traps by Division 15.
 - .2 Outlet colour: black

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 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Handling:
 - .1 The manufacturer must provide proper packaging of the products in order to ensure the integrity of the products up to the final destination.
 - .2 The minimum packaging must correspond to the following: each cabinet must be covered with a plastic wrap and then fixed to a wood pallet, cabinets may be stacked a maximum of two cabinets high, and each assembly covered with cardboard and a plastic wrapping.
 - .3 All counter tops must be protected with cardboard, after their installation, until the final inspection of this work.
- .2 Install laboratory casework plumb with counter tops level to 1.5 mm in 3 m.
- .3 Level base cabinets by adjusting levelling screws.
- .4 Fit closure strips and scribe to irregularities of adjacent surfaces, maximum gap opening 0.5 mm.
- .5 Support wall cabinets on continuous galvanized steel hanging brackets by bolting directly to wall.
- .6 Bolt adjoining cabinets together, maximum width of joint 1 mm.
- .7 Apply small bead of sealant at junction of counter top and adjacent wall finish.
- .8 After installation, adjust operating hardware.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 – General Instructions.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 10 – General Instructions.
 - .1 Touch up marred or abraded finished surfaces.
 - .2 Wipe down surfaces to remove fingerprints and markings.
- .3 Waste Management: separate waste materials for recycling reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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

3.4 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 RELATED SECTIONS

- .1 Section 12 35 53.13 - Steel Laboratory Casework.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A480/A480M-17, Standard for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Stainless steel: to ASTM A480/A480M, type 316.
- .2 Colour and finish to match steel laboratory casework as indicated in Section 12 35 53.13 - Steel Laboratory Casework.

2.2 ACID STORAGE CABINET

- .1 Construct cabinet bodies of sheet metal, flanged and returned at exposed gables to receive flush mounted 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 Provide molded polyethylene interior liner. Acid storage cabinets without a single piece liner are not acceptable.
- .5 The lining on the back of doors shall be fitted so that it overlays the flange on the front of the molded cabinet liner to protect all metal areas of the cabinet from corrosive vapours.

- .6 Acid storage cabinets shall contain one full-width phenolic shelf. It shall be possible to locate shelf in four positions on 75 mm increments. Shelf supports shall be integrally molded into cabinet liner.
- .7 Provide the door with a decal signifying "ACID" storage.
- .8 Molded liner shall incorporate a 25 mm high lip along bottom edge to contain spills.
- .9 Provide one threaded connection fusion welded to the rear of the cabinet. Thread shall be 50 mm NPT for connection to fume hood. Provide piping from cabinet to hood.
- .10 Provide an entirely plastic door catch.

2.3 SAFETY STORAGE CABINET

- .1 Construct storage cabinets of double wall, welded sheet steel construction with double panel door; overall thickness, 50 mm. Provide cabinets with four (4) adjustable levelling devices to compensate for approximately 25 mm base building floor differential. Raise door sill 50 mm above bottom of the cabinet to form a liquid-tight well. Overlap cabinet frame with hinged doors having continuous piano type hinges with three-point locking mechanism ship lapped at opening stile. Shiplap shall be provided with braided fiberglass gasket.
- .2 Walls, back, side and top of cabinet shall be insulated with 50 mm thick mineral fibre insulation.
- .3 Provide adjustable galvanized sheet steel shelves with four (4) edges turned down 25 mm and additionally returned under 16 mm on all edges. Provide 13 mm incremental shelf adjustment.
- .4 Provide 50 mm vent, complete with fire baffle cover with 50 mm fine metal filter.
- .5 Provide overlaid red warning letters 50 mm high on doors as follows: "FLAMMABLE -- KEEP FIRE AWAY".
- .6 Construction shall meet requirements of OSHA Standard 1910-106(d)(3), considered as organized storage centres for flammable and combustible liquids. Cabinets shall comply with National Fire Protection Association's flammable and combustible liquids Code #30 and #45, 1996. Provide grounding screw lug in accordance with Codes.
- .7 Construct safety storage cabinets sized for under fume hood configurations built to provide support for fume hoods.
- .8 Cabinet shall be listed and labelled to the UL1275 standard.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Level base cabinets by adjusting levelling screws.
- .2 Fit closure strips and scribe to irregularities of adjacent surfaces, maximum gap opening 0.5 mm.
- .3 After installation, adjust operating hardware.

3.2 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 REFERENCES

- .1 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Ontario Regulation
 - .1 ONTARIO OBC-2012, 2012 Ontario Building Code Compendium.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 13, Installation of Sprinkler Systems, 2016 edition.
- .4 National Research Council Canada
 - .1 NRCC NBCC-2015, National Building Code of Canada.

1.2 GENERAL

- .1 This section covers items common to all sections of Divisions 20, 21, 22, 23 & 25.
- .2 Coordinate location & installation of all equipment with all trades to ensure the equipment is serviceable.
- .3 Prime mechanical contractor shall be responsible to ensure that all requirements of Divisions 20, 21, 22, 23 & 25 are met and comply with all other divisions and contract documents.
- .4 The word "provide" shall mean "supply and install".
- .5 Conform to the requirements of Division 00, Division 01 and Instructions to Tenderers.

1.3 EQUIPMENT

- .1 General:
 - .1 Mechanical equipment that is not regulated by the Green Energy Act, shall carry a permanent label installed by the manufacturers stating the equipment complies with the requirement of ASHRAE 90.1.
 - .2 The minimum equipment efficiency, standard rating and operating conditions shall be as per ASHRAE 90.1, superceded by Ontario Building Code (OBC) Supplementary Standard SB -10, unless indicated otherwise on contract documents. The higher of the energy efficiencies of the listed equipment shall prevail.
 - .3 Provide new materials and equipment of proven design, quality and of current models with published ratings for which replacement parts are readily available.
 - .4 Uniformity: Use product of one manufacturer unless otherwise specified, for equipment or material of the same type of classification.

- .2 Installation:
 - .1 Unions, flanges and/or couplings: provide for ease of maintenance and disassembly.
 - .2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer, Code or as indicated; whichever is the more stringent.
 - .3 Equipment drains: pipe to floor drains in a manner which is non-obstructing.
 - .4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.
 - .5 Unless otherwise specified, follow manufacturer's recommendations for safety, adequate access for inspection, maintenance and repairs.
 - .6 Permit equipment maintenance and disassembly with minimum disturbance to connecting piping and duct systems without interference with building structure or other equipment.
 - .7 Lubrication: Provide accessible lubricating means for bearings, including permanent lubrication "Lifetime" bearings. Extended grease nipples to be supplied.

1.4 ANCHOR BOLTS AND TEMPLATES

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

1.5 TRIAL USAGE

- .1 Departmental Representative may use equipment and systems for test purposes or for continuity of operation prior to acceptance. Supply labour, material, and instruments required for testing & operation.
- .2 For continuous use, refer to Section 23 05 01 - Use of Mechanical Systems During Construction.

1.6 PROTECTION OF OPENINGS

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.7 ELECTRICAL

- .1 Electrical work to conform to Division 26 including the following:
 - .1 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems. Refer to Division 26 for quality of materials and workmanship.
- .2 Any costs associated with deviation of mechanical equipment rating affecting electrical Division 26 shall be carried by the mechanical contractor.

- .3 All control wiring & conduit associated with Building Automation System & HVAC controls shall be provided by Divisions 20, 21, 22, 23 & 25 including power wiring to all control panels & other field mounted control devices. Emergency power circuits are provided by Division 26 in the vicinity of the power source.

1.8 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Where specified elsewhere in Divisions 20, 21, 22, 23 & 25, manufacturers to provide demonstrations and instructions.
- .3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, Departmental Representative may record these demonstrations on video tape for futurereference.
- .6 Furnish trained instructors to instruct operating staff in the operation, maintenance and adjustment of all mechanical equipment; and, instruct personnel on any changes to or modifications of any equipment made under terms of the guarantee.
- .7 The instructions shall take place during regular working hours before systems are accepted and turned over to staff.
- .8 Ensure that the operating personnel have received and been given opportunity to review the Operating and Maintenance Manuals prior to commencing instruction. Allow two full days on site for review of these manuals with personnel and for their instruction in operation and maintenance of all mechanical equipment.

1.9 CLOSEOUT SUBMITTALS

- .1 Submit operation and maintenance data for incorporation into manual in accordance with Div. 01 - General Requirements.
- .2 Operation and maintenance manual (O&M) to be approved by, and final copies deposited with, Departmental Representative before final inspection.
- .3 For all equipment listed in O&M manuals provide a schedule detailing the supplied component, name, address & phone no. of equipment vendor, parts supplier and warranty agent.

- .4 Operation data to include:
 - .1 Control schematics for each system including environmental controls.
 - .2 Description of each system and its controls.
 - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for each system and each component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
- .5 Maintenance data shall 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.
- .6 Performance data to include:
 - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified elsewhere.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing.
- .7 Approvals:
 - .1 Submit electronic format (pdf) copy of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless so directed by Departmental Representative. PDF file to include tabs to allow navigation to each section of the manual.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
 - .3 Upon acceptance by submit one (1) electronic format (pdf) and three (3) hardcopies of O&M manuals to Departmental Representative.
- .8 Additional data:
 - .1 Prepare and insert additional data into operation and maintenance manual when the need becomes apparent during demonstrations and instructions specified above.

1.10 ACCEPTABLE PRODUCTS

- .1 Design is based on first manufacturer's name under acceptable products. Subsequent manufacturer's names indicate that those named are acceptable providing they meet specifications and space limitations and are subject to acceptance by Shop Drawing Review.

1.11 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit single electronic (pdf) copy of shop drawings and product data along with transmittal, in accordance with Div. 01 - General Requirements. Hard copy shop drawings shall not be accepted.

- .2 Shop drawings and product data shall show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. eg. access door swing spaces.
- .3 Shop drawings and product data shall be accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on full equipment performance curves.
 - .4 Manufacturer to certify as to current model production.
 - .5 Certification of compliance to applicable codes.
- .4 The information to be indicated on manufacturers' shop drawings submitted for review shall include the following:
 - .1 General arrangement drawings showing component parts. Where the equipment proposed, or a component part thereof, includes modifications to a manufacturers' standard to meet the requirements of a specification, a complete assembly drawing must be submitted.
 - .2 Overall dimensions, roughing-in dimensions and clearance dimensions of all major components.
 - .3 Mounting details and dimensions.
 - .4 Complete certified performance data for the specified application with particular reference to rate of flow, operating pressure and temperatures, entering and leaving conditions of air or fluid, operating weights, operating limitation, electrical characteristics and BHP requirements.
 - .5 Gauge of fabricated material and finish specification.
 - .6 Vibration isolators and resilient hangers stating locations and weight distribution.
 - .7 Electrical wiring diagrams, control panel boards, motor test data, motor starters and controls for electrically-operated equipment furnished by mechanical trades.
- .5 Review of shop drawings or detail drawings will not relieve the obligation of ensuring that the equipment, materials, or layouts meet the functional requirements of the specifications, and that all necessary mounting space and clearance requirements are met. Thus, the Departmental Representative's review is for assistance only.
- .6 No equipment will be accepted on the job site without shop drawings having been reviewed by the Departmental Representative.

1.12 CLEANING

- .1 Prior to turnover to client, clean interior and exterior of all new systems. Replace all air & hydronic filters on new & modified systems. Vacuum interior of new and modified ductwork and air handling units.

1.13 AS-BUILT DRAWINGS

- .1 Site records:
 - .1 Mechanical sub-contractor shall mark all changes as work progresses and as changes occur.
 - .2 On a weekly basis, transfer information to record set of documents, revising to show all work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection at all times.
- .2 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing (TAB), 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 copies of as-built drawings for inclusion in final TAB report.

1.14 CONFLICT/CO-ORDINATION DRAWINGS

- .1 For congested areas, prior to installation the contractor shall prepare interference drawings indicating proposed location of all systems & equipment including ductwork, piping, fans, diffusers, VAV boxes, conduits, lighting fixtures, etc. Prior to installation the contractor shall submit the drawings to the Departmental Representative for review.
- .2 Architectural, structural and electrical outlines may be shown to assist in coordination of work; confirm final arrangements before layout of mechanical work.
- .3 Do not scale.
- .4 Except where dimensioned, drawings indicate general mechanical layouts only.
- .5 Provide field drawings to show relative positions of various services. Obtain approval before beginning work. As a minimum provide layout/coordination drawings for mechanical rooms & corridor ceilings. Drawings must show coordination between all equipment and systems within the given space. All sub-trades to coordinate their work in conjunction with others.
- .6 Within six (6) weeks of Letter of Intent, mechanical & electrical trades to verify that proposed rooms, shafts, chases, reflected ceiling elevations, etc. provide adequate space for the installation of mechanical & electrical systems. This is to identify if there are any spatial shortcomings and to give adequate time for construction manager, Departmental Representative and trades to make any dimensional changes and to make clear to all trades where items are to be installed. Installation and layout will not be on a first come first layout basis.

- .7 Request for information (RFI) to be submitted if necessary with contractor's proposed solution & issue of concern. RFI's must be submitted with proposed solution and clearly identify the issues or conflicts so Departmental Representative can respond appropriately.
- .8 If this procedure is not followed the contractor shall be responsible for all modifications required to integrate the systems & equipment.
- .9 When requested by the City, contractor shall provide a single line isometric drawing of the proposed plumbing vent system.

1.15 FEES AND PERMITS

- .1 Pay all fees and obtain all permits, taxes relating to the mechanical scope of work.

1.16 FIRE ALARM BYPASS

- .1 Contractor to pay all costs associated with fire alarm bypass as required to perform mechanical work.

1.17 WARRANTY

- .1 Unless indicated otherwise provide one (1) year warranty starting at substantial completion for all new systems including materials, equipment & labour.

1.18 LOCATION OF MECHANICAL EQUIPMENT

- .1 Allow for 1500 mm of adjustment for exact location of air handling units, pumps, ducts, piping, etc. at no extra cost or credit.

1.19 ELECTRONIC DRAWINGS

- .1 Goodkey, Weedmark & Associates Limited will agree to supply the mechanical drawings in the form of electronic documents for the project to the User for the convenience of the User in carrying out its work. The User shall sign a License Agreement before drawings will be released.

1.20 CUTTING, PATCHING & CORING

- .1 Provide cutting, patching and coring of all walls, ceiling & concrete slabs and other surfaces as required for mechanical work. Check with Departmental Representative or Building Management prior to core drilling and cutting of structure regarding building requirements and policies. Provide notification, clearance & protection.

- .2 The following procedure shall be followed for cutting & core drilling:
 - .1 Contractor to coordinate and summarize all new cores and openings in building structure. Contractor to investigate on site and locate any existing available hole which may be re-used for new systems.
 - .2 Contractor to prepare a layout sketch showing all existing openings & holes and required new openings & holes, with size and locations to the closest grid line in both directions, and submit for review and approval by the Departmental Representative.
 - .3 Provide written report from structural engineer outlining acceptance of openings, as well as specific requirements for reinforcing and support at each location.
 - .4 Contractor to proceed with reinforcing tracing as per report and scanning for electrical conduit. Scanning to be completed using ground penetrating Radar (GPR) technology.
 - .5 Contractor shall identify at each location prior to coring and cutting the location, direction and layer of each reinforcing bar and conduit.
 - .6 Any core or opening where reinforcing steel was cut during the cutting & coring process must be retained on site, and the Contractor must inform the Departmental Representative with the following information: size of the reinforcing bar, reinforcing layer location (top steel or bottom slab steel) and direction of the bar (east - west or north - south).
- .3 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture or as indicated otherwise.
- .4 Provide dust tight screens or partitions to localize dust generating activities and for protection of finished areas of work, workers and public.

1.21 MECHANICAL COST BREAKDOWN

- .1 Upon award of contract, provide mechanical cost breakdown as per attached schedules for Departmental Representative's review and for progress billing purposes.
- .2 Costs such as site trailers, mobilization, shop drawings, engineering, etc. to be included as part of material and labour for each piece of equipment.
- .3 Controls programming and commissioning to be billed upon completion of commissioning.
- .4 Fire protection engineering costs to be included as part of material and labour costs.
- .5 Closeout documents including O&M manuals, as-built drawings, approved air & hydronic TAB reports, seismic letters, NFPA letters, etc. shall constitute 5% of the total mechanical construction cost and shall be approved as a single lump sum line item after submission to and final acceptance by Departmental Representative. Contractor to indicate cost as a separate line item in Progress Billing.
- .6 Proposed billings to be submitted a minimum of fourteen (14) calendar days prior to submission of first billing, for review and approval by Departmental Representative.

- .7 Equipment costs are to be broken down into specific equipment grouping and submitted with proposed billing submittal.

Example: Grilles, VAV boxes, air handling units, VSD's to be separated.

Grilles	\$ _____
VAV boxes	\$ _____
Air handling units	\$ _____
VFD's	\$ _____

1.22 FINAL INSPECTION

- .1 Do not request final inspection until:
- .1 Deficiencies are less than 25 items.
 - .2 All systems have been tested and are ready for operation.
 - .3 All air & water balancing has been completed as applicable.
 - .4 The operating personnel have been instructed in the operation of all systems and equipment.
 - .5 The complete operation and maintenance data books have been delivered to the .
 - .6 All inspection certificates have been furnished including but not limited to seismic certification, NFPA (Fire) 13 certification, City's final plumbing inspection.
 - .7 All record drawings have been completed and approved.
 - .8 All fire extinguishers have been installed.
 - .9 All spare parts and replacement parts have been provided and receipt of same acknowledged.
 - .10 The cleaning up is finished in all respects.
 - .11 Upon completion of above, contractor to request in writing for final site review with a minimal 72 hour notification.
- .2 Final installation shall be subject to the approval of the Departmental Representative.

1.23 COMMISSIONING

- .1 Commissioning of the mechanical systems shall be in accordance with Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.

Contract Price \$ _____

Project:

Date:

Fire Protection		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Mobilization – Admin., Site Set-up							
Engineering							
Fabrication							
Sleeving	Material						
	Labour						
Sprinklers	Material						
	Labour						
Specialty	Material						
	Labour						
Pumps							
Close-out Documentation (5%)							
TOTAL ORIGINAL CONTRACT AMOUNT							
Change Orders							
Architect's CO #	GWA CCO or SI #						
#	#						
#	#						
Total Change Order Amount							
TOTAL CONTRACT AMOUNT							

NOTE: Change Orders that do not reference the Architect's Change Order number and Goodkey, Weedmark's Contemplated Change Order (CCO) or Site Instruction (SI) number will not be reviewed.

Contract Price \$ _____

Project:

Date:

HVAC		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Mobilization – Admin., Site Set-up							
Drafting & Coordinating							
Sleeving	Material						
	Labour						
Sheet Metal	Material						
	Labour						
Grilles, Diffusers	Material						
	Labour						
Fans, VAV & FP Boxes	Equipment						
	Labour						
A/C Units	Equipment						
	Labour						
	Start-up						
Insulation	Material						
	Labour						
Close-out Documentation (5%)							
TOTAL ORIGINAL CONTRACT AMOUNT							
Change Orders							
Architect's CO #	GWA CCO or SI #						
#	#						
#	#						
Total Change Order Amount							
TOTAL CONTRACT AMOUNT							

NOTE: Change Orders that do not reference the Architect's Change Order number and Goodkey, Weedmark's Contemplated Change Order (CCO) or Site Instruction (SI) number will not be reviewed.

Contract Price \$ _____

Project:

Date:

Controls		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Mobilization – Admin., Site Set-up							
Hardware	Equipment						
	Labour						
Wiring	Material						
	Labour						
Close-out Documentation (5%)							
TOTAL ORIGINAL CONTRACT AMOUNT							
Change Orders							
Architect's CO #	GWA CCO or SI #						
#	#						
#	#						
Total Change Order Amount							
TOTAL CONTRACT AMOUNT							

NOTE: Change Orders that do not reference the Architect's Change Order number and Goodkey, Weedmark's Contemplated Change Order (CCO) or Site Instruction (SI) number will not be reviewed.

Contract Price \$

Project:

Date:

Plumbing		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Mobilization – Admin., Site Set-up							
Sleeving	Material						
	Labour						
San. Storm Above Ground Piping & Roof Drains	Material						
	Labour						
Domestic Water Piping	Material						
	Labour						
Heating Water Piping	Material						
	Labour						
Gas Piping	Material						
	Labour						
Plumbing Equipment							
Plumbing Fixtures	Equipment						
	Labour						
Insulation							
Domestic	Material						
	Labour						
Chilled/Condenser	Material						
	Labour						
Heating	Material						
	Labour						

Contract Price \$ _____

Project:

Date:

Plumbing		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Close-out Documentation (5%)							
TOTAL ORIGINAL CONTRACT AMOUNT							
Change Orders							
Architect's CO #	GWA CCO or SI #						
#	#						
#	#						
Total Change Order Amount							
TOTAL CONTRACT AMOUNT							

NOTE: Change Orders that do not reference the Architect's Change Order number and Goodkey, Weedmark's Contemplated Change Order (CCO) or Site Instruction (SI) number will not be reviewed.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 RELATED DOCUMENTS

- .1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Section, apply to work specified in this section.

1.3 DEFINITIONS

- .1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, water and hot gases through penetrations in fire rated wall and floor assemblies.

1.4 GENERAL DESCRIPTION OF THE WORK OF THIS SECTION

- .1 Only tested firestop systems shall be used in specific locations as follows:
 - .1 Penetrations for the passage of duct, piping, and other mechanical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions
 - .2 Repetitive plumbing penetrations in fire-rated floor assemblies. Penetrations exist for the installation of tubs, showers, aerators and other plumbing fixtures.

1.5 RELATED WORK OF OTHER SECTIONS

- .1 Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
 - .1 Section 03 30 00 - Cast-In-Place Concrete
 - .2 Section 04 20 00 - Masonry Work
 - .3 Section 07 84 00 - Firestopping
 - .4 Section 09 20 00 - Plaster and Gypsum Board

1.6 REFERENCES

- .1 Test Requirements: ULC-S115-M or CAN4-S115-M, "Standard Method of Fire Tests of Through Penetration Fire Stops".

- .2 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgements.
- .3 Inspection Requirements: ASTM E2174-14b, "Standard Practice for On-site Inspection of Installed Fire Stops.
- .4 CAN/ULC-S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .5 All major building codes: NBC, OBC.
- .6 NFPA (Fire) 101 - Life Safety Code, 2018 Edition
- .7 ASTM G21-15, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

1.7 QUALITY ASSURANCE

- .1 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- .2 Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- .3 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgement derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgement drawings must follow requirements set forth by the International Firestop Council.

1.8 SUBMITTALS

- .1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Division 01.
- .2 Manufacturer's engineering judgement identification number and drawing details when no ULC or cUL system is available for an application. Engineer judgement must include both project name and contractor's name who will install firestop system as described in drawing.
- .3 Submit material safety data sheets provided with product delivered to job-site.
- .4 Submit documentation showing products are formaldehyde free and low in VOC content in accordance with LEED requirements.

- .5 Submit a complete firestopping and smoke seal schedule. Schedule is to include complete details, cut sheets, system descriptions and location of each proposed firestopping & smoke seal application.

1.9 INSTALLER QUALIFICATIONS

- .1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

1.10 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials undamaged in manufacturer's clearly labelled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.
- .2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- .3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- .4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- .5 Do not use damaged or expired materials.

1.11 PROJECT CONDITIONS

- .1 Do not use materials that contain flammable solvents.
- .2 Scheduling:
 - .1 Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
 - .2 Schedule installation of Drop-In firestop devices after placement of concrete but before installation of the pipe penetration. Diameter of sleeved or cored hole to match the listed system for the device.
 - .3 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- .3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

- .4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- .5 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- .3 Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post installed." Provide cast-in-place firestop devices prior to concrete placement.
- .4 Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with ULC S-115.
 - .1 L-Rating: Not exceeding 25.4 L/s/sq.m (5.0 cfm/sq.ft.) of penetration opening at both ambient and elevated temperatures.
- .5 Mold Resistance: Provide penetration firestoppping with mold and mildew resistance rating of 0 as determined by ASTM G21.

2.2 ACCEPTABLE MATERIALS

- .1 Hilti (Canada) Corporation (1-800-363-4458), 3M (1-800-328-1687), or as alternative materials approved by addendum in accordance with Instructions to Tenderers.

2.3 MATERIALS

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- .2 Pre-Installed firestop devices for use with non-combustible and combustible pipes (closed and open systems) penetrating concrete floors and/or gypsum walls.

- .3 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT).
- .4 Sealants or caulking materials for use with sheet metal ducts.
- .5 Intumescent sealants or caulking materials for use with combustible items (penetrates consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe.
- .6 Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems) tested to 50 Pa. differential.
- .7 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
- .8 Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
- .9 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected.
- .10 For penetrations through a Fire Separation wall provide a firestop system with a "F" Rating as determined by ULC or cUL as indicated below:

Fire Resistance Rating of Separation	Required ULC or cUL "F" Rating of Firestopping Assembly
30 minutes	20 minutes
45 minutes	45 minutes
1 hour	45 minutes
1.5 hours	1 hour
2 hours	1.5 hours
3 hours	2 hours
4 hours	3 hours

- .11 For combustible pipe penetrations through a fire separation provide a firestop system with a "F" rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.
- .12 For penetrations through a Fire Wall or horizontal Fire Separation provide a firestop system with a "FT" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .1 Verify penetrations are properly sized and in suitable condition for application of materials.
 - .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - .3 Ensure all service lines are in place, tested and acceptable to the authority having jurisdiction, prior to application of fire stopping and smoke seal.
 - .4 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 - .5 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
 - .6 Do not proceed until unsatisfactory conditions have been corrected.

3.2 COORDINATION

- .1 Coordinate construction of openings and penetrations to ensure that the fire stop systems are installed according to specified requirements.
- .2 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems.
- .3 Coordinate fire stopping with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems.

3.3 INSTALLATION

- .1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory or Omega Point Laboratories Directory.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.
 - .1 Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
 - .2 Consult with Departmental Representative, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - .3 Protect materials from damage on surfaces subjected to traffic.

3.4 FIELD QUALITY CONTROL

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by applicable code authorities.
- .3 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- .4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.5 IDENTIFICATION & DOCUMENTATION

- .1 The firestop contractor is to supply documentation for each single application addressed. This documentation shall identify each penetration and joint location on the entire project.
- .2 The Documentation Form for through penetrations is to include:
 - .1 A Sequential Location Number
 - .2 The Project Name
 - .3 Date of Installation
 - .4 Detailed description of the penetrations location
 - .5 Tested System or Engineered Judgement Number
 - .6 Type of assembly penetrated
 - .7 A detailed description of the size and type of penetrating item
 - .8 Size of opening
 - .9 Number of sides of assemblies addressed
 - .10 Hourly rating to be achieved
 - .11 Installers Name
- .3 Submit the record document to the Departmental Representative at the completion of the project.
- .4 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - .1 The words: "Warning -Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
 - .2 Contractor's Name, address, and phone number.
 - .3 Through-Penetration firestop system designation of applicable testing and inspecting agency.
 - .4 Date of Installation.
 - .5 Through-Penetration firestop system manufacturer's name.

.6 Installer's Name.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems, 2016 Edition.
 - .2 NFPA (Fire) 14, Standard for the Installation of Standpipe and Hose Systems, 2016 Edition
 - .3 NFPA (Fire) 20, Standard for the Installation of Stationary Pumps for Fire Protection, 2016 Edition.
- .2 National Research Council Canada
 - .1 NRCC NBCC-2015, National Building Code of Canada.

1.3 DEFINITIONS

- .1 SRS: acronym for Seismic Restraint System.

1.4 QUALIFICATIONS

- .1 Prime mechanical contractor shall engage a Seismic Engineer who shall be responsible for all mechanical sections to ensure all mechanical sections listed in Item 1.1.1 are covered. Prime mechanical contractor shall ensure the Seismic Engineer is a Professional Engineer holding a Certificate of Authorization in the Province of Ontario with a minimum of 5 years' experience in seismic design, and is covered with a minimum of \$2 million Professional Liability Insurance.
- .2 The Manufacturer shall be a member of VISCMA (Vibration Isolation and Seismic Control Manufacturers Association). They shall have a letter issued to their Supplier confirming that they have reviewed and accepted the engineering practices used by the Seismic Engineer. The letter shall also state that the manufacturer accepts the Supplier to act as their representative for the product.

1.5 GENERAL DESCRIPTION

- .1 This section covers design, supply and installation of complete SRS for all systems, equipment specified for installation on this project. This includes fire protection piping & mechanical equipment and systems, both vibration isolated and statically supported.

- .2 SRS to be fully integrated into & compatible with:
 - .1 Noise and vibration controls specified elsewhere in this project specification.
 - .2 Structural, mechanical, electrical design of project.
- .3 During a seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position unless noted otherwise. Specified critical systems as noted below must remain operational during and after an seismic event:
 - .1 All systems for buildings as listed in OBC Table 4.1.8.18 - non-structural components.
 - .2 Life safety systems.
 - .3 Natural gas.

1.6 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Seismic Engineer shall be a Professional Engineer specializing in design of SRS and registered in Province of Ontario. The following submittals shall bear the SRS Design Engineer's seal and signature:
 - .1 A complete list of documents reviewed & list of exclusion.
 - .2 Full details of design criteria, calculations for all equipment & associated systems.
 - .3 A spreadsheet identifying all equipment requiring or not requiring seismic restraints and include all calculations.
 - .4 Review connection points to building structure and verify in writing that existing building structure can accommodate the new loads.

1.7 FINAL CERTIFICATION SUBMITTAL

- .1 Seismic Engineer shall be a Professional Engineer specializing in design of SRS and registered in Province of Ontario. The following shall bear the SRS Design Engineer's seal and signature:
 - .1 SRS installation inspections.
 - .2 SRS final certification letter for the project.
- .2 The Fire Protection Contractors shall be responsible for their respective discipline as it relates to Seismic restraints system. The contractor shall adhere to Section 20 05 49.01 and/or more stringent code (i.e. NFPA (Fire) 13, 14 & 20).
- .3 The final certification letter shall be formatted to identify the following within the body of the letter:
 - .1 The date of the final inspection.
 - .2 A statement that lists ALL contract documents which were reviewed including but not limited to the mechanical drawings, project change orders, site instructions, etc.
 - .3 A statement which clearly identifies any exclusions of scope of service.
 - .4 A statement that certifies the complete mechanical seismic installation meets the latest version of OBC & applicable codes & standards.

1.8 MAINTENANCE DATA

- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Definitions
 - .1 Seismic System: isolation and seismic restraint products supplied by one supplier.
 - .2 Manufacturer: manufacturer of the isolation and seismic restraint system.
 - .3 Supplier: manufacturers' and seismic engineer's representative
- .2 Each contractor shall use one Supplier to provide seismic design, isolation, and seismic restraint.
- .3 Seismic restraints are to be provided for all operational and functional components of building services in accordance with the current National Building Code and NFPA (Fire) 13, 14 & 20.
- .4 The contractor shall utilize a Supplier familiar with the design of seismic systems to provide a comprehensive package of isolation and seismic restraint for the project. Provide detailed shop drawings showing the proposed restraint system for all required equipment, piping, and ductwork on the project. The shop drawings submittals shall include all items listed in Item 1.6.
 - .1 Acceptable Manufacturers: Kinetics / Vibron, Tecoustics, Mason, Gripple Seismic.
 - .2 Alternates to be approved by Addendum only.
- .5 Cable restraint systems, rod stiffener clamps and seismic isolator capacities to be verified by an independent test laboratory. Connection materials and site specific designs to be by the Seismic Engineer. The Seismic Engineer may specify material and anchors provided by the contractor where this is appropriate. It is the contractors' responsibility to ensure that the Seismic Engineers' requirements and specification have been met.
- .6 At the completion of the project, the Supplier and the Seismic Engineer shall review the installations on site, and shall prepare a written report, with a sealed letter from the Seismic Engineer, certifying that the installations have been completed in accordance with their design and shop drawings. Refer to item 1.1.

2.2 SEISMIC FORCE

- .1 The Importance Factor for this project is:
 - .1 $I = 1.5$.Note: As per NBC.

- .2 The site classification for seismic site response and shear wave velocity parameters shall be as indicated on structural documents and as recorded in the geotechnical report.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install Seismic Restraint Systems in accordance with Seismic Engineer's and manufacturer's recommendations.
- .2 Install SRS at least 25 mm from all other equipment, systems, services.
- .3 Co-ordinate connections with all disciplines.

3.2 INSPECTION AND CERTIFICATION

- .1 SRS to be inspected and certified by Manufacturer upon completion of installation.
- .2 Seismic Design Engineer shall provide written report to Engineer certifying that SRS has been installed in accordance with the SRS drawings. The report shall bear the seal and signature of the SRS Design Engineer.

3.3 COMMISSIONING DOCUMENTATION

- .1 Upon completion and acceptance of certification, hand over to Engineer complete set of construction documents, revised to show "as-built" conditions.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 National Fire Protection Association
 - .1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems, 2016 Edition.
- .2 Underwriters Laboratories of Canada (ULC).

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements and in accordance with NFPA (Fire) 13, working plans and design requirements.
- .2 Pipe layout shall be the Contractors responsibility and fully coordinated with other trades.

1.4 DRAWING PREPARATION

- .1 Review architectural, mechanical and electrical drawings to determine interferences affecting the distribution layout prior to shop drawing submission.

1.5 ACCEPTABLE SPRINKLER CONTRACTORS

- .1 Contractors shall be members of Canadian Automatic Sprinkler Association (CASA).

PART 2 - PRODUCTS

2.1 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to NFPA (Fire) 13.
 - .2 Ferrous hot dipped galvanized: to NFPA (Fire) 13 in corrosive or damp environments.

- .2 Fittings and joints to NFPA (Fire) 13:
 - .1 Ferrous: screwed, welded, flanged or roll grooved.
 - .2 All exposed piping shall be rigid piping.
- .3 Flexible sprinkler drops:
 - .1 Braided flexible stainless steel sprinkler drops, cULus and FM listed for fire protection service for installation on suspended ceiling grids, wood or metal stud/joist or furring channels.
 - .2 25 mm (1") nominal ID braid hose and fitting made of 304 stainless steel, 1206 kPa (175 psi) maximum working pressure, 178 mm (7") minimum bending radius within length of 750 mm to 1800 mm as per cULus. The maximum amount of allowable bends as per cULus are as follows: 750 mm (36") (5 bends); 1200 mm (48") (8 bends); 1500 mm (60") (10 bends); 1800 mm (72") (12 bends).
 - .3 Inlet nipple 25 mm (1") NPT with straight or 90° reducer for 13 mm (½") or 20 mm (¾") NPT sprinkler.
 - .4 A steel bracket with square bar, adjustable centre bracket and adjustable end brackets suitable for ceiling types. End bracket shall have permanent securement to ceiling system.
 - .5 Acceptable material: Victaulic Model VicFlex AH2; Viking model VKFD28B.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services.
- .5 Sprinkler system shall be rated at 1380 kPa (200 psi).

2.2 SPRINKLERS

- .1 General: to NFPA (Fire) 13 and ULC listed for fire services.
- .2 Provide wire guards in all mechanical rooms, storage areas, electrical rooms, and elevator machine room.
- .3 All sprinklers shall have low zinc content (less than 10%) brass alloy and metal to metal sealing mechanism in the water ways.
- .4 Acceptable materials: Viking, Grinnell, Victaulic and Tyco.

2.3 CONCEALED SPRINKLER

- .1 Fully concealed pendent, quick response for hazard coverage as indicated, 5.6 K factor, enclosed escutcheon, separate two-piece design of mounting cup and coverplate, internal threaded closure, 68°C (155°F) rated, 13 mm (½") adjustment, FM approved, white enamel finish, glass bulb type and white finish cover.

2.4 SEMI-RECESSED SPRINKLER

- .1 Semi-recessed pendent, quick response for hazard coverage as indicated, 5.6 K factor, extended adjustable escutcheon, white enamel finish, FM approved, glass bulb type; 68°C (155°F) rated, 13 mm (½") orifice.

2.5 UPRIGHT SPRINKLER

- .1 Upright bronze, quick response for hazard coverage as indicated, 5.6 K factor, FM approved, chrome finish, glass bulb type c/w wire guard; 68°C (155°F) rated, 13 mm (½") orifice.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with NFPA (Fire) 13.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 National Fire Protection Association NFPA
 - .1 NFPA (Fire) 10, Portable Fire Extinguishers, 2018 Edition.
 - .2 Ontario Fire Code.
 - .3 Underwriters Laboratories of Canada
 - .1 CAN/ULC S508-02 (R2013), Standard for the Rating and Fire Testing of Fire Extinguishers.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

- .1 (FE1) Stored pressure dry chemical type with heavy duty steel cylinder, positive on/off operation, waterproof stainless steel gauge, shut-off nozzle, ULC labelled for A, B and C class protection c/w wall mounting bracket and signage. Size 2.25 kg, 3A-40BC rating.

2.2 IDENTIFICATION

- .1 Identify extinguishers in accordance with recommendations of NFPA (Fire) 10, CAN/ULC S508 and Ontario Fire Code.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install extinguishers where indicated and at a height in accordance with NFPA (Fire) 10 and Ontario Fire Code.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.15-2013, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ASME B16.18-2018, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ASME B16.22-2013, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - .4 ASME B16.24-2016, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150 and 300.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - .2 ASTM B88M-16, Specification for Seamless Copper Water Tube (Metric).
- .3 American Water Works Association (AWWA)
 - .1 AWWA C111/A21.11-17, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.

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.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to 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.

2.3 JOINTS

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111/A21.11.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5 lead free solder. No lead content in excess of 0.2%.
- .4 Teflon tape: for threaded joints.
- .5 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner. Bronze or brass ball valves are an acceptable dielectric fitting where applicable.

2.4 VALVES

- .1 Refer to Section 23 05 23 - Valves.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.
- .2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .3 Install pipe work in accordance with Section 23 05 05 - Installation of Pipe Work, supplemented as specified herein.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Install DCW piping below and away from DHW and DHWR and other hot piping so as to maintain temperature of cold water as low as possible.
- .6 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

- .7 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. No fittings permitted below grade.

- .8 Install isolation valves at all branch take-offs and to isolate each piece of equipment, and as indicated.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA B1800-18, Thermoplastic Nonpressure Piping Compendium.
- .2 Ontario Regulation
 - .1 ONTARIO OBC-2012, 2012 Ontario Building Code Compendium.
- .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.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- .1 DWV PVC (Polyvinyl Chloride):
 - .1 Application: below grade sanitary, storm & vent piping & fittings and above grade where combustible piping is permitted excluding OBC 3.2.6 (High-rise) applications and ceiling plenums.
 - .2 Pipe and Fittings: Drain, waste and vent pipe and fittings shall be certified to CSA B181.2. When combustible pipe and fittings are used in buildings required to be of noncombustible construction, they shall be listed by ULC to the Standard CAN/ULC S102.2 and clearly marked with the certification logo indicating a flame-spread rating not exceeding 25.
 - .3 Acceptable material: IPEX System 15 DWV.
- .2 Expansion/Contraction:
 - .1 Compensation shall be made to accommodate expansion/contraction on the drainage system. It is recommended that there be compensation on every second floor for the vertical piping system. Consult pipe system manufacturer for specific details regarding approved compensation methods.
- .3 Compatibility:
 - .1 To ensure compatibility, performance and material quality, all pipe and fitting drainage system shall be produced by the same manufacturer.

- .4 Quality Control:
 - .1 The manufacturer of the pipe and fitting system shall be contacted prior to the installation to obtain precise installation instructions. Site meetings shall be arranged and include, the Contractor, Manufacturer and Building Inspector.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code and local authority having jurisdiction.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA B1800-18, Thermoplastic Nonpressure Piping Compendium.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 For shop drawings, indicate dimensions, construction details and materials.
- .3 For product data, indicate dimensions, construction details and materials for items specified herein.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.
- .2 Data to include:
 - .1 Description of plumbing specialities and accessories, giving manufacturers type, name, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- .1 Above ground laboratory sanitary and vent:
 - .1 Corrosion resistant laboratory drainage and vent system shall be manufactured from brown pigmented high impact, co-polymer Polypropylene.
 - .2 Pipe and fittings to have a schedule 40 wall thickness and shall be certified to CAN/CSA B181.3.

- .3 Joints shall be Cee Jay (CJ) Compression Joints with male threaded bodies, lock nuts, polyethylene seals and stainless steel lock rings.
- .4 Fire stops as recommended by manufacturer.
- .2 Acceptable material: Watts PH Pro Blueline, Zurn, Ipex

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 In accordance with Section 23 05 05 - Installation of Pipework.
- .2 Install in accordance with Provincial Plumbing Code and Ontario Building Code.
- .3 Install buried pipe on 150 mm bed of washed clean sand, shaped to accommodate fittings, to line and grade as indicated. Backfill with washed clean sand.
- .4 Installation and support of Laboratory Sanitary (LS) piping, fittings and fire stops shall be in accordance with manufacturer's recommendations.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B1.20.1-2013, Pipe Threads, General Purpose (Inch).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM D638-14, Standard Test Method for Tensile Properties of Plastics.
 - .2 ASTM D2564-12, Specification for Solvent Cements for Poly(Vinyl-Chloride)(PVC) Plastic Piping Systems.
 - .3 ASTM D2837-13e1, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
 - .4 ASTM D4101-17, Standard Specification for Polypropylene Injection and Extrusion Materials.
- .3 Deutsches Institut Fur Normung E.V. (German National Standard)
 - .1 DIN 8077, Polypropylene (PP) pipes - PP-H, PP-B, PP-R, PP-RCT - Dimensions.
 - .2 DIN 16962-12, Pipe fittings and Joint Assemblies for Polypropylene Pressure Pipes - Dimensions of Bushings, Flanges and Sealing Elements, for Socket Welding.

1.3 SCOPE OF WORK

- .1 Throughout the building the Laboratory Furniture Contractor will supply and install furniture, that will include, but will not be limited to sinks, laminar flow hoods that include various services, laboratory exhaust fume hoods, etc. Refer to Architectural drawings for types and locations.
- .2 Div. 20, 21, 22, 23 & 25 will provide the following systems for laboratories:
 - .1 Domestic hot water.
 - .2 Domestic cold water.
 - .3 Laboratory drainage and vent piping.
 - .4 Reverse osmosis (R.O.) piping.
 - .5 Compressed air piping.
 - .6 Vacuum piping.
- .3 Provide for final connections to all laboratory equipment.

1.4 RELATED WORK SPECIFIED ELSEWHERE

- .1 Domestic Water Piping - Copper: Section 22 11 16 - Domestic Water Piping - Copper.
- .2 Hangers and Supports: Section 23 05 29 - Bases, Hangers and Supports

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.

PART 2 - PRODUCTS

2.1 REVERSE OSMOSIS PIPING AND VALVES

- .1 Scope:
 - .1 This specification covers requirements for the Beta Polypropylene Piping System as manufactured by Georg Fischer and intended for the safe conveyance of pure fluids, such as reverse osmosis water. Long term service temperatures are not to exceed 176°F (80°C).
- .2 Beta Polypropylene Material:
 - .1 Georg Fischer Beta Polypropylene pipe, valves and fittings shall be from a manufactured Group 1, Class 2, b nucleated homopolymer material meeting the requirements of ASTM D4101.
 - .2 The polypropylene material shall achieve a minimum tensile strength of 4350 psi (300 bar) when tested at 73°F (23°C) according to ASTM D638. Georg Fischer Beta polypropylene material shall comply with guidelines approved by the US Food and Drug Administration (FDA) as specified in the Code of Federal Regulations (CFR), Title 21, Section 177.1520 for basic polypropylene and Section 178.3297 "colourants for polymers" for pigments suitable for contact with food stuff, pharmaceutical use and potable water.
- .3 Beta Polypropylene Pipe:
 - .1 Georg Fischer Beta Polypropylene pipe shall be SDR 11 (Standard Dimension) Ratio which defines the wall thickness in respect to the outside diameter. For this material, SDR 11 determines the pressure rating for all pipe sizes through 12" (315 mm) which is 150 psi (10 bar) when measured at 68°F (20°C). All polypropylene pipe shall conform to the requirements of DIN 8077, and ASTM D2837 for hydrostatic design basis. All pipe shall be marked with ink on the exterior surface to denote pipe dimension, wall thickness and pressure rating.

- .4 Beta Polypropylene Butt Fusion Fittings:
 - .1 Beta Polypropylene butt fusion fittings in sizes through 315 mm (12") shall be butt fusion type suitable for heat fusion as manufactured by Georg Fischer. All fittings, through 225 mm (9") shall have spigot lengths compatible with IR PLUS butt fusion joining. The pressure rating shall be SDR 11 or 150 psi (10 bar) at 68°F (20°C). All butt fusion fittings shall have dimensions and tolerances in accordance with DIN 16962.
 - .2 All flanged connections shall utilize flange rings with bolt patterns to accommodate either ASME or ISO/DIN bolt circles. All threaded connections shall have pipe threads in accordance with the requirements of ASTM D2464, which references ASME B1.20.1 for tapered pipe threads (NPT).

- .5 Beta Polypropylene Valves:
 - .1 Beta polypropylene diaphragm valves in sizes 20 mm (½") through 63 mm (2") shall be Georg Fischer Type 314/315 Diaphragm Valves. All Type 314/315 polypropylene valves shall have spigot or union ends compatible with IR Plus infrared butt fusion joining.
 - .2 Beta polypropylene diaphragm valves in dimensions 75 mm (2½") through 160 mm (6") shall be Georg Fischer Type 317 flanged diaphragm valves. Flange connections shall have bolt patterns to accommodate ASME bolt pattern for Class 150 rating.
 - .3 Beta polypropylene diaphragm valves shall have either EPDM or PTFE Teflon (backed with EPDM) diaphragm seals. Diaphragm valves are rated at 150 psi (10 bar) when measured at 68°F (20°C). Pneumatic valve actuators for Beta polypropylene diaphragm valves shall be supplied by Georg Fischer to ensure proper system operation, integrity and compatibility.
 - .4 Beta polypropylene valves in dimensions from 225 mm (8") through 315 mm (12") shall be Georg Fischer Type 367 butterfly valves. All butterfly valves shall be water style having either EPDM or FPM/Viton seals and have bolt patterns to accommodate either ASME Class 150 or ISO bolt circles. Electric or pneumatic valve actuators for all Beta PP butterfly valves shall be supplied by Georg Fischer to ensure proper system operation, integrity and compatibility.

- .6 Fusion Equipment:
 - .1 Beta polypropylene butt fusion pipe, fittings and valves from 20 mm (½") through 225 mm (9") shall be joined using the IR Plus infrared fusion machines.
 - .2 Fusion joints shall be carried out in accordance with fusion equipment manufacturer's recommendation.

- .7 Fusion Training and Certification:
 - .1 Polypropylene piping installation shall only be performed by factory trained and certified installers in accordance with the manufacturer's written procedures. All Beta polypropylene pipe, valves and fittings shall be properly prepared in accordance with the manufacturer's written instructions.

2.2 PURE WATER FAUCET

- .1 Faucet: Tygon lined, deck-mounted, chrome plated 13 mm male thread inlet.

2.3 R.O. Pump

- .1 Multi-stage pump with six stages, cast iron body, 304 stainless steel impeller, 304 stainless steel diffuser, 316 L stainless steel casing, 316 stainless steel shaft, cast iron adapter, aluminum coupling, 316 L stainless steel seal plate, 304 stainless steel coupling guard, tungsten carbide shaft sleeve and bushing, carbon steel/zinc plated tie rods, PPS wear ring, 316 stainless steel gland.
- .2 Capacity: 0.3 L/s @ 90 kPa.
- .3 Motor: ½ HP, 120 V/1 Ph/60 Hz.

PART 3 - EXECUTION

3.1 INSTALLATION OF WASTE PIPING

- .1 Install in accordance with manufacturer's installation instructions.

3.2 R.O. WATER SYSTEM

- .1 Install, test & commission in accordance with manufacturer's instructions.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM B280-18, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 - PRODUCTS

2.1 PIPING

- .1 Pipe to be type ACR seamless copper tubing, soft annealed or hard drawn up to ¾" diameter. Sizes 1" diameter and larger to be type ACR hard drawn, annealed and cleaned for refrigeration service. Hard drawn copper to be to ASTM B280.
- .2 Fittings to be heavy wrought copper, solder joint type. No cast fittings to be used. Fittings to be cleaned and bright with a maximum residue limit for interior surfaces of 0.0035 grams per square foot when tested to requirements of ASTM B280 (ACR).
- .3 Solder joints 95:5.
- .4 Valves to be chrome plated brass body, 450 psi rated. Acceptable material: Swagelok ball valve B-63 TS12 or equal.

2.2 AIR COMPRESSOR

- .1 Oil-free air using scroll compressors c/w grease filled bearings, motor overload protection, pressure sensor, factory set safety valve, 120 gallon storage tank, 3V bell drive. 4x 5HP compressors, 208V, 3Ø, 60 Hz. UL/CSA certified.
- .2 Acceptable material: Powerex Model SEQ2007HP.

PART 3 - EXECUTION

3.1 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION

- .1 Install shut-off valves at outlets, major branch lines and elsewhere as indicated.
- .2 Install unions to permit removal or replacement of equipment.
- .3 Provide drain from refrigerated air dryer.
- .4 Testing:
 - .1 Pressure test in accordance with requirements of Section 20 05 01 - General Mechanical Requirements, for 4 h minimum, to 1100 kPa, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 10 kPa.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Plumbing and Drainage Institute (PDI)
 - .1 PDI WH201-2010, Water Hammer Arresters Standard.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 For shop drawings, indicate dimensions, construction details and materials.
- .3 For product data, indicate dimensions, construction details and materials for items specified herein.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.
- .2 Data to include:
 - .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.

PART 2 - PRODUCTS

2.1 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.
 - .1 Acceptable material: Watts, J.R. Smith & Zurn Z-1449.

- .2 Access covers:
 - .1 Wall access: face or wall type, polished nickel bronze square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs. Acceptable material: Watts, Zurn ZANB-1463.

2.2 WATER HAMMER ARRESTORS

- .1 Copper construction, bellows or piston type: to PDI-WH201.
- .2 Acceptable material: Watts, J.R. Smith & Zurn Z-1700.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.2 CLEANOUTS

- .1 In addition to those required by code, and as indicated, install at base of soil and waste stacks, and rainwater leaders.
- .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.

3.3 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to fixtures or group of fixtures.

3.4 THERMOSTATIC MIXING VALVE

- .1 Install in accordance with manufacturer's instructions.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA B45S1-04 (R2013), Supplement #1 to CAN/CSA-B45 Series-02, Plumbing Fixtures.
 - .2 CSA B125-01, Plumbing Fittings.
 - .3 CSA B651-12 (R2017), Accessible Design for the Built Environment.
- .2 Ontario Regulation
 - .1 ONTARIO OBC-2012, 2012 Ontario Building Code Compendium.
- .3 National Research Council Canada
 - .1 NRCC NBCC-2015, National Building Code of Canada.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate, for all fixtures and trim:
 - .1 Dimensions, construction details, roughing-in dimensions.
 - .2 Factory-set water consumption per flush at recommended pressure.
 - .3 (For water closets, urinals): minimum pressure required for flushing.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 20 05 01 - Mechanical General Requirements.
- .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.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Fixture piping.
 - .1 Hot and cold water supplies to each fixture:
 - .1 Stops supplies shall be all brass with full turn brass seams and washer replaceable attachment shall be IPS inlet x compression OD outlet to fixture. All fixture stop valves shall be screw driver type.
 - .2 Chrome plated in all exposed places.
 - .2 Waste:
 - .1 Cast brass adjustable style P-trap with cleanout on each fixture not having integral trap.
 - .2 Chrome plated in all exposed places.
 - .3 Sink and lavatory heavy gauge P-traps shall be cast brass adjustable style with 17 ga. seamless brass wall bend. Attachment nuts shall be brass, no zinc allowed. P-traps to be removable/union type or to include cleanout.
 - .4 Lavatory strainers shall be chrome plated cast brass with 17 ga. seamless brass tailpiece.
 - .5 All barrier-free lavatories and sinks shall have chrome plated offset tail piece in addition to P-trap with cleanout. Insulate P-trap and hot & cold water pipes with pre-formed & finished surface insulation. Armaflex insulation and tape not acceptable.
- .2 Fixtures:
 - .1 Manufacture in accordance with CSA B45.
 - .2 All products, where applicable, shall be marked with manufacturer's name or product #.
- .3 Trim, fittings: manufacture in accordance with CSA B125.
- .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 unless otherwise indicated.
- .7 Reference drawing schedule for configuration and type.

2.2 CARRIERS

- .1 Provide for all wall mounted plumbing fixtures.

2.3 ROUGHING-IN OF FIXTURES

- .1 Rough-in for equipment supplied by other to be complete with valved supplies, wastes and vents, capped and associated fitting piping & reducers.

2.4 PLUMBING FIXTURES

- .1 Reference fixture schedule on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
 - .2 Wall-hung fixtures: as indicated on architectural elevations.
 - .3 Physically handicapped: to comply with most stringent of either NBCC, OBC or CAN/CSA B651.

3.2 ADJUSTING

- .1 Conform to water conservation requirements specified in this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates and sensors.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
 - .3 Adjust flush valves to suit actual site conditions.
- .3 Checks:
 - .1 Water closets: flushing action.
 - .2 Aerators: operation, cleanliness.
 - .3 Vacuum breakers, backflow preventers: operation under all conditions.

- END OF SECTION -

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.50-2013, Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
 - .2 ASME B31.9-2017, Building Services Piping.
- .2 ASTM International (ASTM)
 - .1 ASTM A269/A269M-15a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .2 ASTM B819-18, Standard Specification for Seamless Copper Tube for Medical Gas Systems.
 - .3 ASTM F1387-99(2012), Standard Specification for the Performance of Mechanical Attached Fittings.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CSA Z7396.1-17 - Medical gas pipeline systems - Part 1: Pipelines for Medical Gases and Vacuum, Medical Support Gases, and Anaesthetic Gas Scavenging Systems.
- .4 Compressed Gas Association (CGA):
 - .1 Pamphlet G-4.1, "Cleaning Equipment for Oxygen Service".
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-100-2015, Qualification Requirements for Elastomer Diaphragms for Nuclear Service Diaphragm Valves.

1.2 SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- .1 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials in accordance with Section 01 74 21 - Construction Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 PIPING

- .1 Piping:
 - .1 Stainless steel:
 - .1 316/316L stainless steel instrumentation grade tubing to ASTM A169.
 - .2 Copper:
 - .1 Type 'L' copper to ASTM B189.
- .2 Fittings:
 - .1 Stainless steel:
 - .1 Butt or socket weld fittings suitable for orbital welding.
 - .2 Two-ferrule tube fitting, to ASTM F1387.
 - .2 Copper:
 - .1 Wrought copper, brass or bronze pressure fittings, designed for silver brazed connections to ASME B16.50.
- .3 Joints:
 - .1 Stainless steel:
 - .1 Orbital weld.
 - .2 Mechanical coupling at valves and connection to equipment.
 - .2 Copper:
 - .1 NPS 2 and smaller: silver brazed.

2.2 BALL VALVES

- .1 Stainless steel:
 - .1 6 mm: One piece design, straight pattern.
 - .1 Stainless steel body, ball, stem, disc and ring. PTFE packing. Ferruled fitting at both ends. Rated to 2500 PSI at 37°C.
 - .2 13 mm: 3-piece design, straight pattern:
 - .1 Stainless steel body, ball, stem, disc and ring. UHMW polyethylene packing. Ferruled fittings at both ends. Rated to 2500 PSI at 37°C.
- .2 Copper:
 - .1 Three piece design or top entry for ease of in-line maintenance.
 - .1 To MSS SP-100, bronze body, screwed ends, chrome plated ball, 600 WOG.

2.3 IN-LINE REGULATORS

- .1 Stainless steel, single stage regulator for cylinder mounting.
 - .1 316 stainless steel body, diaphragm, nozzle, poppet.
 - .2 Threaded inlet and outlet.
 - .3 Outlet pressure range: 4-80 psig.
 - .4 Maximum inlet pressure: 3000 psig.

- .5 Pressure gauge, inlet and outlet shut off valve, 6mm barbed hose fitting.

2.4 NITROGEN GENERATOR

- .1 Completely engineered system which will convert a compressed air supply into high purity compressed nitrogen using membrane separation technology.
- .2 System to consist of compressed air pressure regulator, isolation valve, sleep mode valve, pre-filter, operating pressure gauge, nitrogen generator, outlet pressure regulator, outlet pressure gauge, flow controller, final membrane filter.
- .3 Acceptable material: Parker Balston Model Nitrovap-2LV.

PART 3 - EXECUTION

3.1 MATERIAL APPLICATION

- .1 The following materials, as specified above, shall be used for gas piping systems for the specific gas:

Gas	Material
High purity helium (He)	Stainless steel
Carbon Dioxide (CO ₂)	Copper
Pure Compressed Air (high purity)	Stainless steel

3.2 GAS PIPING CONNECTIONS AND INSTALLATION

- .1 In accordance with requirements of ASME B31.9, CSA B51.9, CSA Z7396.1 and as specified.
- .2 Installer to be experienced in the installation of laboratory gas piping using the materials specified.
- .3 Install piping in strict accordance with manufacturers' instructions.
- .4 Install shut-off valves at outlets, major branch lines and elsewhere as indicated.
- .5 Changes in direction to be accomplished using fittings.
- .6 Cleaning:
 - .1 Piping and fittings to be kept clean, and sealed in package until time of installation.
 - .2 Inspect and clean any pipe and fittings following procedures for cleaning for oxygen service to CGA Pamphlet G-41.

- .7 Testing:
 - .1 Pressure test for 4 h minimum, to 1034 kPa, with outlets closed. Pressure drop not to exceed 10 kPa.
- .8 Install inline regulator at each CO₂ system drop, as located on the drawings.
- .9 Review termination points and methods, routing of pipe and general installation with Departmental Representative prior to start of installation.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 USE OF SYSTEMS

- .1 Use of new and/or existing permanent heating and ventilating systems for supplying temporary heat and ventilation is permitted only under the following conditions:
 - .1 Entire system is complete, pressure tested, cleaned, flushed out.
 - .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
 - .3 Building has been closed in. Areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .4 There is no possibility of damage from any cause.
 - .5 Supply ventilation systems are protected by 60% filters, which shall be inspected daily, changed every 2 weeks 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 do not commence until equipment is turned over to Departmental Representative.
 - .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 turn-over to Departmental Representative, entire system to be refurbished, cleaned internally and externally and restored to "as- new" condition. Filters in air and water systems are to be 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 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated or specified otherwise.
- .2 Install drain valve at low points in piping systems, at equipment at section isolating valves and at base of all risers.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .4 Drain valves: NPS $\frac{3}{4}$ full port ball valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AUTOMATIC AIR VENTS

- .1 Install automatic air vents at high points of piping systems.
- .2 Install full port ball at each automatic air vent.
- .3 Air vents must have minimum connection of 13 mm ($\frac{1}{2}$ ").

3.5 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.

3.6 PIPEWORK INSTALLATION

- .1 Screwed fittings to be jointed with polytetrafluoroethylene (PTFE) thread seal tape.
- .2 Protect openings against entry of foreign material.
- .3 Install so that equipment can be isolated and removed without interruption to operation of any other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Weldolets sockolets Saddle type branch fittings may be used on mains if branch line is no larger than half the size of the main. Hole saw (or drill) and ream main so as to maintain full inside diameter of branch line prior to welding saddle. Provide isolation valves at each branch connection.

- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework so as to minimize furring space, maximize headroom, conserve space.
- .8 Except where indicated otherwise, slope piping in direction of flow for positive drainage and venting.
- .9 Except where indicated, install so as to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible and as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated and specified.
- .14 Contractor shall carry a structural engineer to design and certify the support system for any piping distribution system exceeding 100 mm (4") or where piping is grouped such that the distributed weight exceeds the building structure limits. (Note: In steel building structure the piping supports shall never be supported by a single joist or off the bottom chord of the joist or truss.

3.7 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 all round 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.

3.8 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.

3.9 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Fill system with water. Ensure all air is removed from system. Boost pressure to test pressure using water only. Pressurization with air or nitrogen is not allowed. Test to 1½ times normal operating pressure to a maximum of the piping systems working pressure including devices (i.e.: valves, fittings, accessories). Minimum test pressure to be 862 kPa (125 psi).
- .3 Maintain specified test pressure without loss for four (4) hours minimum. Temperature of system to remain constant during entire duration of test.
- .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 Bear 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 review and approval of tests results by Departmental Representative.

3.10 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval 10 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.

- END OF SECTION -

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B40.100-2013, 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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 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.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Design point to be at mid-point of scale or range.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, mercury-free, liquid filled, 125 mm scale length: to CAN/CGSB-14.4 ASME B40.200.
 - .1 Resistance to shock and vibration.

2.3 PRESSURE GAUGES

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.
 - .1 .
- .2 Provide:
 - .1 Siphon for steam service.
 - .2 Snubber for pulsating operation.

- .3 Diaphragm assembly for corrosive service.
- .4 Gasketed pressure relief back with solid front.
- .5 Bronze stop cock.

PART 3 - EXECUTION

3.1 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.

3.2 THERMOMETERS

- .1 Install in wells on piping. Include heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
 - .1 Water heating and cooling coils.
- .3 Install wells as indicated only for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

- .1 Install in locations as follows:
 - .1 Inlet and outlet of coils.
- .2 Use extensions where pressure gauges are installed through insulation.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM B16/B16M-10(2015), Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
 - .2 ASTM B62-17, Specification for Composition Bronze or Ounce Metal Castings.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Submit data for all valves specified in this section.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

1.5 ACCEPTABLE MANUFACTURERS

- .1 Refer to Acceptable Products Table in Part 3 of this section.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 All valves of the same type to be from one manufacturer.
- .2 All valves to have CRN registration numbers.

2.2 BALL VALVES

- .1 NPS 4 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B62 or brass to ASTM B16/B16M C36000.
 - .2 Stem: tamperproof ball drive.
 - .3 Stem packing nut: external to body.
 - .4 Ball and seat: replaceable chrome plated brass solid full port ball and Teflon seats.
 - .5 Stem seal: TFE with external packing nut.
 - .6 Operator: removable lever handle.

2.3 CIRCUIT BALANCING VALVES (CBV)

- .1 General:
 - .1 Y style globe valve, designed to provide precise flow measurement and control, with valved ports for connection to differential pressure meter.
- .2 Accuracy:
 - .1 Readout to be within $\pm 2\%$ of actual flow at design flow rate.
- .3 Pressure die-cast dezincification resistant copper alloy construction, Teflon disc, screw-in bonnet.
 - .1 Flow control: At least four 4 full turns of handwheel with digital handwheel and tamperproof concealed mechanical memory.
- .4 Insulation:
 - .1 Use prefabricated shipping packaging of 5.4 R polyurethane as insulation.
- .5 Drain connection:
 - .1 NPS $\frac{3}{4}$ valved and capped, suitable for hose socket.
 - .2 Incorporated into valve body or provided as separate item.
- .6 Size:
 - .1 Valve to be sized for a minimum pressure drop of 6 kPa (2 ft.) at design flow at mid range. Provide pipe reducers as required.
- .7 Acceptable material: Armstrong CBV, or Bell & Gossett, Tour & Anderson.

PART 3 - EXECUTION

3.1 ACCEPTABLE PRODUCTS TABLE

- .1 Refer to Acceptable Products Table in Part 3 of this section.

3.2 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Handwheel with chain operators are to be installed on all valves more than 3 metres above floor.
- .3 Remove internal parts before soldering or brazing.
- .4 Install all valves such that adequate clearance is provided to allow for obstruction free operation.
- .5 Install valves at all branch take-offs and to isolate each piece of equipment, and as indicated.
- .6 For all threaded valves provide one screwed union beside each valve to allow easy replacement of valve.
- .7 Install all valves as per manufacturer's recommendation.

Domestic, Chilled & Heating Water/Glycol up to 200 psi							
Valve Type			Crane	Jenkins	Toyo	Victaulic	Kitz
Ball	NPS 4 & Under	Solder	9202 (up to 3")	202J (up to 3")	5049A	-	59
		Threaded	9201 (up to 4")	201J (up to 4")	5044A	722	58
			Tour & Anderson	Armstrong	Bell & Gossett		
Balancing	NPS 2 & Under	Solder	STAS	CBV-S	CB-S		
		Threaded	STAD	CBV-T	CB		
	NPS 2½ & Over	Flanged	STAF-SG	CBV-G	CB-F		
		Grooved	STAG	CBV-G	CB-G		
Natural Gas							
Valve Type			Crane	Jenkins	Toyo	Kitz	
Ball	2" & Under	Threaded	9201	201J	5044A	58	
Related Sections							
.1 For compressed air systems refer to specification section 22 15 00 - Compressed Air Systems							

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-2018, Power Piping, (SI Edition).
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A125-96(2013)e1, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-14e1, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-15, Specification for Carbon and Alloy Steel Nuts (Metric).
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-58-2009, Pipe Hangers and Supports - Materials, Design, Selection, Manufacture, Application, and Installation.

1.3 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 all 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 to be in accordance with MSS SP-58.

1.4 DESIGN FOR SEISMIC EVENTS

- .1 Design supports, platforms, hangers, racks to withstand seismic events as specified Section 20 05 49.01 - Seismic Restraint Systems (SRS).

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Submit shop drawings and product data for following items:
 - .1 All bases, hangers and supports.
 - .2 Connections to equipment & structure.
 - .3 Structural assemblies.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: Suspension from lower flange of I-Beam.
 - .1 Cold piping NPS 2 maximum: Malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed.

- .2 Cold piping NPS 2½ or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS SP-58.
- .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 to MSS SP-58.
 - .2 Cold piping NPS 2½ or greater, all 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 rod, clevis plate, clevis pin and cotters with forged weldless steel nut.
 - .2 Concrete wedge anchor with knockout protector plate UL listed to MSS SP-58. Anchor installation to be via concrete pre-drilling. Impact insert type anchor not allowed.
- .5 Manufacturer assemblies:
 - .1 Sway braces for seismic restraint systems: to Section 20 05 49.01 - Seismic Restraint Systems (SRS).
- .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 black.
 - .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-58 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis. Ensure "U" has hole in bottom for riveting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-58.
- .10 U-bolts: carbon steel to MSS SP-58 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: black.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-58, Type 43.
 - .1 Finish: Hot dipped galvanized steel.
 - .2 Acceptable material: Tolco or approved equal.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: black carbon steel to MSS SP-58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP-58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping: 64 kg/m³ density insulation plus insulation protection shield to: MSS SP-58, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping: 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-58.

2.5 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 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.

2.6 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger to be 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.

2.7 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.
- .2 For attachment to concrete, provide concrete wedge anchors with knockout protection plate UL listed. Anchor installation to be via concrete pre-drilling. Impact insert type anchor not allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with: manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps and elsewhere 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 be 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.
- .8 When attaching to open web steel joists provide additional hangers for pipes with diameters of 75 mm or greater in order to reduce the magnitude of the concentrated load and spread the load to the joists equally. In these cases the allowable spacing of hangers for pipes permitted under ASME /MSS SP-58 will be reduced and additional hangers will be required as directed by steel fabricator and/or structural engineer.
- .9 Locate hangers at the top of open web steel joists where the horizontal and diagonal members meet at a joint.
- .10 All installations must be in conjunction with Section 20 05 49.01 - Seismic Restraint System.

3.2 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Manufacturer's recommendations, Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas & fuel piping: to applicable code.
- .4 Copper piping: up to NPS ½: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .6 Within 300 mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper	Maximum Spacing XFR
up to 1¼	2.5 m	2.5 m	1.6 m
1½	2.5 m	3.0 m	1.6 m
2	2.5 m	3.0 m	1.8 m
2½	2.5 m	3.0 m	1.8 m
3	2.5 m	3.0 m	2.2 m
4	2,5 m	3.0 m	2.6 m
6	3.7 m		3.1 m
8	3.7 m		3.6 m
10	3.7 m		4.0 m
12	3.7 m		4.4 m

- .7 Pipework greater than NPS 12: to MSS SP-58.

3.3 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.

3.4 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4° 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.

3.5 FINAL ADJUSTMENTS

- .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: Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps: Hammer jaw firmly against underside of beam.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .2 Canadian Standards Association (CSA).
 - .1 CSA B149.1-15, Natural Gas and Propane Installation Code.
 - .2 CSA Z7396.1-17, Medical Gas Pipeline Systems - Part 1: Pipelines for Medical Gases, Medical Vacuum, Medical Support Gases, and Anaesthetic Gas Scavenging Systems.
- .3 National Fire Protection Association
 - .1 NFPA (Fire) 13, Installation of Sprinkler Systems, 2016 Edition.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Product data to include paint colour chips, all other products specified in this section.

1.4 SAMPLES

- .1 Submit samples in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Samples to include nameplates, labels, tags, lists of proposed legends.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers to be 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.
- .2 Construction:
 - .1 1/8" thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size #	Height Sizes (mm)	No. of Lines	Height of Letters (mm)
1	40	1	20
2	75	1	50
 - .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: Use size #1.
 - .2 Equipment in Mechanical Rooms: Use size #2.

2.3 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: To CSA B149.1.
 - .2 Sprinklers: To NFPA (Fire) 13.
 - .3 Medical Gas: To CSA Z7396.1.

2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, legend; direction of flow by arrows. To CAN/CGSB-24.3 except where specified otherwise.
- .2 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.
- .3 Arrows showing direction of flow:
 - .1 Continuous wrap full diameter of pipe at each end of pipe identification markers.

- .4 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate full length of legend and arrows.

- .5 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 3/4" and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 All other pipes: Pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 300°F and intermittent temperature of 400°F.

- .6 Colours and Legends:
 - .1 Where not listed, obtain direction from Departmental Representative.
 - .2 Colours for legends, arrows: To following table:

Background colour:	Yellow	Legend, arrows:	BLACK
	Green		WHITE
	Red		WHITE

- .3 Background colour marking and legends for piping systems:

	Background colour marking	Legend
Contents		
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CW SUPPLY
Acid waste	Yellow	ACID WASTE (add source)
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
Reverse osmosis water	Green	R.O. WATER
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

2.5 IDENTIFICATION DUCTWORK SYSTEMS

- .1 150 mm (6") high stencilled letters and directional arrows 150 mm (6") long x 50 mm (2") high.
- .2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

2.6 MECHANICAL EQUIPMENT, VALVES CONTROLLERS, PUMPS, BOILERS, FAN COIL, ETC.

- .1 Lamicoid tag with 13 mm (1/2") 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.
- .3 Brass tags with 13 mm (1/2") stamped identification data filled with black paint.
- .4 Brass tags to be stamped with system identification and valve number system as outlined below:

SYSTEM	BRASS TAG STAMP
Domestic Cold Water	DC-1,2, ...
Domestic Hot Water	DH-1,2, ...
Domestic Hot Water Recirc.	DHR-1,2, ...
Heating Water	HW-1,2, ...
Compressed Air	CA-1,2, ...
Natural Gas	NG-1,2, ...
R.O. Water	RO-1,2, ...
Nitrogen Gas	N ₂ -1,2, ...
Refrigerant	Re-1,2, ...

2.7 CONTROLS COMPONENTS IDENTIFICATION

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

2.8 LANGUAGE

- .1 Identification to be in English.

PART 3 - EXECUTION

3.1 TIMING

- .1 Provide identification only after all painting specified in Architectural section is complete re: Interior Painting has been completed.

3.2 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.

3.3 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 in any way.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at least one is visible from any one viewpoint in operating areas and walking aisles. At not more than 17 m (55 ft.) 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, other confined spaces, at entry and exit points, and at each access opening.
- .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, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification to be easily and accurately readable from usual operating areas and from access points.

- .10 Position of identification to be 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.
- .11 At branch take-offs on both main and branch.

3.5 MECHANICAL EQUIPMENT, 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.
- .4 Where equipment is above accessible ceiling, provide coloured self-adhesive 13 mmØ dots to identify location of equipments.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 110-2016, Method of Testing Performance of Laboratory Fume Hoods.
- .2 Associated Air Balance Council/Canadian Associated Air Balance Council (AABC/CAABC).
- .3 National Balancing Council (NBC).

1.3 GENERAL

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section.

1.4 QUALIFICATIONS OF TAB PERSONNEL

- .1 Names of all personnel it is proposed to perform TAB to be submitted to and approved by Departmental Representative within 14 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.

1.5 PURPOSE OF TAB

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

1.6 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.7 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.
- .3 Coordinate TAB with controls, mechanical and electrical contractors.

1.8 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 all 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 all TAB devices, equipment, accessories, measurement ports and fittings.

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 Divisions 20, 21, 22, 23 & 25.

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 START OF TAB

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

- .2 Start TAB only when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weatherstripping, sealing, caulking.
 - .3 All pressure, leakage, other tests specified elsewhere in Divisions 20, 21, 22, 23 & 25.
 - .4 All provisions for TAB installed and operational.
- .3 Start-up, verification for proper, normal and safe operation of all 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 All outlets installed, volume control dampers open.

1.12 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 All other HVAC systems: +5%, -5%.
 - .2 Hydronic systems: $\pm 10\%$.
 - .3 Laboratory HVAC systems: +10%, -0%.

1.13 ACCURACY TOLERANCES

- .1 Measured values to be accurate to within $\pm 2\%$ of actual values.

1.14 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.

1.15 SUBMITTALS

- .1 Submit, prior to commencement of TAB.

- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.16 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.17 TAB REPORT

- .1 Format to be in accordance with AABC/CAABC.
- .2 TAB report to show all results in SI units or Imperial (IP), to match drawings and specifications, and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit pdf electronic copy of TAB Report to Departmental Representative for verification and approval.

1.18 VERIFICATION

- .1 All reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30% of all 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.
- .5 At request of commissioning agent, provide manpower and instrumentation to verify an additional 30% of all reported results.

1.19 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close all access doors, lock all devices in set positions and ensure sensors are at required settings.
- .2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.20 COMPLETION OF TAB

- .1 TAB to be considered complete only when final TAB Report received and approved by Departmental Representative.

1.21 SYSTEMS

- .1 Quality assurance: Perform TAB of complete mechanical systems over entire operating range in accordance with most stringent conditions of AABC/CAABC & NBC.
- .2 Air Systems: Include both specified and measured data.
 - .1 Duct Air Quantities - Mains and Branches:
 - .1 Duct size.
 - .2 Number of pressure/velocity readings per traverse.
 - .3 Sum of velocity measurements.
 - .4 Average velocity.
 - .5 Duct air flow volume.
 - .6 Barometric pressure and duct air temperature.
 - .2 Air Outlets:
 - .1 Outlet location and designation.
 - .2 Manufacturers catalogue identification and type.
 - .3 Air outlet flow factors. Use 1.0 when flow hood is used.
 - .4 Air flow volumes.
 - .5 Deflector vane or diffuser cone settings.
 - .3 Laboratory fume hoods:
 - .1 Standard: Government of Canada - MD15128-2013, Laboratory Fume Hoods.
 - .2 TAB procedures: as described in standard.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 - EXECUTION

3.1 BALANCING AND ADJUSTING PREPARATION

- .1 Perform testing, adjusting and balancing work after equipment and systems starting procedures have been properly completed.

- .2 Perform balancing during heating and cooling season of first year of operation, and at times when directed by Departmental Representative, to ensure proper settings of controls under both summer and winter peak load conditions.
- .3 Vary load to verify operation of system under partial load conditions. Test start-up, shut-down, emergency conditions, safety controls operation and automatic and manual resets and interlocks.
- .4 Cap all instrument test ports. Obtain caps from sheet metal contractor and install.

- END OF SECTION -

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 American Society of Safety Engineers (ASSE)/American Industrial Hygiene Association (AIHA)
 - .1 ASSE/AIHA Z9.5-2012, Laboratory Ventilation.
- .2 Public Works and Government Services Canada (PWGSC)
 - .1 PWGSC MD 15128-2013, Laboratory Fume Hoods.

1.2 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 PWGSCC MD 15128.
- .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 laboratory HVAC design course, by US Eagleson Institute or equivalent.
 - .3 Attendance at ASHRAE 110 Testing Workshop, by US Eagleson Institute or equivalent.

PART 2 - PRODUCTS

2.1 TESTING EQUIPMENT

- .1 Test equipment to ASSE/AIHA 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: $\pm 5\%$.
- .4 Thermal anemometer:
 - .1 Mounting: on stand with probe fixed at each traverse grid location.
 - .2 Include: averaging function over twenty second period for each location or 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: $\pm 5\%$.
- .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: $\pm 25\%$; concentrations above 0.1 ppm: $\pm 10\%$.
- .6 Smoke generator:
 - .1 Use smoke generator and diffuser complying with PWGSC MD 15128.

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°C and 24.5°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 PWGSC MD 15128 at design sash position to ensure compliance with design criteria in PWGSC MD 15128.

3.2 "AI" TESTS FOR AND VAV HIGH PERFORMANCE FUME HOODS

- .1 Cross draft tests:
 - .1 Test air currents external to fume hood to PWGSC MD 15128.
 - .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 MD 15128.
- .3 Face velocity and flow response test pass ratings: to PWGSC MD 15128.
 - .1 Average face velocity for high performance fume hoods: 0.35 m/s, with no reading less than 0.25 m/s.
 - .2 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: $\pm 20\%$
 - .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: $\pm 20\%$
 - .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 ASSE/AIHA Z9.5 capable of maintaining 375 air changes per hour.
- .4 Tracer Gas tests:
 - .1 Performance criteria: to PWGSC MD 15128.
 - .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.

3.3 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 $\pm 20\%$ of design flow set point.
 - .3 Alarm response enunciation test: ensure alarm delay is 10 seconds maximum.

3.4 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.

3.5 VERIFICATION LABELS

- .1 Affix label to front of fume hood indicating verification, name of testing agency, and date.

3.6 COMMISSIONING - INTEGRATED SYSTEMS TESTS

- .1 Do commissioning tests in accordance with Section 01 91 13 - General Commissioning Requirements.
- .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.

3.7 REPORTS

- .1 Ensure test reports are signed by testing agency before submitting to Departmental Representative.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM B209-14, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - .2 ASTM C335/C335M-17, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.10-92, Mineral Fibre Board Thermal Insulation.
 - .2 CAN/CGSB-51.11-92, Mineral Fibre Thermal Insulation Blanket.
 - .3 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Manufacturer's Trade Associations: Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .4 Underwriters Laboratories (UL)
 - .1 UL 723, Tests for Surface Burning Characteristics of Building Materials.
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 SAMPLES

- .1 Submit samples in accordance with Section 20 05 01 - Mechanical General Requirements, if requested by Departmental Representative.
- .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 1/2" plywood board. Affix typewritten label beneath sample indicating service.

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 20 05 01 - Mechanical General Requirements, if requested by Departmental Representative.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.7 QUALIFICATIONS

- .1 Installer to be specialist in performing work of this section, and have at least 5 years' successful experience in this size and type of project, qualified to standards.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions required by manufacturer.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Mineral fibre as specified herein 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/C335M.
- .3 TIAC Code C-1: Rigid mineral fibre board to CAN/CGSB-51.10, 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 CAN/CGSB-51.11 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/CGSB-51.11.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/CGSB-51.11.
 - .4 Density: 24 kg/m³.

2.3 JACKETS

- .1 Canvas: 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: Compatible with insulation.
- .3 Aluminum:
 - .1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Stucco embossed.
 - .4 Jacket banding and mechanical seals: 19 mm (¾") wide, 0.5 mm thick stainless steel.
- .4 Acrylic Adhesive (Indoor Applications only):
 - .1 Thickness: 0.18 mm.
 - .2 Finish: Stucco embossed.
 - .3 Peel Adhesion: 18N/25 mm (65 oz./in.)
 - .4 Puncture: 130N (30 lbs.).
 - .5 UL 723 listed (10/20 flame/smoke rating).
 - .6 Acceptable material: VentureClad 1577CW.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive: Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .5 Tape: self-adhesive, aluminum, reinforced, 75 mm (3") wide minimum.
- .6 Contact adhesive: quick-setting
- .7 Canvas adhesive: washable.
- .8 Tie wire: 1.5 mm stainless steel.
- .9 Banding: 19 mm (¾") wide, 0.5 mm thick stainless steel.
- .10 Facing: 25 mm (1") galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .11 Fasteners: 2 mm diameter pins with 38 mm (1½") diameter clips, length to suit thickness of insulation.

PART 3 - EXECUTION

3.1 PRE- INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems to be complete, witnessed and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm (3").
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.

- .5 Supports, Hangers in accordance with Section 23 05 29 - Bases, Hangers and Supports
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: At 300 mm (12") oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness mm (in.)
Cold and dual temperature supply air ducts in concealed ceiling space and all round cold ducts including silencers	C-2	yes	25 (1")
Outside air ducts to mixing plenum	C-1	yes	50 (2")
Supply and return ducts exposed in space being served	none		
Exhaust ducts within 3 m from roof/ exterior wall penetration	C-1	yes	50 (2")
Acoustically lined ductwork inside building	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.

- .3 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/1	CRD/2
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM) (latest edition).
 - .1 ASTM C335/C335M-17, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .2 ASTM C449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.9-92 Mineral Fibre Thermal Insulation for Piping and Round Ducting.
 - .2 CAN/CGSB-51.12-95, Cement, Thermal Insulating and Finishing.
 - .3 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Manufacturer's Trade Associations (latest edition).
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .4 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

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 defined herein.
- .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.

- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.5 SAMPLES

- .1 Submit samples in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm (1/2") plywood board. Affix typewritten label beneath sample indicating service.

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.7 QUALIFICATIONS

- .1 Installer to be specialist in performing work of this section, and have at least 5 years' successful experience in this size and type of project, qualified to standards.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather, construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions required by manufacturer.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Mineral fibre as specified herein 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/C335M.
- .3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/CGSB-51.9.
 - .2 Maximum "k" factor: to CAN/CGSB-51.9.
- .4 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/CGSB-51.9.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/CGSB-51.9.

2.3 INSULATION SECUREMENT

- .1 Tape: Self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 To CAN/CGSB-51.12.
 - .2 Hydraulic setting or Air drying on mineral wool, to ASTM C449.

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

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

2.7 JACKETS

- .1 PVC:
 - .1 Ontario Building Code compliant for 25/50 flame spread and smoke developed.
 - .2 Minimum thickness 0.015 mil.
 - .3 Colour white unless otherwise specified.
 - .4 Non yellowing UV stabilized.
 - .5 Minimum service temperatures: -20°C.
 - .6 Maximum service temperature: 65°C.
 - .7 Moisture vapour transmission: 0.02 perm.
 - .8 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.

PART 3 - EXECUTION

3.1 PRE- INSULATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 All roof drain bodies shall be thermally insulated with 50 mm thick mineral fibre blanket faced with factory applied vapour retarder jacket.
- .5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
 - .2 Saddles to have ridges to limit movement while in hanger.
 - .3 To be edge flared to prevent cutting/damage to insulation coverage.
- .6 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
- .2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: PVC.

3.4 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry at all times. Overlaps to manufacturer's instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: Tape at 300 mm oc.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: Tape at 300 mm oc.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 Thickness of insulation to be as listed in following table:

Application	Temp °C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)			
			½ to 1¼	1½ to 3	4 to 6	8 & over
Hot Water Heating	61 - 93	A-1	38	50	50	50
Chilled Water		A-3	38	38	50	50
Domestic Hot Water		A-1	25	38	38	38

Domestic Hot Water Recirc	A-1	25	38	38	38
Domestic Cold Water	A-3	25	25	25	25

- .5 Finishes:
 - .1 Exposed indoors: PVC.
 - .2 Exposed piping & fittings in mechanical rooms: PVC.
 - .3 Concealed, indoors: PVC on valves and fittings only. No further finish.
 - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
 - .5 Finish attachments: Stainless steel bands at 150 mm oc. Seals: wing or closed.
 - .6 Installation: To appropriate TIAC code CRF/1 through CPF/5.
- .6 Storm piping & fittings to be insulated from all roof drain bodies to storm piping at grade level.
- .7 Domestic hot & cold and recirc piping shall be completely thermally insulated to fixtures, except exposed supply assembly at fixtures.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.15-2013, Cast Bronze Threaded Fittings: Classes 125 and 250.
 - .2 ASME B16.18-2018, Cast Copper Alloy, Solder Joint Pressure Fittings.
 - .3 ASME B16.22-2013, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM B32-08(2014), Specification for Solder Metal.
 - .2 ASTM B88M-18, Specification for Seamless Copper Water Tube Metric.
- .3 American Welding Society (AWS)
 - .1 AWS A5.8/A5.8M:2011-AMD 1, Specification Filler Metals for Brazing and Bronze Welding.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

PART 2 - PRODUCTS

2.1 PIPING

- .1 Type L hard drawn copper: to ASTM B88M.

2.2 FITTINGS

- .1 Cast bronze threaded fittings: to ASME B16.15.
- .2 Wrought copper and copper alloy solder joints pressure fittings: to ASME B16.22.
- .3 Cast copper alloy solder joint pressure fittings: to ASME B16.18.

2.3 DI-ELECTRIC COUPLINGS

- .1 Provide wherever pipes of dissimilar metals are jointed.
- .2 For pipe sizes 2 NPS and under, provide di-electric unions or couplings.

2.4 JOINTS

- .1 Solder, tin-antimony, 95:5: to ASTM B32.
- .2 Silver solder BCUP: to AWS A5.8.
- .3 Brazing: as indicated.
- .4 Application: All closed loop hydronic systems except steam & condensate systems.

2.5 VALVES

- .1 Refer to Section 23 05 23 - Valves.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- .1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.
- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .6 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.
- .7 Assemble piping using fittings manufactured to ASME standards.
- .8 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.

3.2 FILLING OF SYSTEM

- .1 Refill system with clean water adding water treatment as required.

3.3 TESTING

- .1 Test system in accordance with Section 23 05 05 - Installation of Pipework.

3.4 BALANCING

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Refer to Section 23 05 93 - Testing Adjusting and Balancing of Systems for applicable procedures.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A480/A480M-17, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A924/A924M-17a, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .2 Canadian Standards Association (CSA)
 - .1 CSA B228.1-1968, Pipe, Ducts and Fittings for Residential Type Air Conditioning Systems.
 - .2 CSA W48.2-M1992 (R1998), Chromium and Chromium-Nickel Steel Covered Electrodes for Shielded Metal Arc Welding.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 90A, Installation of Air Conditioning and Ventilating Systems, 2018 Edition.
 - .2 NFPA (Fire) 90B, Installation of Warm Air Heating and Air Conditioning Systems, 2018 Edition.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA 016-2012, HVAC Air Duct Leakage Test Manual, 2nd Edition.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate following:
 - .1 Sealants
 - .2 Tape
 - .3 Proprietary Joints

1.4 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum System Total Pressure Pa	SMACNA Seal Class
500	A
250	A
125	A

.2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant.

.3 Application:

- .1 All new & existing supply ductwork.
.2 All new return & exhaust ductwork.

2.2 SEALANT

- .1 Sealant: Indoor/outdoor water based duct sealant c/w UV inhibitors. Flame spread rating of 0. Smoke developed rating of 0. Temperature range of -20°F to +200°F.
.1 Acceptable material: Carlisle Hardcast CCWI-181, or equal.

2.3 DUCT LEAKAGE

- .1 In accordance with SMACNA 016.

2.4 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
.1 Rectangular: standard radius: 1.5 times width of duct.
.2 Round: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
.1 To 400 mm (16"): with single thickness turning vanes.
.2 Over 400 mm (16"): with double thickness turning vanes.

- .4 Branches:
 - .1 Rectangular main and branch: with 45° entry on branch.
 - .2 Round main and branch: enter main duct at 45° with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.

- .5 Transitions:
 - .1 Diverging: 20° maximum included angle.
 - .2 Converging: 30° maximum included angle.

- .6 Offsets:
 - .1 Full radiused elbows.

- .7 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.5 FIRESTOPPING

- .1 Retaining angles all around duct, on both sides of fire separation.
- .2 Firestopping material and installation must not distort duct.

2.6 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A924/A924M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

2.7 ESCUTCHEON ANGLES

- .1 40 mm x 40 mm angle iron frame on both sides of exposed rectangular or round ducts, on both sides of non-rated partitions. Escutcheon angles material & gauge shall be equal to base material.

2.8 STAINLESS STEEL (FUME HOOD) EXHAUST

- .1 Material: To ASTM A480/A480M, type 316 L stainless steel sheets with longitudinal joints. Passivate and anneal stainless steel sheets before welding. For round ducts, roll sheets circular and weld flush. Provide integral 1.6 mm (1/16") flanges on abutting ends of manufactured ducts.
- .2 Continuously weld all joints using Inert Gas Metal Arc process without burning parent metal, using filler rods type ER 316 L to CSA W48.2. Grind smooth and polish all joints.

- .3 Construction:
 - .1 Construct ductwork from following thickness of stainless steel sheet.
 - .1 Rectangular ducts: 18 gauge.
 - .2 Round ducts up to 500 mm (20") diameter: 22 gauge.
 - .3 Round ducts over 500 mm (20") diameter: 20 gauge.
 - .2 Reinforce rectangular ducts with galvanized angle frames at 1,200 (48") on centres, 25 mm x 25 mm x 3 mm (1" x 1" x 1/8") up to 900 mm (36") maximum dimensions and 50 mm x 50 mm x 6 mm (2" x 2" x 4") for larger ducts.
- .4 Flexible connectors: neoprene coated glass fibre, coated both sides, minimum mass 39 oz/yd², secured to ducts and fans with 50 mm x 50 mm x 6 mm (1" x 1" x 1/8") stainless steel type 316 L flat bars and bands using type 316 L stainless steel screws or bolts at 100 mm (4") intervals.

2.9 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm (20").
- .2 Hanger configuration: to SMACNA.
- .3 Hangers: black steel angle with black steel rods to SMACNA and following table:

Duct Size (in.)	Angle Size (in.)	Rod Size (in.)
up to 30	1 x 1 x 1/8	1/4
31 to 42	1 1/2 x 1 1/2 x 1/8	1/4
43 to 60	1 1/2 x 1 1/2 x 1/8	2/5
61 to 84	2 x 2 x 1/8	2/5
85 to 96	2 x 2 x 1/5	2/5
97 and over	2 x 2 x 1/4	2/5
- .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 GENERAL

- .1 Do work in accordance with NFPA (Fire) 90A, NFPA (Fire) 90B, CSA B228.1 and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm (4") beyond insulated duct.

- .3 Support risers in accordance with ASHRAE and SMACNA.
- .4 Install breakaway joints in ductwork on each side of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths to accommodate installation of acoustic duct lining.
- .7 Install escutcheon sheet metal angles on both sides of exposed rectangular or round ducts on both sides of non-rated partitions. Seal void with acoustic sealant.

3.2 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 as follows:

Duct Size	Spacing
mm (in.)	m (ft.)
to 1500 (60)	3 (10)
1525 (61) and over	2.5 (8)

3.3 SEALING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.

3.4 LEAKAGE TESTS

- .1 In accordance with SMACNA 016.
- .2 Do leakage tests for supply duct; maximum leakage rate 1% at 1½ times operating static pressure.
- .3 Make trial leakage tests as instructed to demonstrate workmanship.
- .4 Install no additional ductwork until trial test has been passed.
- .5 Test section minimum of 100 ft. long with not less than 3 branch takeoffs and two 90° elbows.
- .6 Complete test before insulation or concealment.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A924/A924M-17a, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .2 Canadian Standards Association (CSA)
 - .1 CSA W48.2-M1992 (R1998), Chromium and Chromium-Nickel Steel Covered Electrodes for Shielded Metal Arc Welding.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACA)
 - .1 SMACNA 016-2012, HVAC Air Duct Leakage Test Manual, 2nd Edition.

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 DUCTWORK - GALVANIZED STEEL

- .1 Material:
 - .1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A924/A924M.
 - .2 Thickness: to SMACNA.
- .2 Construction - round and oval:
 - .1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.
 - .2 Transverse joints up to 900 mm (36"): slip type with tape and sealants.
 - .3 Transverse joints over 900 (36"): Ductmate.
 - .4 Fittings:
 - .1 Elbows: smooth radius. Centreline radius: 1½ x diameter.
 - .2 Branches: conical transition with conical branch at 45° and 45° elbow.

- .3 Construction - rectangular:
 - .1 Ducts: to SMACNA.
 - .2 Transverse joints: welded, proprietary duct joints or SMACNA Class A.
 - .3 Acceptable Manufacture: Ductmate Canada Ltd. or approved equal.
 - .4 Fittings:
 - .1 Elbows: smooth radius; centreline radius $1\frac{1}{2}$ x width of duct. No vanes.
 - .2 Branches: with conical branch at 45° and 45° elbow.
- .4 Firestopping:
 - .1 50 x 50 x 3 mm (2" x 2" x 1/8") retaining angles all around duct, on both sides of fire separation.
 - .2 Firestopping material must not distort duct.
- .5 Escutcheon Angles:
 - .1 40 mm x 40 mm x angle iron frame on both sides of exposed rectangular or round ducts, on both sides of non-rated partitions. Escutcheon angles material & gauge shall be equal to base material.

2.2 STAINLESS STEEL (LAB EXHAUST)

- .1 Material: type 316 L stainless steel sheets with longitudinal joints. Passivate and anneal stainless steel sheets before welding. For round ducts, roll sheets circular and weld flush.
- .2 Continuously weld all joints using Inert Gas Metal Arc process without burning parent metal, using filler rods type ER 316 L to CSA W48.2. Grind smooth and polish all joints.
- .3 Construction:
 - .1 Construct ductwork from the following thickness of stainless steel sheet.
 - .1 Rectangular ducts: 1.31 mm thick.
 - .2 Round ducts up to 500 mm diameter: 0.853 mm thick.
 - .3 Round ducts over 500 mm diameter: 1.01 mm thick
 - .2 Reinforce rectangular ducts with galvanized angle frames at 120 mm on centres, 25 mm x 25 mm x 3 mm up to 800 mm maximum dimensions and 50 mm x 50 mm x 6 mm for larger ducts.
- .4 Flexible connectors: neoprene coated glass fibre, coated both sides, minimum mass 1.33 kg/m^2 , secured to ducts and fans with 25 mm x 25 mm x 3 mm stainless steel type 316 L flat bars and bands using type 316 L stainless steel screws or bolts at 100 mm intervals.

2.3 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum System Total Pressure (Pa)	SMACNA Seal Class
2500 Pa (8")	A
2000 Pa (8")	A
1500 Pa (6")	A
1000 Pa (4")	A
750 Pa (3")	A

.2 Seal classification: Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with Class A sealant.

2.4 SEALANT

- .1 Oil resistant, polymer type flame resistant high velocity duct sealing compound.
- .2 Acceptable Manufacture: Duro Dyne S-2.

2.5 TAPE

.1 Polyvinyl treated, open weave fibre glass, 50 mm (2") wide. Acceptable Manufacture: Duro Dyne FT-2.

2.6 HANGERS AND SUPPORTS

- .1 Band hangers: use on round and oval ducts only up to 20" diameter, of same material as duct, but next sheet metal thickness heavier than duct.
- .2 Trapeze hangers: ducts over 20" diameter or longest side, to ASHRAE and SMACNA.
- .3 Hangers: galvanized steel angle with galvanized steel rods to following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1000	8 x 38 x 3	6
1001 to 1500	38 x 38 x 3	10
1501 to 2000	50 x 50 x 3	10

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .1 Acceptable Manufacture: Myatt fig. 485 or approved equal.
 - .2 For steel joist: manufactured joist clamp or steel plate washer.
 - .1 Acceptable Manufacture: Grinnell fig. 61 or approved equal.
 - .3 For steel beams: manufactured beam clamps:
 - .1 Acceptable Manufacture: Grinnell fig. 60 or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do work in accordance with ASHRAE and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate band hangers 100 mm (4") beyond insulated duct.
- .3 Support risers in accordance with ASHRAE and SMACNA.
- .4 Install breakaway joints in ductwork on each side of fire separation.
- .5 Ensure installation of firestopping does not distort duct.
- .6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .7 Manufacture duct in lengths to accommodate installation of acoustic duct lining.
- .8 Install escutcheon sheet metal angles on both sides of exposed rectangular or round ducts on both sides of non-rated partitions. Seal void with acoustic sealant.

3.2 HANGERS

- .1 Band hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: as follows:

Duct Size mm (in.)	Spacing m (ft.)
1500 (60")	3 (10)
1501 (61") and over	2.5 (8)

3.3 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturer's recommendations.

3.4 STAINLESS STEEL

- .1 Joints and seams to be continuous inert gas welded.

3.5 LEAKAGE TESTS

- .1 In accordance with SMACNA 016.
- .2 Make leakage tests, as instructed to demonstrate workmanship.
- .3 Complete tests before insulation or concealment.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA B228.1-1968, Pipes, Ducts and Fittings for Residential Type Air Conditioning.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Instrument test ports.

1.4 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Manufacture in accordance with CSA B228.1.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 0.6 mm thick with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at -40°C to +90°C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: 2 sash locks complete with safety chain.
 - .2 301 to 450 mm: 4 sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum 2 sash locks.
 - .4 Doors over 1000 mm: piano hinge and 2 handles operable from both sides.
 - .5 Hold open devices.

2.4 INSTRUMENT TEST PORTS

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.
- .5 Acceptable material: Duro Dyne IP1 or IP2.

2.5 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Flexible connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.

- .2 Length of connection: 100 mm.
- .3 Minimum distance between metal parts when system in operation: 75 mm.
- .4 Install in accordance with recommendations of SMACNA.
- .5 When fan is running:
 - .1 Ducting on each side of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.

- .2 Access doors and viewing panels:
 - .1 Size:
 - .1 450 x 450 mm for person size entry.
 - .2 450 x 450 mm for servicing entry.
 - .3 300 x 300 mm for viewing.
 - .4 As indicated.
 - .2 Location:
 - .1 At fire and smoke dampers.
 - .2 At control dampers.
 - .3 At devices requiring maintenance.
 - .4 At locations required by code.
 - .5 At reheat coils.
 - .6 Elsewhere as indicated.

- .3 Instrument test ports.
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations.
 - .1 For traverse readings:
 - .1 At ducted inlets to roof and wall exhausters.
 - .2 At inlets and outlets of other fan systems.
 - .3 At main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Departmental Representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA 1966-2005, HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm (4").
- .3 For rectangular ducts adjustable lever with shaft extension to accommodate insulation thickness.
- .4 For round branch ducts adjustable lever with shaft extension to accommodate insulation thickness.
- .5 Inside and outside nylon end bearings.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm (4").
- .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: 0.07% at 750 Pa.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 All dampers to be vibration free.
- .6 Ensure damper operators are observable and accessible.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate the following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.

1.3 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

1.4 MANUFACTURED ITEMS

- .1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

1.5 CERTIFICATION OF RATINGS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board and as specified.
 - .3 Concealed fasteners.
- .3 Concealed operators.
- .4 Acceptable material: E.H Price Ltd., Nailor, Titus, Krueger, Metal-aire.

2.2 SUPPLY DIFFUSERS

- .1 Type SD1: 304 stainless steel radial flow diffuser 1220 mm x 610 mm, multi-angular perforated face, non- aspirating c/w directional control vanes, quick-release latches and full length hinging plenum, off-white baked enamel finish. Equivalent to E.H. Price Model RFDSS.
- .2 Type SD2: steel, square diffuser with adjustable pattern 600 mm x 600 mm, T-bar or drywall mounting as indicated, off-white. Equivalent to E.H. Price Model SCD.

2.3 RETURN AND EXHAUST GRILLES AND REGISTER

- .1 Type RG1: aluminum, 13 mm x 13 mm egg crate type face bars, baked white enamel finish, ducted where indicated, drywall of T-bar mounted. Size 600 mm x 150 mm unless otherwise indicated. Equivalent to E.H. Price Model 80.
- .2 Type TG1: aluminum, 13 mm x 13 mm egg crate type face bars, baked white enamel finish, ducted where indicated, drywall of T-bar mounted. Size 600 mm x 200 mm unless otherwise indicated. Equivalent to E.H. Price Model 80.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturers instructions.

- .2 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible.

- END OF SECTION -

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 The laboratory hoods conform to the following regulations and standards:
 - .1 ASHRAE 110-2016, Method of Testing Performance of Laboratory Fume Hoods.
 - .2 ASTM E84-18a, Test Method for Surface Burning Characteristics of Building Materials.

1.2 REQUIREMENTS

- .1 Laboratory hoods are double-wall construction with epoxy-coated, cold rolled steel exterior and 3/16 inch sheet molded composite board internal liner and baffle. The hoods have a separate upper and lower 3/16 inch thick vertical-rising sash with epoxy-coated aluminum sash handles. Viewing height shall be 73.5 inches access for maintenance shall be from both the front and interior sides of the hood. All hood-mounted service fixtures, where provided, are pre-plumbed except for the inlet tubing. All electrical services are pre-wired to a single point internal junction box at the top right of the hood. Hoods shall be shipped in two sections, top and bottom.

1.3 QUALITY ASSURANCE

- .1 The hood manufacturer maintains a testing facility at its place of business for the testing of floor-mounted laboratory hoods in accordance with ASHRAE 110. Both hoods and installation are in conformance to good construction practice and approved by the Departmental Representative. Only hood manufacturers who have had fume hoods as a principal product for ten years are considered. The hood manufacturer's manufacturing and test facilities and its quality control procedures must be available for Departmental Representative inspection.

1.4 DELIVERY AND STORAGE

- .1 Laboratory hoods and work surfaces are delivered adequately protected from damage during shipment.

1.5 WARRANTY

- .1 Manufacturer's warranty against defects in material or workmanship on its fume hoods are for 1 year from date of installation or 2 years from date of purchase, whichever is sooner, includes replacement of parts (except lamps) and labour

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Hood exterior construction are 20 gauge (or heavier) cold rolled sheet steel or galvanized steel supports. All exterior painted surfaces are baked on dry powder epoxy applied electrostatically. Base metal material are properly prepared for epoxy coating.
- .2 Hood interior liner and baffles are sheet molded homogeneous polyester panels. High performance baffles include chemically resistant polyester brackets for support. Minimum thickness are 3/16 inch. Flame spread is less than 25 per ASTM E84.
- .3 Corner posts are 16 gauge cold-rolled steel with epoxy-coated finish. Both corner posts are pre-punched and plugged to accommodate up to 4 service fixtures and 2 electrical receptacle boxes on each side. Right-hand corner post has ADA-compliant light and blower switches.
- .4 Exhaust connection is epoxy-coated 316 stainless steel.
- .5 Hose connectors are chemical-resistant, glass-filled polypropylene with 6 serrations.
- .6 Hood sashes are 3/16 inch thick tempered safety glass surrounded by an epoxy-coated aluminum frame.
- .7 Sash tracks shall be epoxy-coated aluminum.
- .8 Hood service fixtures (on models with service fixtures) shall feature ¼ inch copper tubing with extruded brass valve and rotating seat, TFE coated silicone bronze stem and TFE packing. Gas valves feature brass service lines.
- .9 Sash handles on upper sash of vertical models shall incorporate a perforated sash handle to bleed air into the hood chamber directing fume concentrations away from the user's breathing zone.

2.2 SPECIFIC FABRICATION REQUIREMENTS

- .1 Overall exterior dimensional information is as follows:

NOMINAL DIMENSIONS OF HOOD

8 ft. - 96 in. W x 95 in. H x 43.7 in. D

- .2 The floor-mounted laboratory hood with by-pass design minimizes face velocity fluctuations as the sash is closed or opened. With the sash closed to a six inch opening, the average inflow velocity is not less than twice the selected full open face velocity nor greater than three times that amount.

- .3 Exhaust air volume requirements and static pressure losses are as described in the table.

Vertical Sash Hood Style (High Performance)

Face Velocity (fpm) - top sash fully open (64 inches)	Airflow Volumetric Rate (CFM) @ Static Pressure (Inches of Water)
100	8 foot hood 1640, 0.31 in
80	1310, 0.20 in.
60	1025, 0.12 in.

Face Velocity (fpm) - top sash 62.5% open (54 inches)	Airflow Volumetric Rate (CFM) @ Static Pressure (Inches of Water)
100	8 foot hood 1025, 0.12 in.
80	820, 0.08 in.
60	820, 0.08 in. 615, 0.04 in.

Notes: Bottom sash is closed for testing, and only open for loading. Top sash is fully open at 64 inches

- .4 The exhaust connection is 12.81 inches I.D. The hoods have two exhaust connections.
- .5 Interchangeable lift-away side panels and removable front panels provide access to plumbing fixtures, electrical wiring, counterbalance sash weights, and lighting fixtures, where specified on the individual hoods. All services are accessible from the front of the hood. Interior access panels, two on each side, shall provide additional access.
- .6 The exterior of the hood features baked on powder epoxy paint applied electrostatically.
- .7 The interior liner and perforated baffles are cut to fit in terms of size and securely held in place with supports. The baffles provide uniform draw throughout the fume cavity. Baffles are removable for cleaning.
- .8 The hoods have upper and lower vertical-rising sashes counterbalanced by single weights suspended by two vinyl-coated stainless steel cables that pass through ball bearing pulleys or four horizontal-sliding sashes.
- .9 The hoods will be provided with a total of up to 8 service fixtures as required capable of providing hot and cold tap water, natural gas, air, vacuum, nitrogen, argon and low pressure steam. Fixtures are rated at maximum pressure of 200 psi with a working pressure of 125 psi. Coefficient of flow for the valve, $C_v=0.43$. Services are provided through remote-controlled valves and 6-serration hose connectors located inside the fume hood cavity. Services are pre-plumbed except for the inlet tubing using 1/4 inch copper tubing except for the upper right hand fixture which is 1/4 inch brass for use with gas. Fixture handles are plastic and colour coded as well as labelled for the designated type of service. Speciality service fixtures are available upon request including CW gooseneck with and without, as required, vacuum breaker (3/8 inch lines) and SST valves with 1/4 inch SST lines for purified water. Other service fixtures are available from various valve manufacturers (consult Labconco).

8 Foot Hoods - 4 each, 3-foot 25-watt fluorescent lamps

- .10 The vapour-proof hoods accommodate up to four 115 volt, three-wire polarized and grounded electrical duplex receptacles as required.
- .11 Face velocity alarms to monitor hood performance are to be factory installed.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify equipment rough-in before proceeding with work.
- .2 Coordinate with other trades for the proper and correct installation of plumbing and electrical rough-in and for rough opening dimensions required for the installation of the hood.

3.2 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 installations to ensure utility connections are achieved in an orderly and expeditious manner.
- .5 Touch up minor damaged surfaces caused by installation. Replace damaged components as directed by Departmental Representative.

3.3 ADJUSTING

- .1 Adjust operating equipment, with exception of air moving equipment, to efficient operation for its intended use, and as required by the manufacturer.

3.4 TESTING CRITERIA

- .1 Reverse Airflows and Containment - When tested "As Manufactured" ("AM"), the hood provides containment less than or equal to 0.10 ppm when tested per ASHRAE 110

- .2 Test Criteria: The following test criteria shall apply when determining the As Manufactured performance rating
- .3 Face velocity: 60, 80 or 100 feet per minute $\pm 20\%$
- .4 Ambient temperature: 68 to 74°F.
- .5 Containment per ASHRAE 110: At a tracer gas release rate of 4 litres per minute, the AM leakage does not exceed 0.10 ppm (rating = 4 AM 0.10).
- .6 Flow Visualization: Swab a strip of titanium tetrachloride along both walls and the hood floor in a line parallel to the hood face and 6 inches (152 mm) back into the hood. (Titanium tetrachloride is corrosive to the skin and extremely irritating to the eyes and respiratory system.) Swab an 8 inch (200 mm) circle on the baffle of the hood on centreline and on each side. Define air movement toward the face of the hood as reverse airflow and define lack of movement as dead air space. Swab the floor, making sure to swab lines around all equipment in the hood. All smoke should be carried to the back of the hood and out. Before going on to the next test, move the cotton swab around in the face of the hood. If there is any outfall, the exhaust capacity test should not be made.
- .7 Exhaust Capacity: Ignite and place a 30-second smoke bomb near the centre of the floor, making sure that the hole on the side of the smoke bomb faces into the hood. After the smoke bomb begins to work, pick it up with tongs and move it around in the hood. There should be no visual or odour indications of smoke outside the hood.
- .8 Installed Performance: Per ASHRAE 110, the "As Used" ("AU") requirement involves the design of the room supply system and the toxicity of the materials handled in the hood. The AU specification should be tailored to suit the needs of the laboratory room location.

- END OF SECTION -

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 110-2016, Method of Testing Performance of Laboratory Fume Hoods.
- .2 ASTM International
 - .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM A1008/A1008M-16, 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.
 - .3 ASTM B456-17, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - .4 ASTM E84-18a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-12.1-M90, Tempered and Laminated Safety Glass.
- .4 CSA International
 - .1 CAN/CSA-C22.2 No. 61010-1-12 (R2017), Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.
 - .2 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Public Works and Government Services Canada (PWGSC)
 - .1 PWGSC MD15128 2013, Laboratory Fume Hoods.
- .6 Scientific Furniture and Equipment Association (SEFA)
 - .1 SEFA 1-2010, Recommended Practices for Laboratory Fume Hoods.
 - .2 SEFA 2-2010, Recommended Practices for Installations.
 - .3 SEFA 3-2010, Recommended Practices for Laboratory Work Surfaces.
 - .4 SEFA 7-2010, Recommended Practices for Fixtures.
- .7 Underwriter Laboratories of Canada (ULC)
 - .1 UL 723, Tests for Surfaces Burning Characteristics of Building Materials.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Submit list of fume hood materials, components and accessories to be incorporated into Work.
- .3 Include product names, types and series numbers for fume hood components and accessories.
- .4 Include contact information for manufacturer for fume hood components and accessories used on this Project.

- .3 Site Visit:
 - .1 Manufacturer's representative to inspect hood installations after each phase. Allow for two (2) inspections. Allow for separate site visit for test and evaluation at time directed by Client.

- .4 Test and Evaluation Reports:
 - .1 Submit detailed performance reports in accordance with PWGSC MD15128, fume hood design criteria and materials thickness. Include hood superstructure details.
 - .1 Indicate exhaust air flow rate.
 - .2 Indicate pressure drop through fume hood.
 - .3 Perform smoke test.

- .5 Field reports: submit manufacturer's field reports within 3 days of manufacturer representatives' site visit.

- .6 Submit detailed seismic anchorage and attachment drawings and calculations complying with requirements and regulations for seismic restraint.

1.3 QUALITY ASSURANCE

- .1 Certification: submit catalogued or published certified ratings obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying performance capabilities, including "As Manufactured (AM)" tests in accordance with PWGSC MD15128.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .1 Upon arrival and before installation, demonstrate that fume hood is consistent with prototype and product data, and has not been damaged in transit.
 - .2 Ensure fume hood bears CSA label.
 - .3 Inspect fume hood and record condition using approved check sheet.
 - .4 Departmental Representative will supply check sheet.
 - .5 After check of fume hood inspection has been carried out have Departmental Representative sign sheet and submit sheet as part of record documentation.

- .2 Storage and Handling Requirements:
 - .1 Store and protect fume hood, components and accessories from nicks, scratches, and blemishes.

- .2 Replace defective or damaged materials with new.

1.5 WARRANTY

- .1 Project Warranty: refer to Contract Conditions for project warranty provisions.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- .1 Laboratory fume hood: ventilated, enclosed work space, designed for continuous use to capture, confine and exhaust fumes, vapours and particulates generated within fume hood cavity.
- .2 Factory fabricated package, piped and wired for single connections to exhaust system, electrical power, laboratory services, water supply, and laboratory drainage system.
- .3 Fume hood to be variable volume low flow (0.3 m/s) type.

2.2 DESIGN CRITERIA

- .1 Fume hood, controls and alarms: UL or ULC labelled.
- .2 Fume hood face velocity: 0.30 m/s.
 - .1 Design sash position (normal operating sash height) at 450 mm.
- .3 Seismic: ensure fume hood manufacturer supplies anchor bolts and templates.
 - .1 Ensure anchor bolts are sized to withstand seismic zone acceleration and velocity requirements for location.
- .4 Meet performance criteria in PWGSC MD15128.
- .5 Construct to SEFA 1 Recommended Practices for Laboratory Fume Hoods.

2.3 VARIABLE AIR VOLUME (VAV)

- .1 For detailed requirements refer to schedules on drawing.
 - .1 Width: 1500 or 1800 mm nominal as indicated.
 - .2 Height: 1500 mm nominal.
 - .3 Depth: 840 mm nominal.

- .2 Sash: 6 mm thick minimum tempered safety glass to CAN/CGSB-12.1 in corrosion resistant PVC track with provisions for raising and lowering sash.
 - .1 Sash handle: type 316 stainless steel with #4 satin finish, designed to eliminate eddies in plane of sash opening and thin enough in profile to minimize interference with line-of-sight of fume hood user.
 - .2 Clear openable height to 700 mm.
- .3 Sash opening: normal operating position to:
 - .1 Form part of fume hood design criteria.
 - .2 Ensure normal operating position is labelled on front.
 - .3 Ensure opening is restricted by sash stop.
 - .4 Normal operating position of sash:
 - .1 450 mm opening above airfoil.
- .4 Counterbalance mechanism: use single counterweight, chain and sprocket design or stainless steel multi-strand wires, 39 mm minimum diameter nylon-tired ball-bearing pulley assembly, cable retaining device, assembled to prevent creep or tilting of sash during operation.
 - .1 Sash to move easily and quietly with one finger operation, and remain in place where it is stopped.
 - .2 Spring counterbalance mechanisms not acceptable.
 - .3 Sash to open and close against rubber bumper stops, installed to ensure user can readily adjust sash opening when moving sash from either end.
 - .4 In event of failure of counterbalance mechanism, sash must remain 50 mm minimum above lowest part of airfoil.
 - .5 Sash guides; full length corrosion resistant extruded PVC tracks.
- .5 Sash stop: include physical stop to prevent sash from opening beyond normal operating position under regular working conditions.
 - .1 Allow sash to open beyond normal operating position when placing apparatus in hood.
 - .2 Ensure sash automatically resets to normal operating limit.
- .6 Horizontal air-foil:
 - .1 1.9 mm type 316 stainless steel with #4 satin finish, installed 25 mm above raised portion of work surface and designed for eddy-free air entry.
 - .2 Project into fume hood beyond edge of sash.
 - .3 Design airfoil to eliminate reverse flow within 75 mm of plane of sash.
- .7 Work surface: recess 316 stainless steel work surface 12 mm minimum to contain spills and include coved corners and raised edges. Construct to SEFA 3.
 - .1 Ensure joints with interior panels are sealed.
 - .2 Adhere 50 mm minimum line of yellow PVC tape to work surface 150 mm inside plane of sash for full width of work surface.
- .8 Interior panels:
 - .1 Stainless steel: to ASTM A167 1.2 mm thick minimum, type 316 with #4 satin finish with 12 mm minimum radius interior corners and welds ground smooth.
 - .1 Flexural strength: 96.5 MPa.

- .2 Flame spread: 25 or less to UL 723 and ASTM E84.
- .2 Interior access panels: gasketed, removable and replaceable without use of special tools.
- .9 Fastenings: ensure fastenings inside fume hood are corrosion resistant and remain unaffected by repeated manipulations.
- .10 Baffles: construct baffles from same material as interior panels.
 - .1 Design baffles to provide multiple exhaust slots to minimize variations in face velocity across sash opening when sash is in normal operating position.
 - .2 Set baffles at manufacturer's plant on basis of prototype testing, and permanently mark setting.
- .11 Exhaust duct collar: 305 mm diameter, integral with top panel and constructed from stainless steel, with bell-mouthed entry, and flanged to accept exhaust duct.
 - .1 Exhaust duct collar size: to provide exhaust flow rate of 5.0 - 7.5 m/s minimum.
- .12 Exterior panels:
 - .1 Cold rolled steel to ASTM A1008/A1008M finished with powder coating procedure, fastened using concealed stainless steel screws and devices.
 - .1 Do not use external screws.
 - .2 Ensure panels are easily removable to allow access to services.
 - .2 Top closure panels: of same material and finish as exterior panels and designed to enclose ductwork up to ceiling.
 - .1 Ceiling heights as indicated.
 - .3 Finish: electrostatically applied urethane powder coat of selected colour and baked in controlled high temperature oven to assure a smooth, hard satin finish.
 - .1 Ensure surfaces have a chemical resistant, high-grade laboratory furniture quality finish with thicknesses as follow:
 - .1 Exterior surfaces exposed to view: 0.0375 mm average and 0.03 mm minimum.
 - .2 Backs of hood and other surfaces not exposed to view: 0.025 mm average.
 - .3 Colour selected from manufacturer's standard range by Departmental Representative.
- .13 Superstructure: rigid self-supporting unit consisting of double wall construction with outer metal shell and inner lining of corrosion-resistant material.
 - .1 Panels must be attached to full frame construction, minimum 1.9 mm galvanized members.
 - .1 Attach panels and brackets to eliminate screw heads and metallic brackets from hood interior.
 - .2 Double wall to house and conceal steel framing members, attaching brackets and remote operating service fixture mechanisms, and complete with:
 - .1 Include levelling screws.
- .14 Vertical side posts of fume hood face: angled or radiused airfoil shape to reduce eddies and promote smooth entry of air into hood.
 - .1 Ensure service fixtures do not disturb air flow pattern.

- .2 Incorporate removable panels to provide access to service valves as indicated.
- .3 Ensure unit is capable of accepting 5 minimum plumbing and laboratory services and one duplex electrical receptacle on each side of opening.
- .4 Include light switch.
- .15 Light fixture: CSA approved or ULC listed and labelled. T8 two-tube fluorescent, rapid start, with electronic sound-rated ballasts, mounted on exterior of fume hood roof with safety lens and approved sealant to isolate fixture from fume hood interior.
 - .1 Sealant to be approved by Departmental Representative.
 - .2 Include bulbs with fixtures.
 - .3 Interior illumination at work surface: 860 lux minimum.
 - .4 Accessible for maintenance from fume hood exterior.
 - .5 Include flush-mounted switch on side post of fume hood.
- .16 Factory wire electrical outlets and switches and terminate in box on roof of fume hood to CAN/CSA-C22.2 No. 61010-1.
 - .1 Only ULC listed or CSA approved electrical devices are acceptable.
 - .2 Provide switch for light.

2.4 LABORATORY SERVICES

- .1 To SEFA 7.
- .2 Remote controls:
 - .1 Brass body, bolted and flanged and with chromium plated finish to ASTM B456, service condition SC 4, coating classification CuNi30dCr.
 - .2 Install remote controls on vertical side posts of fume hood face, located to avoid interference with smooth entry of air into hood.
 - .3 Include needle valves on all services except gas service.
 - .4 Equip remote controls with universal joints, wall flanges, couplings and tailpieces for connection to services.
- .3 Outlets:
 - .1 Forged or cast brass body complete with tailpiece for connection to service piping.
 - .2 Turrets and handles to be of forged brass.
 - .3 Finish: inside fume hood powder coating corrosion-resistant fluorocarbon.
- .4 Electrical: 2 duplex receptacles 120 V, 15 amp, CSA approved or ULC listed and labelled, GFI, hospital grade, mounted in side posts, stainless steel cover plate.
 - .1 Connect electrical service to each fume hood to dedicated electrical circuit.
- .5 Plumbing: include domestic cold water service.
 - .1 Isolating valves: include remote controlled valves located within end panels, controlled by handles projecting through side posts of fume hood.
 - .2 Locate to avoid interference with smooth entry of air into fume hood.

- .6 Fixtures: fixtures exposed within fume hood to have chemical-resistant metallic bronze finish.
 - .1 Ensure portions exposed to fume hood exterior are chrome plated.
- .7 Cup sinks: 75 x 150 mm oval (or nearest standard), rigidly clamped in approved manner to work surface, with approved acid-resisting seal, 38 mm drain with cross strainer debris catcher.
 - .1 Standing waste and overflow with 76 long minimum PVC tailpiece.
 - .1 Install with rim above work surface to prevent spills entering waste system.
 - .2 Finish welds smooth and polished.
 - .2 Cold water faucet: deck mounted with rigid gooseneck of heavy duty 10 mm brass pipe with integral backflow preventer upstream from serrated nozzle and remote control on exterior panel. Faucets are to be mixing faucets.
- .8 Nitrogen: single straight serrated nozzle outlet with flange, mounted on side panel inside fume hood.
 - .1 Remote control on exterior panel.
- .9 Identify service fixtures using colour coding as follows:

Service	Letter	Colour
	Coding	Coding
Cold water	CW	Green
Nitrogen	N	Yellow-orange
- .10 Access to services:
 - .1 Ensure fume hood manufacturer includes 5 cut-outs per side post.
 - .2 Cap unused openings with cap plugs of same material as exterior panels.
 - .3 Ensure service connections are accessible from fume hood exterior through removable access panels.
 - .4 Include isolating valves on building side of services.
 - .5 Where two or more fume hoods are installed side by side, use interior access panels of same material as interior panels, with bevelled edges, moulded PVC gaskets, and secured with non-corrosive fasteners set flush with face of access panel.
- .11 Corrosion resistant label:
 - .1 Provide corrosion-resistant label permanently attached to fume hood exterior with abbreviated information relating to sash position and recommended location of apparatus and accessories when placed within the fume hood.

2.5 AIRFLOW MONITOR ALARM

- .1 Audible and visual airflow alarm with digital air speed display shall be provided with fumehood.
- .2 Airflow alarm to activate on high and low ventilation as based on face velocity.
- .3 Airflow monitor alarm to have I/O terminal points to allow for connection to BAS to show alarms at the operators station and allow for alarm disable.

- .4 Airflow monitor alarm to have constant power with battery back-up.
- .5 Acceptable material: Labconco Catalogue Number 9413400.

2.6 FABRICATION

- .1 Do welding to CSA W48 or utilize automated welding.

2.7 SOURCE QUALITY CONTROL

- .1 Testing to be performed by third party retained by fume hood manufacturer.
- .2 "As Manufactured" Testing Equipment: to PWGSC MD15128.
 - .1 Data logger:
 - .1 Recording interval: 10 Hz or better.
 - .2 Memory: sufficient to allow data collection for duration of test.
 - .2 In-duct flow sensor to measure flow response:
 - .1 Speed: 10 Hz.
 - .2 Range: 95 L/s to 950 L/s.
 - .3 Accuracy: $\pm 5\%$.
 - .3 Thermal anemometer:
 - .1 Mounting: on stand with probe fixed at each traverse grid location.
 - .2 Include: averaging function over 20 second period for each location or output recorded for 20 seconds minimum at a rate of 1 reading/second on data logger.
 - .3 Accuracy:
 - .1 Below 0.50 m/s: ± 0.025 m/s.
 - .2 0.50 m/s and over: $\pm 5\%$.
 - .4 Detector for tracer gas containment:
 - .1 Type: continuous reading.
 - .2 Minimum Detectable Level (MDL): 0.01 ppm.
 - .3 Accuracy:
 - .1 Concentrations below 0.1 ppm: $\pm 25\%$.
 - .2 Concentrations above 0.1 ppm: $\pm 10\%$.
 - .5 Smoke generator:
 - .1 Use smoke generator and diffuser complying with PWGSC MD15128.
- .3 Conduct "as manufactured" (AM) tests in manufacturer's testing facility to ASHRAE 110 and PWGSC MD15128 procedures before transportation to site.
- .4 Conduct "AM" tests as follows:
 - .1 With fume hood empty.
 - .2 With fume hood loaded to simulate apparatus in hood.
 - .1 Locate simulated apparatus 150 - 250 mm behind plane of sash in manner approved by Departmental Representative as follows:
 - .1 1 - 3.8 litre paint cans.
 - .2 1 - 300 x 300 x 450 mm cardboard box.

- .3 4 - 150 x 150 x 300 mm cardboard boxes.
- .3 With simulated cross-drafts:
 - .1 Challenge with 0.25 m/s using 620 mm recirculation fan under conditions as follows:
 - .1 Air directed horizontally at 45 degrees to plane of sash.
- .5 Witnessing "AM" Tests:
 - .1 Perform "AM": tests in presence of Departmental Representative.
 - .2 Notify Departmental Representative 2 weeks minimum before start of testing.
- .6 Conduct "As Manufactured" (AM) Fume Hood Performance Tests as follows:
 - .1 Visualization (smoke) tests: meet or exceed performance criteria of PWGSC MD15128.
 - .2 Face velocity and flow tests: to PWGSC MD15128.
 - .1 Average face velocity: 0.5 m/s, with variation allowed for individual readings; maximum $\pm 20\%$.
 - .2 CAV bypass effectiveness at 150 mm sash opening: 1.25 m/s maximum average face velocity.
 - .3 Tracer gas tests: to PWGSC MD15128.
 - .1 Conduct tests at target average face velocity.
 - .2 Use approved tracer gas.
 - .3 Perform tests with probes at heights of 560 mm above work surface.
 - .4 Leakage with sash at normal operating position:
 - .1 Average leakage: 0.025 ppm maximum.
 - .2 Peak reading: 0.100 ppm.
 - .5 Leakage with sash in fully open position:
 - .1 Average leakage: 0.05 ppm maximum.
 - .2 Peak reading 0.25 ppm.
 - .6 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.
 - .7 Sash movement effect (SME), to determine potential for escape after movement of sash to ASHRAE 110 procedures.
 - .1 Maximum 45 second rolling average: 0.05 ppm

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install to SEFA 2.
- .2 Install plumb, with work surface level to within 1.5 mm in 3000 mm by adjusting base unit levelling screws.

- .3 Secure fume hood to base furniture using stainless steel fasteners spaced at 750 mm maximum on centre maximum, 3 minimum per side.
 - .1 Use 4 minimum for each fume hood.
- .4 Secure fume hood to meet seismic criteria.
- .5 Connect plumbing, laboratory services, electrical services and exhaust system to fume hood.

3.2 ADJUSTING

- .1 Adjust operable hardware for correct function.
- .2 Ensure sash does not bind while opening and closing.

3.3 PROTECTION

- .1 Protect installed fume hood components from damage during construction.
- .2 Repair damage to adjacent materials caused by fume hood installation.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 Air-Conditioning, Heating, and Refrigeration Institute (ARI)
 - .1 ARI 410-2001, Forced-Circulation Air-Cooling and Air-Heating Coils.
 - .2 ARI 430-2009, Central Station Air Handling Units.
- .2 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.2-2017, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .3 American Society for Testing and Materials (ASTM)
 - .1 ASTM E84-18a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .4 Canadian Standards Association (CSA).
- .5 National Fire Protection Association (NFPA).
- .6 Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- .7 Underwriters Laboratories of Canada (ULC).

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Submit product data sheets for fan coil units. Include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 Specified features and options.
 - .6 kW rating, voltage, phase.
 - .7 Cabinet material thicknesses.
 - .8 Limitations.
 - .9 Colour and finish.

- .3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence and cleaning procedures.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Indicate:
 - .1 Equipment, piping, connections, valves, strainers, controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system.
 - .2 Piping, valves and fittings shipped loose showing final location in field assembly.
 - .3 Dimensions, internal and external construction details; sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
 - .4 Wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories.
 - .5 Manufacturers shall submit fan coil schedule identifying each individual fan coil, tagged by room number, and showing the following:
 - .1 Pipe sizing.
 - .2 Heating & cooling capacities.
 - .3 Air flow.
 - .4 Air & water pressure drops.
 - .5 Electrical data.
 - .6 Options.
 - .7 Fan data.
 - .8 Motor data.
 - .9 Electrical data.
 - .10 Filter data.
 - .11 Unit configuration.
 - .12 Special unit detail/comments.
 - .13 Sound power levels.

1.5 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.

1.6 MAINTENANCE MATERIALS

- .1 Provide one (1) spare set of filters.

1.7 MANUFACTURED ITEMS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

1.8 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for vertical fan coil units for incorporation into manual specified in Section 20 05 01 - Mechanical General Requirements.
- .2 Provide brief description of systems at beginning of manual, properly indexed, with details of function, operation, control, and service for each piece of apparatus.
- .3 Manufacturer's instructions shall govern installation and, unless otherwise noted, operation, maintenance and service of items. Include names and addresses of spare parts suppliers.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Piping systems to Section 23 21 13.01 - Copper & Piping and Fittings - Hydronic Systems.

2.2 HORIZONTAL FAN COIL

- .1 Cooling, 2-pipe horizontal fan coil units consisting of casing, blow-thru fan assembly, coil, filter, return air plenum lined with 25 mm glass fibre with mat finish, insulated 18 gauge galvanized steel drain pan, 3-speed PSC 115V/1Ø/60 Hz, 1050 rpm motors wired to a junction box ready for single point field connection.
 - .1 Filters: removable 25 mm thick replaceable media type installed within the return air duct as indicated on the drawings.
 - .2 Coils
 - .1 Capacity: as indicated on drawings.
 - .2 Copper tubes mechanically expanded into evenly spaced aluminum fins, tested to 860 kPa.
 - .3 Wiring: factory installed, CSA approved, ready for connection to electric service.

- .2 Electrical:
 - .1 The main power supply shall connect to the unit. Standard electrical supply voltage shall be 115V AC single phase, 60 Hz. All fan coils shall have single point power supply to service unit's supply fan, controls & safeties. Cabinet shall be complete with a terminal strip for two (2) separate components; Component No. 1 to wire a supply fan through a magnetic motor starter capable of being controlled by Building Automation System (BAS); Component No. 2, will supply control 120/24V control transformer for all DDC control functions. All circuits feeding from terminal strip to have proper ESA fused ratings. Provide main-un-fused disconnect switch ahead of terminal switch for Div. 21, 22, 23 & 25 to connect; all internal wiring by manufacturer to have CSA approval.
- .3 Service Disconnect:
 - .1 Each unit shall be supplied with a line voltage service disconnect and a door switch for control voltage interrupt to disable the mechanical components when the service panel is removed.
- .4 Acceptable materials: Williams HH-series, International, Enviro-Tec, or as alternative materials approved by Addendum in accordance with Instructions to Tenderers.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install units in accordance with manufacturers instructions and as indicated.
- .2 Install all the units on level floor. Level unit using neoprene pad to shiver unit.
- .3 Install all units using threaded rod with hanger mount isolated bushing.
- .4 Maintain clearances as recommended by manufacturer to permit performance of service maintenance.
- .5 Check final location with Departmental Representative prior to installation. Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .6 Install full port ball isolation valves on inlet & outlet of fan coil c/w with CBV.
- .7 Check all units for excessive vibration.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 DEFINITIONS

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfil 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 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intent.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 20 05 01 - Mechanical General Requirements
- .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 20 05 01 - Mechanical General Requirements.
- .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 20 05 01 - Mechanical General Requirements.

1.6 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
- .2 Carry out commissioning under direction of and in presence of Commissioning Agent.
- .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 Commissioning Agent until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances : higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

PART 3 - EXECUTION

3.1 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the Commissioning Agent.
- .3 Commission integrated systems using procedures prescribed by Commissioning Agent.
- .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 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.
 - .3 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .4 Additional instruments to include:
 - .1 DP transmitters.
 - .2 VAV supply duct SP transmitters.
 - .3 DP switches used for dirty filter indication and fan status.
 - .5 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.
 - .6 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
 - .7 Cx Agent to mark instruments tracking within 0.5% in both directions as "approved for installation".
 - .8 Transmitters above 0.5% error will be rejected.
 - .9 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 converter.
 - .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 for commissioning technician and Cx Agent. 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 Cx Agent 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 Cx Agent'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 Cx Agent.
 - .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 Cx Agent to verify reported results.

3.3 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by Cx Agent, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

- .1 Demonstrate to Cx Agent 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.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 The Instrumentation, Systems and Automation Society (ISA)
 - .1 ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-00(R2011), Canadian Metric Practice Guide.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE 260.1-2004, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

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 ISA S5.5.
 - .1 Printouts: to IEEE 260.1.

1.5 SYSTEM DESCRIPTION

- .1 Refer to control schematics and Points List 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 Consultant prior to installation.
 - .3 Location of controllers as reviewed by Consultant prior to installation.
 - .4 Provide utility power to EMCS and emergency power to EMCS as indicated.
 - .5 Metric references: in accordance with CAN/CSA Z234.1.

- .4 Language Operating Requirements:
 - .1 Provide English or French operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English and French.
 - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English and or French.
 - .4 System manager software: include in English and or French 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 and French:
 - .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-definitions).
 - .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 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 20 05 01 - Mechanical General Requirements.
- .2 Submit for review:
 - .1 Equipment list and systems manufacturers within 10 days after award of contract.
 - .2 List existing field control devices to be re-used included in tender.
- .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. Label or listing of specified organization is acceptable evidence.
 - .4 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.
 - .5 Permits and fees: EMCS Contractor shall apply to the Electrical Safety Authority (ESA) for an ESA Permit for work which fall under the Ontario Electrical Safety Code. Upon completion of work, the EMCS Contractor shall apply for inspection and submit the final inspection report to Departmental Representative prior to occupancy of building.
 - .6 Existing devices intended for re-use: submit test report.

1.7 QUALITY ASSURANCE

- .1 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
- .2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.

- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

1.8 EXISTING - CONTROL COMPONENTS

- .1 Utilize existing control wiring and piping as indicated.
- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
 - .1 Do not modify original design of existing devices without written permission from Consultant.
 - .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.
 - .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 Building Owner 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.
 - .1 Be responsible for items repaired or replaced by Building Owner.
 - .2 Be responsible for repairs due to negligence or abuse of equipment.
 - .3 Responsibility for existing devices terminates upon final acceptance of EMCS.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 National Electrical Manufacturer's Association (NEMA).

1.3 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 01 - EMCS: General Requirements.

1.5 EXISTING CONDITIONS

- .1 Repair surfaces damaged during execution of Work.
- .2 Turn over to Client 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 and 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 30. Noise generated by any device must not be detectable above space ambient conditions.

2.2 TEMPERATURE SENSORS

- .1 Room temperature sensors and display wall modules.
 - .1 Temperature sensing and display wall module.
 - .1 LCD display to show space temperature and temperature setpoint.
 - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
 - .3 Jack connection for plugging in laptop personal computer for access to zone bus.
 - .4 Integral thermistor sensing element 10,000 ohm at 24°.
 - .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.
 - .2 Room temperature sensors.
 - .1 Wall mounting, in slotted type covers having brushed aluminum 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 +/-0.2°C.

2.3 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: 5V AC maximum at 24V AC.
 - .5 Operating range: 0-10V DC or 4-20 mA DC.
 - .6 For VAV box applications floating control type actuators may be used.
 - .7 Fume hood damper actuator to drive damper from full open to full closed in less than 10 seconds.

2.4 WIRING

- .1 In accordance with Section 26 27 26 - Wiring Devices.
- GWA 2018-363

- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18AWG or 20AWG stranded twisted pair.
 - .2 Analog input and output: shielded #18 minimum solid copper or #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. Maintain fire rating integrity.
- .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
 - .3 Trace existing control wiring installation and provide updated wiring schematics including additions and deletions to control circuits before beginning Work.
 - .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
 - .5 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Maximum conduit fill not to exceed 40%.
 - .4 Design drawings do not show conduit layout.
 - .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

- .7 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 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 20 05 01 - Mechanical General Requirements, all mechanical sections, and all other disciplines related to the project.

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 Lab Controls:
 - .1 Controls will modulate supply air (S/A), fume hood exhaust (FH/E) and general exhaust (G/E) automatic air valves as required to maintain lab airflow offset.
 - .2 Individual supply air flow (S/A) will be modulated to maintain the associated minimum occupied and unoccupied setpoints, space temperature setpoint and lab offset. Refer to table on drawings for minimum setpoints and offset for each lab.
 - .3 Occupied period to be scheduled as Monday - Friday 6:00 to 18:00 (adjustable). Provide occupied override for each lab to allow occupied period to be temporarily modified as required.
 - .4 Supply air valve and reheat control will modulate to maintain space temperature setpoint.
 - .5 If lab space temperature setpoint is satisfied then S/A flow setpoint will be reset as per following equation but not less than minimum:
 - .1 $S/A = FH/E - \text{offset}$
 - .6 If lab S/A is greater than fume hood plus equipment exhaust then general exhaust will be controlled as per following equation:
 - .1 $G/E = S/A - FH/E + \text{offset}$
 - .7 Individual fume hood exhaust will be controlled by associated sash position controller.
 - .8 Individual equipment exhaust will be controlled by a local switch.
- .3 Fan Coil:
 - .1 Fan to operate continuously.
 - .2 Modulate 2-way control valve to maintain space temperature setpoint.
 - .3 System to alarm if space temperature is more than 2°C (adjustable) above setpoint.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

- END OF SECTION -

DISTRIBUTION PANEL	Start Up and Process Verifications Checklists		
Building ID:		Project Name:	
Building Name:		Project Number:	
Connected to		Area(s) Served	
Location		CMMS #	
Measuring Technician		Date	
Company		Phone	
Title		Email	
CX Agent Name		Reviewed <input type="checkbox"/>	Approved <input type="checkbox"/>
Company		Signature	

Equipment Data			
Item	Specified	Shop Drawings	Installed
Manufacturer			
Type			
Voltage/phase/wires			
Bus Amperage			
Short CCT Rating			
Bus bracing (kA)			
Copper or aluminum bus			
Floor mounted			
Wall mounted: flush or surface			
Enclosure EEMAC type			
Drip hood			
Hinged lockable door			
Circuit directory in door			
Isolated ground bus			
Metering (Amps, Volts, kW)			
Main breaker type and size			
Main breaker lock-off facility			
Ground wire size			
Feeder conduit size			

DISTRIBUTION PANEL	Start Up and Process Verifications Checklists		
Building ID:		Project Name:	
Building Name:		Project Number:	
Connected to		Area(s) Served	
Location		CMMS #	
Measuring Technician		Date	
Company		Phone	
Title		Email	
CX Agent Name		Reviewed <input type="checkbox"/>	Approved <input type="checkbox"/>
Company		Signature	

Branch Breaker List			
Designation	Type and Frame	Short CCT Rating	Amp Trip
Feeder -			
Feeder -			

Start Up Checklist

Installation Review			
Item	Yes	No	Comments
Verification Report Complete			
Nameplate Complete			
Identification Label			
Wiring circuits identified			
Cable phasing colour-coded			
Clearance around equipment			
Grounding of equipment			
Check for signs of overheating			
Check breakers for mechanical operation			
Bus cable lugs, bus bolts and breaker bolts torqued to MRT			
Filler pieces in place			
Spare breakers installed			
Warning signs			

DISTRIBUTION PANEL	Start Up and Process Verifications Checklists		
Building ID:		Project Name:	
Building Name:		Project Number:	
Connected to		Area(s) Served	
Location		CMMS #	
Measuring Technician		Date	
Company		Phone	
Title		Email	
CX Agent Name		Reviewed <input type="checkbox"/>	Approved <input type="checkbox"/>
Company		Signature	

Verification Tests and Measured Data

<p>Feeder insulation test: (MΩ)</p> <p>Phase A - B = _____</p> <p>Phase B - C = _____</p> <p>Phase C - A = _____</p> <p>_____</p> <p>BC = _____</p> <p>CA = _____</p> <p>Line Voltage test:</p> <p>Phase V:</p> <p>AN = _____</p> <p>BN = _____</p> <p>CN = _____</p> <p>Line V:</p> <p>AB = _ currents:</p> <p>IA = _____</p> <p>IB = _____</p> <p>IC = _____</p>
Note* Equipment to be isolated from all sources of power
Remarks/Observations:

PART 1 - GENERAL

1.1 GENERAL

- .1 Inspection authorities shall mean Electrical Safety Authority.
- .2 Supply authority shall mean Hydro Ottawa.
- .3 Provide shall mean supply, install, test and commission.
- .4 Refer to General Instructions, Contract Requirements, Amendments and Divisions 00 & 01 and be governed by same.

1.2 CODES AND STANDARDS

- .1 Provide complete installation in accordance with the latest edition of the Ontario Electrical Safety Code and Electrical Bulletins.
- .2 Provide overhead and underground systems in accordance with CAN/CSA C22.3 No. 1-15 except where specified otherwise.
- .3 Comply with the following additional codes as a minimum:
 - .1 CSA Standards.
 - .2 ULC Standards.
 - .3 National Building Code - Latest Edition.
 - .4 Fire Code.
 - .5 NFPA.

1.3 CARE, OPERATION AND START UP

- .1 Instruct operating personnel in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .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 all aspects of its care and operation.

1.4 TIME OF COMPLETION

- .1 Commence work upon notification of acceptance of offer, or as outlined in the approved construction schedule.

- .2 Verify equipment delivery times immediately and notify Departmental Representative within two (2) weeks of contract award of any deliveries which would affect schedule.

1.5 SHOP DRAWINGS

- .1 Submit single electronic format (pdf) of shop drawings and product data along with transmittal. Hard copy shop drawings shall not be accepted.
- .2 The review is for the sole purpose of ascertaining conformance with the general design concept, and does not mean approval of the design details inherent in the shop drawings, responsibility for which shall remain with the Contractor. Such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents.
- .3 Do not commence manufacture or order materials before shop drawings are reviewed.
- .4 Shop drawings shall clearly indicate:
 - .1 Name of Contractor.
 - .2 Name of component.
 - .3 Name of service or system.
 - .4 Contractors signed review stamp.
- .5 Shop drawings shall include, but is not limited to, the following information:
 - .1 Arrangement of specific system.
 - .2 Electrical characteristics, volts, phase, amps, etc.
 - .3 Dimensions of equipment and required clearances.
 - .4 Performance data.
 - .5 Finish.
 - .6 Gauge of materials.
 - .7 Wiring diagrams (where applicable).
 - .8 Product data (where applicable).
- .6 Review relevant shop drawings of other Divisions to ensure interface of systems with respect to wiring, voltages, ampacities, phases, size, controls, etc. Notify Departmental Representative of any discrepancies immediately.
- .7 Provide shop drawings for the equipment listed below and/or as indicated in this specification:
 - .1 Distribution equipment.
 - .2 Light fixtures.
 - .3 Emergency lighting.
 - .4 Motor control equipment.
 - .5 Emergency - power generation.
 - .6 Fire alarm.

1.6 FIRE & SAFETY REQUIREMENTS

- .1 Comply with National Building Code (Part 8, Health and Safety Measures at Construction and Demolition Sites) and Provincial Regulations for Construction Projects.

1.7 EXISTING SERVICES

- .1 Existing services required for work may be used by the Contractor with the Departmental Representative's written consent. Ensure capacity is adequate prior to imposing additional loads. Connect and disconnect at own expense and responsibility.
- .2 Notify the Departmental Representative a minimum of 15 working days in advance of intended interruption of services; obtain requisite permissions.
- .3 Keep duration of these interruptions to a minimum. Carry out all interruptions on weekdays between 6:00 pm and 6:00 am, preferably on weekends or as approved by the Departmental Representative in writing.
- .4 Any unscheduled disruption to services to be immediately reinstated.
- .5 Existing fire alarm and security systems are to remain fully functional, throughout, provide conduit and wire as required to maintain services during construction.

1.8 DEMOLITION

- .1 Unless otherwise specified, materials for removal become the Contractor's property and shall be taken from site, and disposed of in accordance with all applicable codes, standards and regulations.
- .2 Existing lighting ballasts may contain P.C.B.'s. Contact the local Ministry of Environment (M.O.E.) office for confirmation of ballasts containing P.C.B. material. Submit written confirmation from M.O.E. verifying the presence or non-presence of P.C.B.'s. If P.C.B.'s are found to be present, provide removal of ballasts from light fixtures and place in approved 45 gallon drums for storage on site. Handle P.C.B. contaminated equipment in accordance with codes, standards and guidelines.
- .3 Disconnect and make safe all systems to be demolished by other Divisions. Refer to other Divisions for extent.
- .4 Maintain existing remaining circuits, systems, etc., which pass through construction/demolition areas. Provide additional wire and conduit as required to maintain systems. Additional wire and conduit to be concealed when construction is complete.
- .5 Reinstate immediately, any existing remaining systems, inadvertently interrupted during construction or demolition.

- .6 Remove all redundant wiring and conduit in ceiling spaces, (power, communications, systems, etc.).

1.9 PROTECTION

- .1 Protect access areas through existing building (lobby, elevator, corridor stairwell, etc.) from damage. Clean area daily or more frequently if directed by Departmental Representative.
- .2 Protect exterior areas (roof, walls, etc.) against damage during handling of new and removed materials.
- .3 Repair and make good all damaged equipment, etc. to satisfaction of the Departmental Representative.
- .4 Protect stored materials, work in process and finished work against damage until take-over.
- .5 Protect adjacent areas against spread of dust and dirt beyond work areas.
- .6 Protect operatives and other users of site from all hazards.

1.10 ANCHORING METHODS

- .1 Electrical equipment, fixtures, cable tray, conduit and cabling is to be securely anchored or fastened to the building structure using drilled hole wedge anchors for concrete structures or steel clamps for steel structures.
- .2 Air, fuel or powder actuated devices or any other equivalent type of fastening devices are not to be used.
- .3 Where anchoring method forms part of seismic restraint requirements, anchoring methods to comply with Section 26 05 05 - Seismic Restraint Systems (SRS).

1.11 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Particular attention shall be given to minimizing dust, noise and other forms of contamination from occupied areas.
- .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.

1.12 CUTTING, PATCHING AND MAKING GOOD

- .1 Provide cutting & patching of existing surfaces as required to accommodate new work.
- .2 Remove all items so shown or specified.
- .3 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture or as indicated otherwise.
- .4 Provide dust tight screens or partitions to localize dust generating activities and for protection of finished areas of work, workers and public.
- .5 Scan slabs before coring or drilling deeper than 1" (25 mm). Provide all required notification, clearance & protection for scanning process. Adjust coring & drilling locations as necessary to avoid rebar & conduits.

1.13 EXAMINATION

- .1 Examine site and conditions which will affect the work. Submission of tender shall be deemed as confirmation that tenderer has inspected site and is conversant with conditions, and shall not constitute additional costs as a result of site conditions.
- .2 Verify existing conditions including but not limited to, structural elements, sprinkler piping and heads, roof drains and storm sewer piping, electrical conduit and wiring, process utility piping, ductwork and other building services.
- .3 The fact that not all existing conditions discussed in Item .2 above are shown on the drawings does not relieve the responsibility of coordinating the work with the existing construction.

1.14 CO-ORDINATION

- .1 Co-ordinate the work with all other Divisions, especially Divisions 21, 22 & 23, to ensure systems compatibility, and to ensure schedules and requirements are maintained.
- .2 Where perceived interferences occur, prepare detailed sketches indicating proposed solution for review and acceptance by Departmental Representative.

1.15 OPERATION AND MAINTENANCE INSTRUCTION MANUALS

- .1 Submit electronic format (pdf) copy of draft Operation and Maintenance Manual to Departmental Representative for approval, compiled as follows:
 - .1 Enclose title sheet labelled "Operating and Maintenance Instructions", project name, date and list of contents. Project name must appear on binder face and spine.

- .2 Organize contents into applicable sections of work to parallel project specifications breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .2 Include following information plus data specified.
 - .1 Installation and maintenance instructions for equipment and materials.
 - .2 Description: Operation of the equipment and systems defining start-up, shut-down and emergency procedures, and any fixed or adjustable set points that affects the equipment operation. Include nameplate information such as make, size, capacity and serial number.
 - .3 Maintenance: Use clear drawings, diagrams or manufacturers' literature which specifically apply and detail the following:
 - .1 Lubrication products and schedules.
 - .2 Trouble-shooting procedures.
 - .3 Adjustment techniques.
 - .4 Operational checks. Suppliers names, addresses and telephone numbers and components supplied by them must be included in this section. Components must be identified by a description and manufacturer's part number.
- .3 Spare Parts: List all recommended spares to be maintained on site to ensure optimum efficiency. List all special tools appropriate unique application. All parts/tools detailed must be identified as to manufacturer, manufacturer part number and supplier (including address).
- .4 Include shop drawings, operation and maintenance instructions (bound as one) in accordance with the above for all equipment specified.
- .5 Include one complete set of final shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.
- .6 Within four (4) weeks of acceptance of draft manuals, submit four (4) copies.
- .7 Include appropriate wiring diagrams, schematics, elevations, mounting requirements, options included, etc. as it pertains to each system and/or device.
- .8 Information in manuals is to be specific to this project. Generic information is unacceptable.

1.16 AS-BUILT DRAWINGS

- .1 Site records:
 - .1 Electrical sub-contractor shall mark all changes as work progresses and as changes occur.
 - .2 On a weekly basis, transfer information to record set of documents, revising to show all work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection at all times.

- .2 As-built drawings:
 - .1 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 ELECTRICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
 - .2 Submit hard copy to Departmental Representative for approval and make corrections as directed.
 - .3 Following approval, submit completed hard copy as-built drawings with Operating and Maintenance Manuals.

1.17 GUARANTEES AND WARRANTIES

- .1 Before completion of work, collect all manufacturer's guarantees and warranties and submit to the Departmental Representative.
- .2 Identify, bind and index material in maintenance manuals.
- .3 Division 26's Contractor to submit a written, signed guarantee stating that all systems and components have been installed to manufacturers recommendations and that systems are operating satisfactorily and meet the design requirements, and all material and labour deficiencies will be corrected, at no cost, for a period of one year after substantial completion.

1.18 FINAL INSPECTION

- .1 Do not request final inspection until:
 - .1 Deficiencies are less than 25 items.
 - .2 All systems have been tested and are ready for operation.
 - .3 All balancing of loads has been completed.
 - .4 The Departmental Representative's operating personnel have been instructed in the operation of all systems and equipment.
 - .5 The complete operation and maintenance data books have been delivered to the Departmental Representative.
 - .6 All inspection certificates have been furnished.
 - .7 All record drawings have been completed and approved.
 - .8 All spare parts and replacement parts have been provided and receipt of same acknowledged.
 - .9 The cleaning up is finished in all respects.
 - .10 Fire alarm verification certificates submitted.
- .2 Final inspection shall be subjected to the approval of the Departmental Representative.

1.19 CLEAN UP

- .1 Clean up work area as work progresses.

- .2 At the end of each work period, and more often if ordered by the Departmental Representative, remove debris from site.
- .3 Clean areas under contract to a condition at least equal to that previously existing and to approval of Departmental Representative.
- .4 Provide cleaning of light fixture reflectors, lamps and lenses, vacuum panelboards, cabinets switchgear, etc., upon completion of contract, to Departmental Representative's satisfaction.

1.20 CONTRACT DOCUMENTS

- .1 Drawings and specifications are complementary, items shown or mentioned in one and not in the other are deemed to be included in the contract work.
- .2 The contract documents are intended to describe complete fully functional systems although not all components are indicated. Division 26 shall provide all required conduits, wiring, equipment, etc. to provide fully functional systems which meet the design intent.
- .3 Discrepancies in the design documents, or doubt as to the full intent of the design shall be brought to the Departmental Representative's attention prior to tender close. Failure to do this means that the Contractor is fully aware and shall be responsible of design intent and requirements and shall provide fully functional and coordinated systems.

1.21 PROJECT SCHEDULE

- .1 On award of contract and upon Departmental Representative's request, submit bar chart construction schedule for work, indicating anticipated progress stages within time of completion.
- .2 All building operations must be maintained during all phases of construction.
- .3 All plant shutdowns causing interruption of services to the building occupants will be scheduled for unoccupied hours (nights or weekends) as approved by the Departmental Representative. Provide minimum of 72 hours notice.
- .4 When schedule has been reviewed by the Departmental Representative, take necessary measures to complete work within scheduled time. Any change of schedule must be authorized by Departmental Representative.

1.22 COST BREAKDOWN

- .1 Within one (1) week of award of contract, submit breakdown of costs as separate amounts of labour, materials, etc. of each system. Break down electrical systems generally as follows:
 - .1 Start-up.
 - .2 Permits and inspections.
 - .3 Site work.

- .4 Distribution.
 - .5 Coordination study.
 - .6 Branch circuit roughing.
 - .7 Wiring devices.
 - .8 Lighting:
 - .1 Exterior.
 - .2 Interior.
 - .3 Exit Lights.
 - .9 Fire alarm.
 - .10 C.A.T.V.
 - .11 Telephone.
 - .12 PA/intercom.
 - .13 Security.
 - .14 Generator & associated equipment.
 - .15 Clocks.
 - .16 Motor control.
 - .17 Data system.
 - .18 Testing, commissioning and job cleanup. (Generally 1.5 to 3% of total cost). Indicate material & labour costs separately for each item.
- .2 After acceptance by Departmental Representative, cost breakdown will be used as the basis of progress payments.

1.23 PERMITS, FEES AND INSPECTIONS

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Notify Departmental Representative of changes required by Electrical Inspection Department prior to making changes.
- .4 Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to and include in manuals. Final payment will not be made until certificates have been submitted.

1.24 MATERIALS AND EQUIPMENT

- .1 Equipment and material to be new CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.
- .2 Factory assemble control panels and component assemblies.

1.25 TRADE QUALIFICATIONS

- .1 The work shall be carried out by licensed electricians with minimum five years experience who hold Ontario Certificates of Qualifications, and current contractors license.
- .2 Installation methods and materials to be of strictest quality, and conform to Canadian General Standards Board, Canadian Standards Association, National Building Code and all Local and Provincial Codes and Standards. Discrepancy in Codes to mean strictest rule applies.
- .3 The ratio of Journeymen to Apprentices shall not exceed the ratio in the Trade Qualifications and Apprenticeship Act of Ontario.

1.26 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 to EEMAC Y1-1.
 - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.27 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates:
 - .1 Lamicoid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.

NAMEPLATE SIZES			
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:
 - .1 Electronically printed, self-adhesive plastic labels with 6 mm high letters unless specified otherwise.
 - .3 Wording on nameplates to be as indicated c/w volts, phase, amps, HP, etc.
 - .4 Allow for average of twenty-five (25) letters per nameplate.
 - .5 Identification to be English and French.
 - .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
 - .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage, Size 7.
 - .8 Terminal cabinets and pull boxes: indicate system and voltage, Size 7.

- .9 Transformers: indicate capacity, primary and secondary voltages, Size 7.
- .10 Panelboards nameplate, Size 7.
- .11 Provide typed circuit directory for each panelboard.
- .12 Identify all receptacle outlets by panel, circuit number and voltage, with Brother P-Touch labeller.
- .13 Provide identification on service poles and prewired partitions at 300 mm A.F.F.
- .14 Provide system, circuit, voltage, phase, etc., on all ceiling space junction box covers, red for fire alarm & emergency circuits, black for others.
- .15 All circuit protective devices to be c/w a lamacoid label mounted inside door of device listing all fuse type and ratings, circuit breaker settings and minimum interrupting ratings.
- .16 All switchboards and panelboards to have a permanent lamacoid label mounted on inside of door with minimum circuit breaker interrupting rating.

1.28 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

1.29 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	blue	
up to 600 V	yellow	
Voice/data	green	
Security	green	blue
Fire Alarm	red	
Emergency power (250V)	red	blue
Emergency power (600V)	red	yellow

1.30 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.31 MANUFACTURERS AND CSA LABELS

- .1 Visible and legible after equipment is installed.

1.32 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Inspection Department.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

1.33 LOCATION OF OUTLETS

- .1 Locate outlets as indicated.
- .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. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

1.34 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: 1100 mm.
 - .2 Wall receptacles:
 - .1 General: 400 mm.
 - .2 Above top of continuous baseboard heater: minimum 200 mm.
 - .3 Above top of counters or counter back splashes: 175 mm.
 - .4 In mechanical rooms: 1200 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Telephone and interphone outlets: 400 mm.

- .5 'F' indicates floor mounting.
- .6 'C' indicates ceiling mounted.
- .7 Wall mounted telephone and interphone outlets: 1100 mm.
- .8 Fire alarm pull stations: 1100 mm.
- .9 Fire alarm bells: 2100 mm.
- .10 Television outlets: 400 mm.
- .11 Wall mounted speakers: 2100 mm.
- .12 Clocks: 2100 mm.
- .13 Door bell pushbuttons: 1100 mm.
- .14 Thermostats: 1200 mm.

1.35 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads operating. Do tests after space is fully occupied and operational. 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, after space is fully occupied and operational.
- .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.36 CONDUIT AND CABLE INSTALLATION

- .1 Provide all required accessories, inserts, hangers, toggle bolts, support channels, anchors etc. as required to complete systems.

1.37 FIELD QUALITY CONTROL

- .1 Conduct and pay for following tests:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system, P.A.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .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 Submit test results for Departmental Representative's review.
- .6 Hot spot testing:
 - .1 After 24 hours of operation under full load, perform infrared tests on all cable terminations and connections and all transformer, panel and breaker connections, to ensure the integrity of the system.
 - .2 Tests to be carried out by using an infrared camera.
 - .3 Terminations and/or connections failing tests shall be replaced immediately as part of the contract.

1.38 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to values and settings, as per approved coordination study.

1.39 FIRE AND SMOKE STOPPING

- .1 Provide fire and smoke stopping where conduits, cables, trays, etc., penetrate floor slabs or fire rated walls with an approved ULC listed putty, equal to 3M caulk CP25 and putty 303.
- .2 Installation of fire stops by trained manufacturers representative.

1.40 SPRINKLER-PROOF EQUIPMENT

- .1 Provide sprinklerproof equipment in all sprinklered areas to the local authorities requirements.

1.41 ACCESS DOORS

- .1 Provide access doors as required by inspection authorities and Departmental Representative to ensure access to concealed electrical work.
- .2 Access doors shall be as specified in Division 09 with fire resistance rating equal to wall or ceiling in which door to be installed. Minimize access door requirements and obtain approval of locations prior to electrical systems installation. Prepare a sketch drawing indicating locations for review by Departmental Representative.
- .3 Submit access door shop drawings.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

Contract Price \$ _____

Project:

Date:

Item		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Job Set-up (Mobilization)							
Permits & Inspections							
Site Work							
Distribution	Material						
	Labour						
Branch Circ. Roughing	Material						
	Labour						
Wiring Devices	Material						
	Labour						
Lighting (Interior & Exterior)	Material						
	Labour						
Emergency & Exit Lighting	Material						
	Labour						
Fire Alarm	Material						
	Labour						
Data/Communications	Material						
	Labour						
Generator & Transfer Switches (if applicable)	Material						
	Labour						
	Start-up						

Contract Price \$ _____

Project:

Date:

Item		Total Contract Amount \$	% to Date	Total to Date \$	Previous Amount Invoiced \$	Amount this Claim \$	Balance Remaining \$
Systems (job specific)	Material						
	Labour						
	Start-up						
Motor Control (if applicable)	Material						
	Labour						
Testing & Job Clean-up (Demobilization)							
Commissioning							
As-builts and O&M Manuals							
TOTAL ORIGINAL CONTRACT AMOUNT							
Change Orders							
Architect's CO #	GWA CCO or SI #						
#	#						
#	#						
Total Change Order Amount							
TOTAL CONTRACT AMOUNT							

NOTE: Change Orders that do not reference the Architect's Change Order number and Goodkey, Weedmark's Contemplated Change Order (CCO) or Site Instruction (SI) number will not be reviewed.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

1.2 DEFINITIONS

- .1 SRS: acronym for Seismic Restraint System.

1.3 GENERAL DESCRIPTION

- .1 This section covers design, supply and installation of complete SRS for all systems, equipment specified for installation on this project by Division 26. This includes, but is not limited to, electrical light fixtures, transformers, MCC's, UPS, diesel generators, fire protection, conduit, communications, electrical equipment and systems, both vibration isolated and statically supported.
- .2 Cable restraint systems, rod stiffener clamps and seismic isolator capacities to be verified by an independent test laboratory. Connection materials and site specific designs to be by the Seismic Engineer. The Seismic Engineer may specify material and anchors provided by the contractor where this is appropriate. It is the contractors' responsibility to ensure that the Seismic Engineers' requirements and specification have been met.

1.4 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA S832-14, Seismic Risk Reduction of Operational and Functional Components (OFCs) of Buildings.
- .2 National Research Council Canada
 - .1 NRCC NBCC-2015, National Building Code of Canada 2015.

1.5 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Submit seismic restraint shop drawings, c/w seal of Professional Engineer registered in Province of Ontario, clearly identifying equipment/systems reviewed and the equipment/systems requiring restraint. Shop drawings must clearly show all forces transferred to structure.

- .3 Seismic Design Engineer shall provide a spreadsheet identifying all equipment and systems requiring or not requiring seismic restraints and include all circulations.
- .4 Submit additional copy of shop drawings and product data to project Structural Engineer for review of connection points to building structure.

1.6 MAINTENANCE DATA

- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 26 05 00 - Electrical General Requirements.

1.7 SEISMIC FORCE

- .1 The Importance Factor for this project is:
 - .1 $I = 1.0$ - All other buildings i.e.: Office & General Buildings.Note: As per NBCC.

PART 2 - PRODUCTS

2.1 SRS MANUFACTURER

- .1 SRS to be from one manufacturer regularly engaged in production of same, 5 years experience.
- .2 Acceptable materials: Korfund-Sampson, Mason Industries, Tecoustics, Vibra-Sonic Control, Vibron.

2.2 GENERAL

- .1 Design to be by Professional Engineer specializing in design of SRS and registered in Province of Ontario. Division 26 to include all costs associated with this work as it relates to Division 26 installations.
- .2 SRS to be fully integrated into, compatible with:
 - .1 Noise and vibration controls specified elsewhere in this project specification, telecommunications.
 - .2 Structural, mechanical, electrical design of project.
- .3 During seismic event, SRS to prevent systems and equipment from causing personal injury, interfering with other systems, and from moving from normal position.
- .4 Design and installation in accordance with NBCC & CSA S832.
- .5 SRS to provide gentle and steady cushioning action and avoid high impact loads

- .6 SRS to restrain seismic forces in all directions.
- .7 Fasteners and attachment points to resist same load as seismic restraints.
- .8 SRS of conduit systems to be compatible with:
 - .1 Expansion, anchoring and guiding requirements.
 - .2 Equipment vibration isolation and equipment SRS.
- .9 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .10 Attachments to RC structure:
 - .1 Use high strength mechanical expansion anchors.
 - .2 Drilled or power driven anchors not permitted.
- .11 Seismic control measures not to interfere with integrity of firestopping.

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

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

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

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

- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Slack cable restraint system.
 - .2 Brace back to structure via vibration isolators and snubbers.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install Seismic Restraint Systems in accordance with Seismic Engineer's and manufacturer's recommendations.
- .2 Install SRS at least 25 mm from all other equipment, systems, services.
- .3 Co-ordinate connections with all disciplines.

3.2 INSPECTION AND CERTIFICATION

- .1 SRS to be inspected and certified by Manufacturer upon completion of installation.
- .2 Seismic Design Engineer shall provide written report to Departmental Representative certifying that SRS has been installed in accordance with the SRS drawings. The report shall bear the seal and signature of the SRS Design Engineer.

3.3 COMMISSIONING DOCUMENTATION

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

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No. 18.4-15, Hardware for the Support of Conduit, Tubing and Cable.
 - .2 CSA C22.2 No. 65-18, Wire Connectors.
- .2 National Electrical Manufacturers Association (NEMA)

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 conductors 10 AWG or less.
- .3 Bushing stud connectors: to NEMA to consist of:
 - .1 Connector body and stud clamp for copper.
 - .2 Clamp for copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, flexible conduit, as required to: CSA C22.2 No. 18.4.

PART 3 - EXECUTION

3.1 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.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

1.2 SHOP DRAWINGS

- .1 Submit cabletrough and busway shop drawings. Indicate mounting details, capacities, connections, etc.

1.3 LOCATION OF CONDUIT

- .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.
- .2 Conduit to be concealed.

1.4 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.1HB-18, Canadian Electrical Code Handbook - An Explanation of Rules of the Canadian Electrical Code, Part 1.
 - .2 CSA C22.2 No. 65-18, Wire Connectors.
 - .3 CSA C22.2 No. 126.1-09 (R2014), Metal Cable Tray Systems.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

PART 2 - PRODUCTS

2.1 CONDUITS

- .1 Electrical metallic tubing EMT, with steel set screw couplings and connectors.
- .2 Rigid PVC conduit.
- .3 Flexible steel conduit and liquid-tight flexible metal conduit.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Six mm dia threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

2.4 FISH CORD

- .1 Polypropylene.

2.5 CABLETROUGH

- .1 Cabletroughs and fittings: to EEMAC F5-1.
- .2 Wire basket type, Class C1 to CSA C22.2 No. 126.1.
- .3 Galvanized steel tray 300 mm wide with depth of 100 mm.
- .4 Horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required. Fittings: manufactured accessories for cabletrough supplied. Radii on fittings: 600 mm minimum.
- .5 Barriers where different voltage systems are in the same cabletrough.
- .6 Provide supports at intervals recommended by manufacturer.

2.6 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG (including ground wires).
- .2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90. RWU-90 for buried services.

2.7 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90 XLPE insulation, 600 V rated.
- .3 Armour: interlocking type fabricated from aluminum.

2.8 NON-METALLIC SHEATHED CABLE

- .1 Non-metallic sheathed copper cable type: NMD-7 or NMW-10, size as indicated.

2.9 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.2.1HB.
- .2 100 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.10 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.11 CONDUIT BOXES

- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of all devices.

2.12 BOX FITTINGS- GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.13 WIRE AND BOX CONNECTORS

- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required. Equal to T&B-PT Series.
- .2 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
- .3 Clamps or connectors for armoured cable as required.

2.14 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended. Equal to Unistrut, Burndy or Cantruss.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Conduit Systems:
 - .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.
 - .3 Use rigid galvanized steel threaded conduit in hazardous classified areas and where indicated.
 - .4 Use electrical metallic tubing EMT except in where indicated or specified elsewhere.
 - .5 Use rigid PVC conduit underground.
 - .6 Use liquid tight flexible metal conduit for connection to motors which may vibrate or must be moved for servicing.
 - .7 Use liquid tight flexible metal conduit for connection to equipment in damp, wet or corrosive locations.
 - .8 Minimum conduit size 21 mm.
 - .9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
 - .10 Mechanically bend steel conduit over 21 mm dia.

- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
 - .12 Install fish cord in empty conduits.
 - .13 Run 2-27 mm spare conduits up to ceiling space and 2-27 mm spare conduits down to ceiling space from each flush panel. 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.
 - .14 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
 - .15 Dry conduits out before installing wire.
 - .16 Run parallel or perpendicular to building lines.
 - .17 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
 - .18 Run conduits in flanged portion of structural steel.
 - .19 Group conduits wherever possible on channels.
 - .20 Do not pass conduits through structural members except as indicated.
 - .21 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.
 - .22 Do not install horizontal conduits runs in masonry walls.
 - .23 Do not install conduits in terrazzo or concrete toppings.
 - .24 Locate conduits in concrete to suit reinforcing steel. Install in centre one third of slab.
 - .25 Protect conduits from damage where they stub out of concrete.
 - .26 Install sleeves where conduits pass through slab or wall.
 - .27 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
 - .28 Encase conduits completely in concrete with minimum 25 mm concrete cover.
 - .29 Organize conduits in slab to minimize cross-overs.
 - .30 Slope conduits to provide drainage.
 - .31 Install rigid galvanized steel conduit at roof areas, if exposed.
 - .32 Ream raceways to remove burrs.
 - .33 Provide nylon pull cord in all empty raceways.
- .2 Wiring:
- .1 Install RW-90 conductors in raceways except as otherwise indicated.
 - .2 Installation of type AC-90 will be permitted from:
 - .1 Conduit system junction boxes to recessed lighting fixtures in suspended ceilings, maximum length 2.5 m each run.
 - .2 Conduit system junction boxes to hollow gypsum partitions, maximum length 2.5 m each run.
 - .3 AC-90 is permitted in hollow gypsum partitions.
 - .4 AC-90 is not permitted in insulated masonry walls or concrete walls.
 - .3 Leave minimum 200 mm length of conductor at junction and outlet boxes.
 - .4 Splices shall not be pulled into conduits.
 - .5 Install type RWU-90 conductors in all underground conduit systems.
 - .6 Group AC-90 cables where possible. Do not bundle.
 - .7 Provide approved wire pulling lubricants for cable installations in conduits.
- .3 Outlet boxes:
- .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. Reducing washers are not allowed.
- .5 Provide circuit number identification on all junction boxes with black marker.

- .4 Wire and Box Connections:
 - .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.
 - .2 Install fixture type connectors and tighten. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

- .5 Fastenings and Supports:
 - .1 Secure equipment to hollow masonry, tile and plaster surfaces with lead anchors or nylon shields.
 - .2 Secure equipment to poured concrete with expandable inserts.
 - .3 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. Provide additional supports to T-bar ceiling as required.
 - .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
 - .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
 - .6 Suspended support systems:
 - .1 Support individual cable or conduit runs with 6 mm dia. threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia. threaded rod hangers where direct fastening to building construction is impractical.
 - .7 For surface mounting of two or more conduits use channels at 1.5 m oc spacing.
 - .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
 - .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
 - .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
 - .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
 - .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

- .6 Cabletrough:
 - .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.
 - .4 Confirm support requirements with manufacturer.
 - .5 Use angle iron supports under tray over 18" (450 mm) in width.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Grounding conductors: bare stranded copper, tinned, soft annealed.
- .2 Insulated grounding conductors: green, type RW90.
- .3 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Compression wire connectors.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding and bonding system including, conductors, connectors, accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect all exposed grounding conductors from mechanical injury.
- .4 Use compression connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.

- .6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .8 Provide continuous ground conductor for raceways, outlets, and junction boxes for all systems.
- .9 Ground all transformer secondary neutrals and enclosures back to primary feeder distribution panel.
- .10 Provide a ground conductor in all EMT conduits.
- .11 Provide ground conductor for all non conductive raceways.
- .12 Ground all systems raceways, provide ground bushings.
- .13 Provide #6 AWG green insulated ground in all cabletroughs bonded at 3 m intervals.
- .14 Provide new 'ground bars' where indicated, each a length of copper busbar, 450 mm W, 100 mm H, 6 mm D, mounted on insulating offset adaptors (phenolic plastic). Each ground window to be interconnected as indicated and grounded to the building service ground. Provide compression type cable connectors, 2 hole type at each end. Provide #2/0 conductor interconnecting ground windows to building ground.
- .15 Provide #6 AWG insulated copper bonding conductors from 'ground bars' up to individual pieces of equipment located on raised floor. Confirm connections on site with the Departmental Representative. Provide all required connectors, cable clips, 2 hole connectors, cadmium plated bolt-washer-nut assembly and all necessary drilling for installation of connectors.

3.2 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, communications systems and conduits, raised floors, etc.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements.

- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 - Electrical General Requirements.

1.3 EQUIPMENT

- .1 Receptacle and switch devices shall be of a single manufacturer.
- .2 Acceptable manufacturers: Hubbell, Arrow Hart, Pass and Seymour, Leviton, Bryant.

1.4 REFERENCES

- .1 Canadian Standards Association (CSA).

PART 2 - PRODUCTS

2.1 SWITCHES

- .1 15 or 20 A, 120 V, or 347 V single pole, double pole, three-way, four-way switches as required.
- .2 Manually-operated general purpose ac switches with following features:
 - .1 Silver alloy contacts.
 - .2 Urea or melamine molding for parts subject to carbon tracking.
 - .3 Suitable for back and side wiring.
 - .4 White toggle.
 - .5 Specification Grade.
- .3 Switches equal to the following:
 - .1 120 V, 15 A - Hubbell #1201.
 - .2 120 V, 15 A , Keyed - Hubbell #1201-L.
 - .3 120 V, 15 A, 3-way - Hubbell #1203.
 - .4 120 V, 15 A, 4-way - Hubbell #1204.
 - .5 347 V, 15 A - Hubbell #18201.
 - .6 347 V, 20 A - Hubbell #18221.

- .7 347 V, 20 A, 3-way - Hubbell #18223.
- .8 Wall mounted occupancy switches, white, 1500 W rated equal to Hubbell #WSS-120 c/w relay pack.
- .9 Ceiling mounted occupancy switches:
 - .1 Hallway (narrow).
 - .2 Area (wide).

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type, voltage, ampacity, phase as indicated, with following features:
 - .1 White urea molded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
 - .6 Ground fault interrupter 5 mA, Class 'A' type where indicated.
 - .7 Surge suppressor type where indicated.
 - .8 Child safety receptacles where indicated.
 - .9 Provide receptacles equal to the following:
 - .1 15 A, 120 V, - Hubbell #5262.
 - .2 20 A, 120 V, - Hubbell #6331.
 - .3 20 A, 250 V, - Hubbell #6391.
 - .4 30 A, 125/250 V (Dryer) - Hubbell #9430-P.
 - .5 50 A, 125/250 V (Range) - Hubbell #9450-P.
 - .6 Isolated ground - Hubbell #IG-5262.
 - .7 Ground fault - Hubbell #GF5252-W.
 - .8 Safety receptacles - Hubbell #SG-62-HI.
 - .9 Surge suppressor - Hubbell #5252-S.
 - .10 Specification grade.
 - .11 Receptacles connected to emergency power to be colour orange.

2.3 CLOCK OUTLETS

- .1 Special wiring devices:
 - .1 Clock hanger outlets, 15 A, 125 V, 3 wire, grounding type, suitable for No. 10 AWG for installation in flush outlet box.

2.4 COVER PLATES

- .1 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .2 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

- .3 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

2.5 INDOOR SERVICE POLES

- .1 Indoor service pole assembly to meet telephone company requirements.
- .2 Indoor service poles: extruded aluminum sections to CSA HA Series - M1980 anodized finish of 10 micrometres thickness.
- .3 Nominal length of poles: to suit ceiling height, with plus or minus 50 mm adjustment. Total adjustment: 100 mm.
- .4 Service poles approximately 50 mm square with snap-on covers to provide access to wiring without removing unit. Barrier to isolate power from communication systems.

2.6 TELEPHONE, DATA & CABLE TV OUTLET

- .1 Provide 100 x 100 mm outlet box c/w plaster ring and 21 mm EMT to accessible ceiling space at indicated locations.
- .2 Coverplates to be provided by respective companies or as specified in other sections.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height specified in Section 26 05 00 - Electrical General Requirements or as indicated.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height specified in Section 26 05 00 - Electrical General Requirements or as indicated.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3 Coverplates:
 - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

- .2 Install suitable common cover plates where wiring devices are grouped.
- .3 Do not use coverplates meant for flush outlet boxes on surface-mounted boxes.

- .4 Provide weatherproof devices as indicated.

- .5 Install service poles to manufacturers recommendations and secure to ceiling and floor.
Make electrical connections and test.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 26 05 00 - Electrical General Requirements.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA).
 - .1 CSA C22.2 No. 141-15, Emergency Lighting Equipment.
 - .2 CSA C860-11 (2016), Performance of Internally Lighted Exit Signs, Includes Update No. 1 (2011).
- .2 International Organization for Standardization (ISO)
 - .1 ISO 3864-1:2011, Graphical symbols - Safety Colours and Safety Signs - Part 1: Design Principles for Safety Signs and Safety Markings.
 - .2 ISO 7010:2011, Graphical Symbols - Safety Colours and Safety Signs - Registered Safety Signs.
- .3 Underwriters' Laboratories of Canada (ULC)
 - .1 UL 1310, Class 2 Power Units.

PART 2 - PRODUCTS

2.1 LED FIXTURES

- .1 Except as otherwise indicated, provide LED luminaires, of type and size indicated on fixture schedules.
- .2 Including the following features unless otherwise indicated:
 - .1 Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
 - .2 Each luminaire shall be rated for a minimum operational life of 50,000 hours utilizing a maximum ambient temperature of (25°C).
 - .3 Light Emitting Diodes tested under LM-80 standards for a minimum 12,000 hours.
 - .4 Colour Rendering Index (CRI) of 80 at a minimum.
 - .5 Colour temperature as per fixture schedule.

- .6 Rated lumen maintenance at 70% lumen output for 50,000 hours, unless otherwise indicated.
- .7 5 year luminaire warranty, minimum.

2.2 DRIVERS

- .1 Electronic driver for LED fixtures: Comply with UL 1310 Class 2 requirements for dry and damp locations. Include the following features unless otherwise indicated:
 - .1 Rated for 50,000 hours of life or greater, unless otherwise noted.
 - .2 Sound rating: Class A.
 - .3 Total Harmonic Distortion Rating: 20 percent or less.
 - .4 Current Crest Factor: 1.5 or less.
 - .5 0-10V dimming standard, unless otherwise indicated.

2.3 FINISHES

- .1 Light fixtures to be factory primed and painted after fixture construction.

2.4 LUMINAIRES

- .1 Provide light fixtures as per fixture schedule, c/w ballasts, lamps and mounting accessories.
- .2 Each 347V fluorescent luminaire shall have an integral disconnecting means as per the Canadian Electrical Code.

2.5 EXIT LIGHTS

- .1 Exit lights: to CSA C22.2 No. 141 and CSA C860.
- .2 Housing: extruded aluminum, brushed aluminum finish.
- .3 Face and back plates: extruded aluminum.
- .4 Lamps: LED with 25-year rated life.
- .5 Pictogram: aluminum frame, opal diffuser panel, pictogram panel with multiple films for direction selection, and clear protective panel. Pictogram panel shall consist of green pictogram and white graphic symbol meeting the visibility specifications referred to in ISO 3864-1, and conform to the dimensions indicated in ISO 7010.
- .6 Suitable for 347V or 120V normal supply.
- .7 Die cast mounting bracket for wall, ceiling, or end mounting as indicated.
- .8 Provide circuit labels at all exit signs.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide sufficient cable length and/or access panels, to provide access to wiring connections in hard ceiling areas, to the inspection authorities requirements.
- .3 Install light fixtures to manufacturers recommendations.
- .4 Connect fixtures to indicated circuits and connect exit lights to emergency battery units.
- .5 Verify and coordinate location of light fixtures on site with other trades to verify clearances at indicated locations prior to installation.

3.2 LUMINAIRE SUPPORTS

- .1 For recessed or surface mounted lighting in suspended ceiling installations, support luminaires independently from ceiling, by means of a minimum of two chain hangers bolted to diagonal corners of the fixture body and secured to building structure in accordance with ESA, Section 26 05 00 - Electrical General Requirements and Section 26 05 05 - Seismic Restraint Systems (SRS).

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 TESTING

- .1 Verify operation of lighting systems, and controls.

- END OF SECTION -

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCES

- .1 Treasury Board of Canada Secretariat (TBS), Occupational Safety and Health (OSH)
 - .1 Fire Protection Standard-10.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524-14, Standard for the Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S526-16, Visible Signal Devices for Fire Alarm Systems, Including Accessories.
 - .3 CAN/ULC-S528-14, Manual Stations for Fire Alarm Systems, Including Accessories.
 - .4 CAN/ULC-S529-16, Smoke Detectors for Fire Alarm Systems.
 - .5 CAN/ULC-S530-91(R1999), Heat Actuated Fire Detectors for Fire Alarm Systems.
 - .6 CAN/ULC-S536-13, Standard for Inspection and Testing of Fire Alarm Systems.
 - .7 CAN/ULC-S537-13, Standard for the Verification of Fire Alarm Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for fire alarm devices 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 shop drawings:
 - .1 Overall system riser wiring diagram identifying control equipment initiating devices & zones signalling devices & circuits; identifying terminations, terminal numbers, conductors and raceways.
 - .2 Details for devices.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Operation and Maintenance Data: submit operation and maintenance data for fire alarm system changes for incorporation into manual.
- .3 Include:
 - .1 Technical data - illustrated parts lists with parts catalogue numbers.
 - .2 Copy of approved shop drawings with corrections completed and marks removed except review stamps.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

PART 2 - PRODUCTS

2.1 EXISTING FIRE ALARM SYSTEM DESCRIPTION

- .1 Existing fire alarm system is a fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital, and multiplexing techniques for data transmission. Simplex 4200.
- .2 Audible signal devices: to CAN/ULC-S524.
- .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 Regulatory Requirements:
 - .1 To TBS Fire Protection Standard.
 - .2 Subject to Fire Commissioner of Canada (FC) approval.
 - .3 Subject to FC inspection for final acceptance.
 - .4 System components: listed by ULC and comply with applicable provisions of NBCC, and meet requirements of local authority having jurisdiction.

2.2 INITIATING/INPUT CIRCUITS

- .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration to central control unit.
- .2 Alarm receiving circuits: compatible with smoke detectors and open contact devices.
- .3 Actuation of alarm initiating device: cause system to operate in accordance with existing system operation.
- .4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLA configuration to central control unit.
- .5 Actuation of supervisory initiating device: cause system to operate as specified in in accordance with existing system operation.

2.3 ALARM OUTPUT CIRCUITS

- .1 Alarm output circuit: connected to signals, wired in class A configuration to central control unit.
 - .1 Signal circuits' operation to follow system programming; capable of sounding bells continuously. Each signal circuit: rated at 2 A, 24 VDC; fuse-protected from overloading/overcurrent.

2.4 AUXILIARY CIRCUITS

- .1 Auxiliary contacts for control functions.
- .2 Alarm and or trouble on system to cause operation of programmed auxiliary output circuits.
- .3 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.
- .4 Auxiliary circuits: rated at 2 A, 24 Vdc or 120 Vac, fuse-protected.

2.5 WIRING

- .1 Twisted copper conductors: rated 300 V.
- .2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.
- .3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.
- .4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

2.6 MANUAL ALARM STATIONS

- .1 Addressable manual pull station.
 - .1 Pull lever, surface wall mounted type, single stage, electronics to communicate station's status to addressable module/transponder over 2 wires and to supply power to station. Station address to be set on station in field.
 - .2 Note: Pull stations associated with magnetic lock release to have integral aux. contacts to de-energize & release magnetic lock immediately upon activation.

2.7 AUTOMATIC ALARM INITIATING DEVICES

- .1 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, fixed temperature 88 degrees C.
 - .1 Electronics to communicate detector's status to addressable module/transponder.
 - .2 Detector address to be set on detector base in field.
- .2 Addressable variable-sensitivity smoke detectors.
 - .1 Photo-electric type.
 - .2 Electronics to communicate detector's status to addressable module/transponder.
 - .3 Detector address to be set on detector base in field.
 - .4 Sensitivity settings: 3 settings, determined and operated by control panel. No shifting in detector sensitivity due to atmospheric conditions (dust, dirt) within certain parameters.
 - .5 Ability to annunciate minimum of 2 levels of detector contamination automatically with trouble condition at control panel.

2.8 AUDIBLE SIGNAL DEVICES

- .1 Bells: 250 mm vibrating, 24 V dc.

2.9 VISUAL ALARM SIGNAL DEVICES

- .1 Strobe type: 75 cd white Zenon flashing, 24 V dc.
- .2 Designed for surface mounting on ceiling or walls as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Install manual alarm stations and connect to alarm circuit wiring.

- .3 Locate and install detectors and connect to alarm circuit wiring. Mount detectors more than 1 m from air outlets. Maintain at least 600 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 Install bells and visual signal devices and connect to signalling circuits.
- .6 Connect signalling circuits to main control panel.
- .7 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .8 Splices are not permitted.
- .9 Provide necessary raceways, cable and wiring to make interconnections to central control unit, as required by equipment manufacturer.
- .10 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .11 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical, CAN/ULC-S536 & CAN/ULC-S537.
- .2 Fire alarm system:
 - .1 Test each device added or modified plus device before and after in the circuit, and the alarm circuit to ensure manual stations, thermal and smoke detectors sprinkler system transmit alarm to control panel and actuate first stage alarm general alarm ancillary devices.
 - .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 systems.
 - .4 Addressable circuits system style DCLA:
 - .1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
 - .2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

- .3 Provide final PROM program re-burn for system Departmental Representative incorporating program changes made during construction.

3.3 CLEANING

- .1 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by fire alarm system installation.
- .3 Replace existing smoke detectors within construction zone with heat detectors for duration of construction.

- END OF SECTION -