

City of Toronto - Union Station
3rd Floor Security Office Reno

Project No. TR1024-0297

20 September 2024

Issued for Tender

PROJECT MANUAL

NORR

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**Union Station State of Good Repair
3rd Floor Security Office Renovation**

Issued for Tender

The professional seals and signatures below apply to documents, specifications and schedules prepared by the respective architectural and engineering professionals.

Architect



Mechanical Engineer



Electrical Engineer



Number	Title	Date	Pages
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Project Manual for

**Union Station State of Good Repair
 3rd Floor Security Office Renovation**

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1 CONTRACT DOCUMENTS, LANGUAGE AND STYLE

- 1.1 Where Contract Documents do not provide sufficient information for complete installation of item, then as supplement, comply with manufacturer's written instructions for quality of work.
- 1.2 In cases where an item or part of materials or equipment is referred to in the singular number, it is intended that such reference shall apply to as many items or parts as are required to complete the Work. Provide as many as required to complete Work.
- 1.3 Words used in one gender only shall mean females and as well as males and conversely.
- 1.4 Read the word "provide" to mean "supply and install, including accessories, finishes, tests and services as required to render item ready for use to result in a complete installation".
- 1.5 Wherever words "acceptable", "approved", "reviewed", "satisfactory", "selected", "directed", "designated", "permitted", "inspected", "instructed", "clarification", "required", "report", "submit", "obtain", "consult", "advise", or similar words or phrases are used in Standards or in Contract Documents, it shall be understood that, unless context provides otherwise words "by/to/with/from the Consultant" shall follow them as applicable.

2 SPECIFICATIONS

- 2.1 Specifications are not intended as detailed description of installation methods but serve to indicate particular requirements in completed Work.
- 2.2 Portions of Specifications are written in short form. Therefore, it shall be understood that where item of Work is stated in heading followed by material, equipment, component, or operation, words "shall be", "shall consist of" or similar words or phrases are implied which denote supply, fabricate and supply, install, provide or commission of such materials, equipment or operations for component of Work designated by heading.
- 2.3 Whenever used in Specifications following definitions shall apply:
 - .1 Supply - Procurement or fabrication of standard components not to special design of materials, equipment, or components, or performance of services to extent indicated. Where used with respect to materials, equipment, or components, term shall include delivery to Site but is not intended to include installation of item, either temporary or final.
 - .2 Fabricate and Supply - Fabrication of materials, equipment, or component, to special customized design to extent indicated including delivery to Site, assisting in form of supervision to those Section(s) installing materials, equipment or component. Term does not include installation of item either temporary or final.
 - .3 Install - Placement of materials, equipment, or components, including receiving, unloading, transporting, storage, uncrating and installing, and performance of such testing and finish work as is compatible with degree of installation specified complete ready for use.
 - .4 Provide - to Supply and Install, complete and in place, including accessories, finishes, tests and services as required to render item so specified complete ready for use.

- .5 Commission - Startup and initial operation of equipment as required and/or as specified in respective Sections, to demonstrate satisfactory operation of components and entire system including calibration of any control instrumentation as required to maintain operations.
- 2.4 Drawings, Lists or Schedules of Items are intended to show scope and arrangement of work. For location of item described refer to such Drawings, Lists or Schedules unless location stipulated in Specifications.
- 3 DIVISION OF WORK**
- 3.1 Work specified in the specifications is divided into sections by the Consultant for ready reference only and not for the purpose of establishing limits of Subcontractor subcontracts.
- 3.2 Division of The Work amongst Subcontractors is the sole responsibility of the Contractor. The Consultant assumes no responsibility to act as an arbitrator to establish Subcontract limits.
- 4 WARRANTY**
- 4.1 Except for extended warranties as described in the Contract Documents, Contractor shall warrant the Work under this Contract to be free of defects in materials and workmanship for a period of two (2) years from the date of Ready-for-Takeover, as per Conditions of the Contract.
- 4.2 This warranty shall cover labour and material, including, without limitation, the costs of removal and replacement of covering materials.
- 5 EXAMINATION OF SITE AND DOCUMENTS**
- 5.1 Make a careful examination of the Place of the Work, and investigate, at no cost or risk to the Owner, matters relating to the nature of The Project to be undertaken, the means of access and egress thereto and there from, the obstacles to be met with and the rights and interests which may be interfered with during the performance of The Work.
- 5.2 Make a careful examination of the extent of the Work to be performed and any and all matters which are referred to in the Contract Documents, or which are necessary for the full and proper construction of The Project and the conditions under which it will be performed.
- 6 EXAMINATION OF SURFACES AND CONDITIONS**
- 6.1 The Contractor shall ensure each Subcontractor examines job conditions and the work to which his work is to be applied, anchored or connected.
- 6.2 Report unsatisfactory conditions likely to prevent the proper installation of work.
- 6.3 Correct unsatisfactory conditions before commencing the particular work.
- 6.4 Commencement of the work implies acceptance of conditions.

7 **EXISTING UTILITIES**

- 7.1 When breaking into or connecting to existing services or utilities, execute work at times directed by local governing authorities, with a minimum of disturbance to Work, and to building occupants and to pedestrian. Co-ordinate work with the City.
- 7.2 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in a manner approved by authority having jurisdiction and stake or otherwise record location of capped service.
- 7.3 Do not shut down any services without obtaining written approval from the building Owner.

8 **COOPERATION**

- 8.1 Ensure that all Subcontractors cooperate with each other in order that work will be carried out expeditiously, and will be satisfactory in all respects at completion of the Project.
- 8.2 Ensure that all Subcontractors examine Drawings and Specifications covering the Work which may affect the performance of their own work.
- 8.3 Examine the work of all Subcontractors and correct defects and deficiencies which may adversely affect the Work.
- 8.4 Ensure that the Work is in compliance with the Contract Documents and accept responsibility for delays or costs resulting from failure to inspect, and any replacement required.
- 8.5 Be responsible for damage of any kind to The Work. Replace any materials or work so damaged that cannot be repaired or restored to the Consultant's satisfaction. Such repairs or replacements shall be made by the trade that performed the original work.
- 8.6 Ensure that all Subcontractors cooperate with other Subcontractors whose work attaches to or is affected by their own work, and ensure that minor adjustments are made to make adjustable work fit to fixed work.
- 8.7 Ensure that Subcontractors requiring openings to be left for the installation of their work furnish the necessary information to the Subcontractors concerned in ample time.
- 8.8 Items to be built-in shall be supplied as and when required by the Subcontractor building in the items together with forms, templates, anchors, sleeves, inserts, measurements, shop drawings and accessories required to be fixed to or inserted in the Work and set in place or instruct the related Subcontractors as to their location.
- 8.9 Pay the cost of extra work caused by, and make up time lost as the result of, failure to provide the necessary cooperation, information or items to be fixed to or built into the Work in adequate time.

9 **PROTECTION**

9.1 Adequately protect the Work, existing buildings and equipment, service poles, wires, utilities above and below ground from damage at all stages of the operations, and maintain the protection until the Work is completed. Remove and replace at no expense to the Owner, any work and materials damaged that cannot be repaired or restored to the Consultant's satisfaction.

10 **CONSTRUCTION WASTE MANAGEMENT**

10.1 During construction, maintain the Work and access to the Work in tidy condition.

.1 Comply with all applicable Environmental Protection Act of Ontario regulations relating to construction waste management including Ontario Regulation 102/94 and Ontario Regulation 103/94. Follow a strategy based on the 3R's hierarchy: Reduce, Reuse, Recycle.

10.2 At frequent and regular intervals during progress of the Work clean up Project Site, building and access to building, and dispose of waste materials, rubbish, and debris. Do not permit waste, rubbish and debris to accumulate and become unsightly or hazardous.

10.3 Conduct clean-up and disposal operations to comply with local ordinances, anti-pollution laws and sorting or recycling requirements of City of Toronto and other authorities having jurisdiction.

11 **DIMENSIONS**

11.1 Wall thicknesses shown on the drawings are nominal only. In all cases, determine the actual sizes at the building.

11.2 Dimensions of shop fabricated portions of the building shall be verified on the site before shop drawings and fabrication are commenced.

11.3 Where dimensions are not available before fabrication is commenced, the dimensions required shall be agreed upon between the various trades concerned.

11.4 Owner will not accept claims for extra expense on the part of the Contractor by reason of non-compliance with this article.

11.5 Location of plumbing, heating and electrical fixtures and outlets, ducts, conduits and pipes shown or specified but not dimensioned shall be considered approximate. Consult with the Consultant to determine the actual location of items not dimensioned as may be required to suit the job conditions. Relocation caused by failure to determine the actual locations shall be executed without charge to the Owner.

12 **SETTING OUT**

12.1 Verify on the property, grades, lines, levels and dimensions shown, and report discrepancies in levels or dimensions to the Consultant before commencing work.

12.2 Work done prior to the receipt of the Consultant's decision, shall be at the risk of the Contractor.

12.3 Layout on the forms or floors, the locations of walls as a guide to the various Subcontractors, and layout or check the layout of other Subcontractors.

13 **DOCUMENTS ON SITE**

13.1 Keep on the site at all times, one copy of the drawings and specifications, including a Consultant's reviewed and stamped set of all shop drawings.

14 **POWDER ACTUATED FASTENINGS**

14.1 Powder actuated fastenings shall not be used on any portion of the Work, unless written consent for a specific use is obtained from the Consultant.

14.2 Only low velocity tools will be permitted under any condition. Operators to be qualified and to be in possession of a valid operator's certificate. Tools and operation shall conform to CSA Z166.

15 **OVERLOADING**

15.1 Take precautions to prevent the overloading of any part of the structure, false work, form work or scaffolding during the progress of the Work, and make good, at no expense to the Owner, all damage resulting from such overloading.

15.2 No load bearing members shall be cut, drilled or sleeved without the written consent of the Consultant.

16 **HOLES THROUGH FLOORS AND WALLS**

16.1 Where holes are made in floors for the passage of pipes, ducts and conduit or wires, the holes shall be sealed with cement grout after the pipes, ducts and conduit or wires have been placed.

16.2 Where holes are made in walls for the passage of pipes, ducts, conduit or wires, holes shall be filled with a suitable material, cement grout in masonry or concrete walls or plaster in plaster or drywall walls, regardless of whether or not the pipes have escutcheon plates. Grout or plaster around outside of sleeves where holes are sleeved.

16.3 In mechanical rooms above grade and in other rooms where faucets occur, (for example, washrooms, kitchens) the pipes, ducts, conduits or wires or all, which pass through floors, shall be enclosed in a 100 mm high metal sleeve and then grouted around pipes and ducts.

16.4 Above requirements shall apply to both exposed and concealed walls and floors.

16.5 Holes in fire rated floors or walls shall be proper CAN/ULC approved: sleeves with fire stopping and seals, and proper fire dampers in ducts.

16.6 Where holes are to be made through the terracotta flat arched floors and terracotta speed tiles partitions, care should be made to preserve the integrity of the terracotta. Where such integrity is compromised, a whole panel of terracotta arches shall be replaced by a reinforced concrete slab. Such a slab shall be soundly supported on steel floor beams and steel girders as the case may be. For holes up to 2 inches coring through the terracotta can be performed using appropriate equipment and bits. Coring shall ensure no breakage of larger parts of the terracotta. The contractor shall conduct some prototype cores to establish effectiveness of procedure.

17 **NUMBER OF ITEMS**

17.1 In cases where an item or part of materials or equipment is referred to in the singular number, it is intended that such reference shall apply to as many items or parts as are required to complete the Work.

18 **CASH FLOW**

18.1 Submit detailed breakdown of cost of Work in form acceptable to Consultant, divided to coincide with organization of specifications into sections, per month and coincident with approved construction schedule.

18.2 Cost breakdowns when totalled, shall be same as Contract Price.

18.3 Purpose of the cost breakdown is to assist Consultant with evaluation of progress draws and to assist Owner with cash flow arrangements.

19 **SPECIAL CLEANING**

19.1 Remove oil, grease, loose paint, mill scale, dirt and any foreign substance of deleterious material from the surfaces to receive sprayed fireproofing in accordance with the Fireproofing manufacturer's requirements. Remove by sandblasting when scraping, brushing and washing are non-effective.

20 **METRIC MEASUREMENT**

20.1 Drawings and Specifications for the project are prepared in accordance with the International Metric Standards which came into effect in Canada on 1 January, 1978.

20.2 Variations from the hard metric "base" bid will be allowed to ensure that the metric standards do not:

- .1 Limit the number of manufacturers able to participate in the bidding.
- .2 Cause a cost penalty to the project.
- .3 Adversely affect the scheduling of the project.
- .4 Require that materials and/or equipment be manufactured for the first time in "hard" metric sizes (prototype).
- .5 Preclude the submission of non-metric (Imperial) materials and/or equipment as "alternatives".
- .6 Discourage competition.
- .7 Create problems of connection at the interfaces (e.g. metric threads).

21 **INTERFERENCE DRAWINGS**

21.1 Prepare dimensioned interference drawings indicating relationship of new installations and existing and/or unforeseen conditions prior to commencement of work.

- 21.2 Before commencing installation, prepare drawings showing relationship of ductwork, conduit, piping, sprinklers, ceiling supports and framing, communication and specialized equipment located within ceiling and shaft spaces.
- 21.3 Indicate locations of visible items such as air handling outlets, light fixtures, smoke detectors, sprinkler heads, communication grilles, and access panels occurring at these locations.
- 21.4 Drawings shall be initialled by responsible person of each Sub-Contractor involved along with Contractor's signature and submitted to Consultant for review and record purposes.
- 21.5 Contractor shall request background drawings and make payments to the Consultant for the cost of reproduction plus all applicable taxes based on the number of drawing electronic files as specified in Section 01 33 00 – Submittal Procedures.
- .1 Consultant will provide background drawings for the purpose of preparation of interference drawings.

End of Section

- 1 **CONSTRUCTION SEQUENCING AND MAINTENANCE OF OPERATIONS**
- 1.1 In order to keep the station operational for GO Transit, VIA, retail customers and tenants, construction activities must be restricted and separated, protected pedestrian routes maintained as follows:
 - .1 Maintain construction separation from other Tenant fit-up contractors operating within the Union Station.
 - .2 Do not block common areas with stored materials.
- 1.2 All hoarding shall be properly secured fast fence hoarding, continuous, full height, and shall fully delineate the construction area.
- 1.3 Access off of public areas must be secured at all times.
- 1.4 No exhausting/ventilation of any construction areas will be permitted into any indoor or public areas. All construction activities shall be conducted such that existing building fresh air intakes are not affected.
- 1.5 Working hours/noise restrictions:
 - .1 Movement of equipment/materials is not allowed during peak rush hours (6:00-9:00 am and 3:00-6:00 pm).
 - .2 Work requiring coring, drilling and other loud/noisy work to be completed after hours.
- 1.6 Access to site and deliveries:
 - .1 All materials to be delivered to the Loading Dock in coordination with the City. Movement of large items will only be permitted during Station closure (02:00-05:00) or upon the City's expressed written approval.
 - .2 Use of the City's loading dock will be permitted outside of peak rush hours (see above).
 - .3 From the loading dock take ELEV-19 up to the GO York Concourse to obtain the access to the new Security office through the York Street Promenade.
 - .4 Coordinate deliveries and waste removal. Provide Trades contact information for inclusion into the C3 system (Managed by Dock Master and MLSE) to be allowed clearance to the Loading Dock.
 - .5 Overnight access can only be obtained through the West vestibule Great Hall perimeter door G-C928H.
 - .6 If stairs must be used for deliveries, use ST-008 (East side of south centre block).
 - .7 Otherwise use ELEV-04 off peak hours 10:00 AM – 2:00 PM or during station closures 12:30 AM – 5:30 AM.
 - .8 Hazardous Materials can only be removed between 12:30 AM and 5:30 AM during station closure in an enclosed space with ELEV-19 through the loading dock. Removal shall follow all regulations, as defined by authority having jurisdiction, related to environmental protection.

2 SECURITY CLEARANCES

- 2.1 Contractor's personnel requiring access shall complete and sign the attached Union Station Request for ID / Access Card Form for site access.
- .1 Submit completed Form to unionstationaccess@toronto.ca for approval.
 - .1 For "Work Location" in the Form include R-W927 and R-W937A (B2 back of house to Food Court), and G-C928H for overnight perimeter access.
 - .2 Contractor's personnel will be issued an ID / Access cards through Badging Office upon final approval.
 - .3 Refer to the attached "Badging Procedures" document for additional information, requirements and Badging Office hours.

3 CONTRACTOR IS THE CONSTRUCTOR

- 3.1 The Contractor is the Constructor for this project as defined by this Contract Scope of Work and as defined by the Ministry of Labour and will be responsible for administration and control of construction safety on the project site.
- 3.2 The Contractor is to be aware and coordinate with adjacent projects and as such will enter into a construction separation plan agreement to manage boundaries between sites and that separation in time and space is established and maintained.

4 FIRE AND LIFE SAFETY

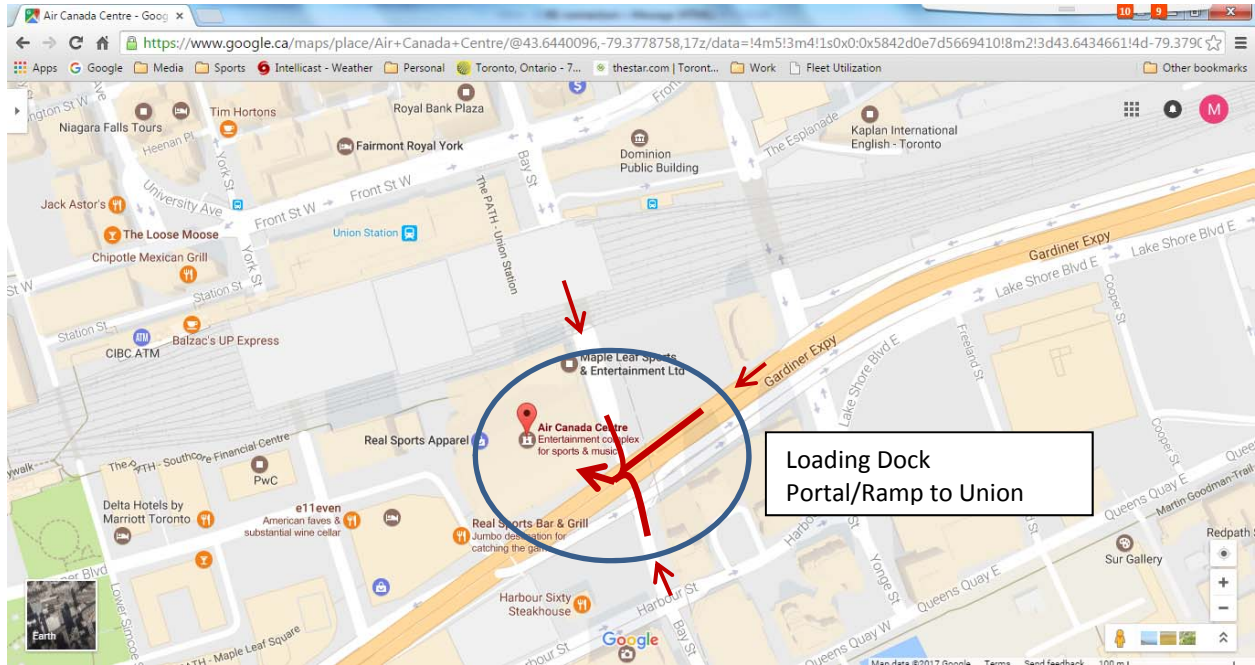
- 4.1 Any impairment requests for fire alarm devices or shutdown requests for sprinkler work, will require fire watch at both the site location and the CACF Room.
- .1 Fire watch at the site is the responsibility of the Contractor and will be paid from the Fire Watch cash allowance based on the invoiced from the Security Company providing the guard. No profit and overhead allowed for this expense.
- 4.2 Contractor shall make the request by filling the appropriate form and submitting the form in writing with five (5) working days' notice to unionstationaccess@toronto.ca .
- 4.3 For day-to-day work, submit Fire Watch Log Sheets to the City on a weekly basis.
- 4.4 The following templates are attached:
- .1 "Fire System Zone Control and Impairment",
 - .2 "Shutdown Request",
 - .3 Fire Watch Log Sheets.

End of Section

Union Station Loading Dock Instructions:

Updated: April 2017

Access/Approach:



Access to the shared service tunnel is located at the North West corner of Bay and Lakeshore. Take the Ramp down and proceed to the security guard booth. After access is approved then proceed to the right and follow the tunnel to the end where you will make a left to enter the Union Station loading dock.



Failure to complete all the sections of this form may result in your request being returned. Send enquiries to Security Access (ussoc@toronto.ca)

SECTION 1 – Access Approver's Information (To be completed by the Designated Access Approver)

Access Approver's Full Name & Title	Access Approver's Work Address
Access Approver's Phone No.	Access Approver's E-mail Address
Access Approver's Signature	Date (yyyy-mm-dd)

SECTION 2 – Employee/Contractor/Tenant Information (To be completed by the Designated Access Approver)

<input type="checkbox"/> City Employee	<input type="checkbox"/> Contractor	<input type="checkbox"/> Tenant	<input type="checkbox"/> Other: _____
<input type="checkbox"/> Access Card	<input type="checkbox"/> ID Only Card	Previous City of Toronto Card?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Surname (as it appears on Government issued ID)	Given Name	Position Title	
Company Name	Company Phone Number	Work Location	
Employee/Contractor/Tenant's Expiry Date		(yyyy-mm-dd)	

Specify employee/contractor/tenant's access requirements in the space below. Be as specific as possible.
(e.g. Go concourse, Monday – Friday, Daytime only)

SECTION 3 – Personal Information (To be completed by the Employee/Contractor/Tenant)

Employee/Contractor/Tenant's Emergency Contact (Full Name)	Emergency Contact Number	N/A Personal Vehicle Licence Plate Numbers (If applicable for City parking)
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CITY CONTRACT ADMINISTRATOR (If different from DAA)

Full name:	Phone Number:
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City of Toronto Corporate Security ID / Access Card Regulations
(Read each item, then sign and date below to accept)

1. ID / Access cards are the property of the City of Toronto.
2. The photo on the ID / Access card reflects a current, true likeness of the cardholder.
3. ID / Access cards must be visibly worn while on City of Toronto property.
4. ID / Access Cards must be presented upon request of Security or City management personnel.
5. Lost, stolen or damaged ID / Access cards must report immediately to Corporate Security at 416-338-8000 (24 hrs).
6. ID / Access cards are not to be loaned to anyone, not to family, friends, or co-workers.
7. ID / Access cards must be returned to Corporate Security upon termination, leave or retirement.
8. ID / Access card replacements due to Cardholder misuse may result in cost recovery.

SIGNATURE:		DATE:	(yyyy-mm-dd)
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- CORPORATE SECURITY USE ONLY -

ID / PROX / FACEPLATE	PHOTO #	PHOTO LOCATION	PHOTO DATE	BADGER
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The personal information on this form is collected under the authority of the City of Toronto Act, 2006, s. 136 (c). The information is used to issue employee identification cards and for contact purposes in case of emergency. Questions about this collection can be directed to: City of Toronto, Corporate Security, 65 Front St. W., Toronto, Ontario M5J 1E6 or by telephone at 416-338-8000.



Union Station Security - Access Card Badging Procedures

Employees and long-term contractors working out of Union Station for a period longer than 03 months should be in possession of a permanent photo access card. This card is obtained by completing an authorized Request for ID / Access Card Form (badging form) and then attending a badging session.

Scheduled Badging Sessions:

Badging Sessions at Union Station are held on Monday and Tuesday mornings from 9:30am until 11:00am. Employees can attend the Badging Office at any time during this window without a confirmed appointment. Employees will have their picture taken and then their access card will be printed. Lanyards will be provided for City of Toronto staff, retail employees and station tenants.

Alternate Badging Sessions:

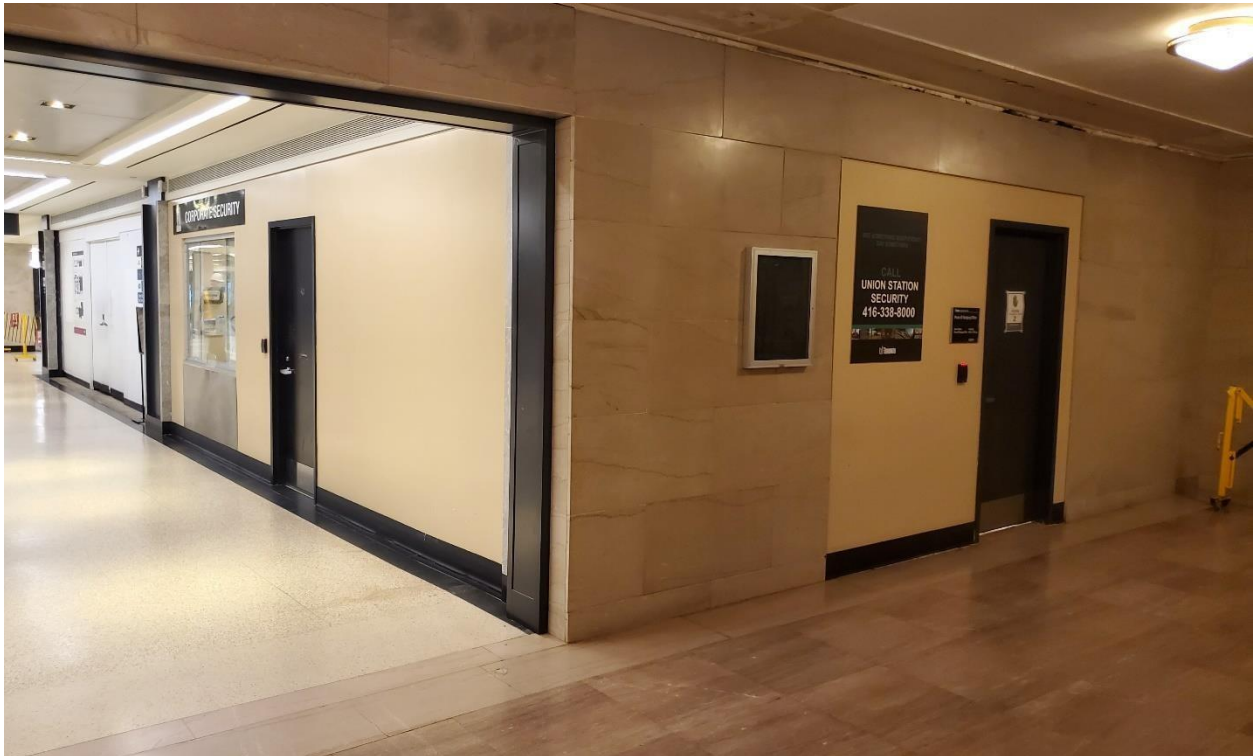
Staff who are unavailable during the above mentioned days or times can request to schedule alternate badging sessions. Appointments have to be made in advance with Senior Security Coordinators Dan Amaro, Robert Carriere or Steven Chin. Walk-ins should be discouraged and are subject to be declined.

Requirements:

Staff attending a badging session are required to bring their completed and approved badging form; signed by themselves as well as their Designated Access Authority. Staff are also required to bring 01 piece of photo-identification. These include but are not limited to the following: Drivers Licence, City of Toronto access card, Passport, Citizenship Card, Permanent Residence Card, photo Firearms Licence.

Location:

The Badging Office is located in the York Promenade, on the B1 Level of the building. It is around the corner from the Security Office, and can be found in the image below. The Badging Office is the door on the right.



Holidays:

Badging sessions are not held on any Statutory Holidays

Cancelation:

Badging sessions are subject to cancelation with little or no notice.

Corporate Security Contact Information:

Senior Security Coordinators: Dan.Amaro@toronto.ca / Robert.Carriere@toronto.ca / Steven.Chin@toronto.ca

Office Phone Number: 416-392-6113

Union Station Security Operations Centre: ussoc@toronto.ca

Phone Number: 416-338-8000

Information / Details:

Name: _____ Company: _____

Date (dd-mmm-yy): _____ Time (24 hr format): _____

Type of Action: _____
(panel bypass, zone bypass, removal, addition, repair, testing, other)

Affected panel (s) _____ Area(s) / Zone(s) _____

Expected Duration of Work _____ hrs / days

Will the system be returned to the same state as before the work began? _____

Reason for System Change & Impairment Details:

Authorization / Notification:

One day or less in duration:

CoT Operations Supervisor authorization & signature required: _____

More than one day in duration:

CoT Operations Manager authorization & signature required: _____

Addition or Removal of Equipment:

CoT Operations Manager authorization & signature required: _____

Confirm with Security Control Room 416-338-8000 that monitoring company has been notified.
Wait for okay to proceed. Sign here => _____

Completion of Work:

Date (dd-mmm-yy): _____ Time (24 hr format): _____

Signature of individual restoring system to normal _____

Notes:

REQUEST FOR SHUTDOWN OF:

- ELECTRICAL/ FIRE / COMMUNICATIONS EQUIPMENT
- MECHANICAL EQUIPMENT / SYSTEM

REQUESTED BY (CONTRACTOR): _____ DATE: _____ TIME: _____

CONTACT PERSON: _____ CELL: _____

PROPOSED DATE: _____ TIME: _____

AREA AFFECTED, WORK PROCEDURE AND RISKS: _____

EQUIPMENT AFFECTED: _____

DURATION OF SHUTDOWN: _____

APPROVALS: _____ DATE: _____

USRP

_____ DATE: _____

CoT OPERATIONS

CONTRACTOR SIGN OFF AT COMPLETION OF WORK: _____

DATE : _____

NOTE:

1. The system(s) must be returned to a fully operational state by the end of the Contractor's shift or alternative measures must be put in place and agreed to by the CoT.
2. Provide a detailed schedule that must be maintained.
3. The trades are to complete and submit forms 5 days minimum in advance of request for shutdown & interruption.
4. Trades are not to proceed without a copy of this form fully executed by USRP /and CoT.

Fire Watch Log Sheet

Date	Time	Area of Patrol / Comments	Patroller's Initials

1 **CASH ALLOWANCES**

- 1.1 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation and other authorized expenses incurred in performing the Work.
- 1.2 The Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
- 1.3 Unit rates to be used against cash allowances will be as per rates provided in the Contract Documents. Overhead and Profit to be in accordance with the terms of the Contract.
- 1.4 The Owner reserves the right to call competitive Bids for portions of the work to be paid for out of any or all cash allowances. The relationship of the Contractor and the trades performing portions of the work to be paid out of cash allowances shall be such as between the Contractor and his Subcontractors.
- 1.5 Make expenditures out of the cash allowance only on receipt of an order signed by the City.
- 1.6 Unexpended amounts of cash allowances maybe reallocated to other specific cash allowances at the sole discretion of the City.
- 1.7 Unexpended amounts of cash allowances shall be deducted from the Contract Price at completion of the Work.
- 1.8 Descriptions and Amounts of Cash Allowance:
- .1 Fire Watch as specified in Section 01 14 00, Work Restrictions: \$10,000.
 - .2 Abatement: refer to the Bid Form, prepared by the City of Toronto.
- End of Section

- 1 **SUBSTITUTIONS**
- 1.1 Whenever Products are specified exclusively by trade name, manufacturer's name or by catalogue reference, use only those items, unless written approval for substitution is obtained from Consultant.
- 1.2 No substitutions will be permitted without prior written approval of the Consultant.
- 1.3 No substitutions will be permitted where materials and products require to match existing conditions.
- 1.4 Proposals for substitutions may only be submitted after award of Contract.
- 1.5 Substitutions submitted on shop drawings without following requirements of this Section prior to submission of the shop drawings will cause the shop drawings to be rejected at any time. Consultant's review of shop drawings shall not be construed as approval of substitutions.
- 1.6 Requests for substitutions must include statements of:
 - .1 Description of proposed substitution.
 - .2 Respective costs of items originally specified and the proposed substitution.
 - .3 Compliance with the Building Codes and requirements of authorities having jurisdiction.
 - .4 Affect concerning compatibility and interface with adjacent building materials and components.
 - .5 Compliance with the intent of the Contract Documents.
 - .6 Reason for the request.
- 1.7 Proposed substitutions will be considered only under the following conditions:
 - .1 If the materials and products specified are not available; or
 - .2 If substitute materials and products to those specified, which are brought to the attention of and considered by the Consultant as superior to those specified, will provide a benefit to the Owner; and
 - .3 If a request for substitution is accompanied with all necessary information to facilitate evaluation.
- 1.8 Substitutions Processing Time
 - .1 For scheduling purposes allow 10 Working Days following Consultant's receipt of substitution.
 - .2 Concurrent Review: When concurrent review of substitution by Prime Consultant's Subconsultants, City, or other parties is required, allow a minimum of fifteen (15) working days for initial review of each substitution.
 - .3 Failure to provide substitutions in ample time in advance of Work to permit correct and accurate evaluation of substitution by the Consultant will result in rejection of substitutions.
- 1.9 There is no obligation on the part of the Consultant or Owner to accept proposed substitutions. Acceptance of proposed substitutions by Owner does not relieve the Contractor's responsibility under the Contract.

- 1.10 Should proposed substitution be accepted either in part or in whole, bear full responsibility and costs when substitution affects other work on the project. Pay for Consultant's design and contract document changes required as result of the substitution.
- 1.11 The Consultant will record the time required to evaluate equivalents and alternates proposed by Contractor including making changes to the Contract Documents occasioned thereby. Whether or not the Consultant accepts a proposed substitute, the Contractor shall reimburse the Owner for the charges of the Consultant for evaluating any proposed substitute.
- 1.12 Amounts of all credits arising from acceptance of substitutions will be determined by the Consultant and the Contract Price adjusted accordingly.
- 1.13 Wherein the expression "other acceptable equivalents" or similar expressions in specification Sections, submissions under the expression shall be as specified in this Section.

End of Section

Substitution Request No: _____ Date: _____

Project: _____ Project No: _____

Contractor: _____

Specified Product Specification Reference

Section Number	Section Title	Paragraph Number
----------------	---------------	------------------

Proposed Substitution

**Manufacturer and
Product Trade Name**

Address

Phone Number

Contact Name

Model Number

History of Product

New Product 2-5 years old 5-10 years old More than 10 years old

Similar Installation

Project Name & Address

Consultant

Owner

**Proposed
Substitution Affects
Other Parts of Work**

No Yes, explain:

**Differences Between
Proposed Substitution
and Specified Product**

**Reason For Not
Providing Specified
Product**

**Changes to Contract
Price**

Add/Deduct \$

**Changes to Contract
Time**

Add/Deduct

_____ working days

Contractor's Declaration

The Contractor Declares that:

- Proposed substitution has been fully investigated and determined to be equivalent or superior in all respects to specified product, and complies with requirements of authorities having jurisdiction.
- Same warranty will be furnished for proposed substitution as for specified product.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Proposed substitution is compatible with adjacent materials and assemblies.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Signed By: _____ Date: _____

Supporting Data Attached: Drawings Product Data Samples Reports Other _____

Consultant's Review

- Substitution Accepted – Provide submittals in accordance with Specification requirement.
- Substitution Accepted as Noted – Provide submittals in accordance with Specification requirement.
- Substitution Not Accepted – Use specified product.

Signed By: _____ Date: _____

Owner's Acceptance

Signed By: _____ Date: _____

Additional Comments:

Consultant _____

Contractor _____

Owner _____

1 **COORDINATION**

- 1.1 Coordinate scheduling, submittals, and Work of the various sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- 1.2 Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various specification sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- 1.3 Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- 1.4 In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- 1.5 Be responsible for completion and cleanup of Work of separate specification sections in preparation for Substantial Completion and Handover.
- 1.6 After City occupancy of premises, coordinate access to Project Site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of City's activities.

2 **ALTERATION PROJECT PROCEDURES**

- 2.1 Materials: As specified in product sections; match existing products and work for patching and extending work.
- 2.2 Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- 2.3 Remove, cut, and patch work in a manner to minimize damage and to provide a means of restoring products and finishes to original condition.
- 2.4 Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes.
- 2.5 Where new work abuts or aligns with existing, perform a smooth and even transition. Patched work to match existing adjacent work in texture and appearance.
- 2.6 When finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Consultant.
- 2.7 Where a change of plane of 6 mm or more occurs, submit recommendation for providing a smooth transition for Consultant's review or request instructions from Consultant.
- 2.8 Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
- 2.9 Finish surfaces as specified in individual product sections.
- 2.10 For work in Heritage Zones, submit procedures for approval prior to the commencement of the work.

3 PRE-CONSTRUCTION CONFERENCE

- 3.1 Consultant shall schedule a conference after Notice of Award and prior to Contractor occupancy of the Project Site.
- 3.2 Attendance Required: City, Consultant, Contractor and Subcontractors.
- 3.3 Agenda:
 - .1 Distribution of Contract Documents.
 - .2 Submission of list of Subcontractors, list of products, Schedule of Values, and Construction Schedule.
 - .3 Designation of personnel representing the parties in Contract, Owner, and Consultant.
 - .4 Safety requirements.
 - .5 Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, contract changes and contract closeout procedures.
 - .6 Scheduling.
 - .7 Use of premises by City.
 - .8 Owner's requirements and partial occupancy.
 - .9 Security and housekeeping procedures.
 - .10 Procedures for mock-ups.
 - .11 Daily Reports/ Daily Logs preparation
 - .12 Construction separation agreement requirements.
 - .13 Access procedures for accessing non-construction areas.
 - .14 Procedures for the notification of conditions that differ from the Contract Documents – in particular the discovery of undocumented heritage fabric and materials.
 - .15 Procedures for testing.
 - .16 Procedures for maintaining record documents.
 - .17 Requirements for start-up of equipment.
 - .18 Inspection and acceptance of equipment put into service during construction period.

4 PROGRESS MEETINGS

- 4.1 Contractor shall schedule and administer meetings throughout progress of the Work.
- 4.2 Contractor shall make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within three (3) working days to City, Consultant and to all in attendance.
- 4.3 Attendance Required: City, Consultant, Contractor's Project Manager, Job superintendent, as well as major Subcontractors and suppliers as appropriate to agenda topics for each meeting.

- 4.4 Refer to the terms of the Contract for further details.
- 4.5 As a minimum, the following items shall be included on the Agenda:
 - .1 Review minutes of previous meetings.
 - .2 Safety
 - .3 Review of Work progress.
 - .4 Field observations, problems, and decisions.
 - .5 Identification of problems which impede planned progress.
 - .6 Review of submittals schedule and status of submittals.
 - .7 Review of off-site fabrication and delivery schedules.
 - .8 Maintenance of progress schedule.
 - .9 Corrective measures to regain projected schedules.
 - .10 Planned progress during succeeding work period.
 - .11 Coordination of projected progress.
 - .12 Maintenance of quality and work standards.
 - .13 Effect of proposed changes on progress schedule and coordination.
 - .14 Other business relating to Work.

5 **PRE-INSTALLATION CONFERENCES**

- 5.1 When required in individual specification section, convene a pre-installation conference at Project Site prior to commencing work of the section.
- 5.2 Attendance Required: Parties directly affecting, or affected by, work of the specific section.
- 5.3 Notify Consultant minimum five working days in advance of meeting date, unless indicated otherwise in specific trade section.
- 5.4 Prepare agenda, preside at conference, record minutes, and distribute copies within three working days after conference to participants, with two copies to Consultant.
- 5.5 Review conditions of installation, preparation and installation procedures, and coordination with related work.

6 **DAILY REPORTS/DAILY LOGS**

- 6.1 Prepare a Daily Reports/ Daily Logs reporting on work force of the its own workers, Subcontractors, Suppliers and any other forces on site and record the general nature of Project activities.
- 6.2 Make these Daily Logs available to the Owner and Consultant for inspection.

End of Section

1 **SCHEDULES REQUIRED**

1.1 Submit the following schedules:

.1 Construction Schedule in accordance with Conditions of Contract.

.2 Submittals Schedule in accordance with the Contract containing the following:

.1 Shop Drawings Schedule

.2 Sample Schedule

.3 Product Data Schedule

.3 Mock-ups Schedule

2 **CONSTRUCTION SCHEDULE**

2.1 Prepare Construction Schedule using Primavera Version 6 or later.

2.2 In addition to hardcopy, ensure that the schedule information and electronic native file is 100% compatible and useable by the City.

2.3 Refer to the terms of the Contract for further details.

3 **SUBMITTALS SCHEDULE**

3.1 Include schedule for submitting shop drawings, product data, and samples.

3.2 Format for listings: the table of contents of this specification.

3.3 Identification of listings: by specification section numbers.

3.4 Indicate dates for submitting, review time, resubmission time, float time, last date for meeting fabrication schedule.

3.5 Refer to the terms of the Contract for further details.

4 **MOCK-UPS SCHEDULE**

4.1 Include schedule of mock-up installation.

.1 Follow requirements of Section 01 45 00 for mock-ups.

End of Section

1 **RELATED WORK**

1.1 Individual submittals are described under pertinent sections of this specification.

2 **SUBMITTALS SCHEDULE**

2.1 Format and Content:

.1 Prepare schedule identifying all required Shop Drawing, Product data, and sample submissions, including samples required for testing.

.2 Prepare schedule in electronic format.

.3 Provide a separate line for each required submittal, organized by Specifications section names and numbers, and further broken down by individual Products and systems as required.

.4 For each required submittal, show planned earliest date for initial submittal and date for return of reviewed submittal by Consultant.

.5 Allow time in schedule for resubmission of submittals, should resubmission be necessary.

2.2 Submission:

.1 Submit initial schedule to Consultant within 15 Working Days after Contract award.

.2 Submit schedule as Excel file.

.3 Consultant will review format and content of initial schedule and request necessary changes, if any, within 10 Working Days after receipt.

.4 If changes are required, resubmit finalized schedule within 5 Working Days after return of review copy.

.5 Submit updated submittals schedule monthly to Owner and Consultant.

3 **SUBMITTALS**

3.1 Submit to Consultant, shop drawings, samples and other items, in strict accordance with the provisions of the Contract and these Submittal Procedures.

3.2 All submittals to the Prime Consultant's office to include prepaid carrying and all other charges.

3.3 The Contractor shall keep one reviewed copy of each submission at the Project Site.

4 **SHOP DRAWINGS**

4.1 The term shop drawings means drawings, diagrams, illustrations, schedules, performance charts, product data, brochures and other data which are to be provided by the Contractor to illustrate details of portions of the work.

4.2 The Contractor shall arrange for the preparation of clearly identified shop drawings as the Consultant may reasonably request.

- 4.3 Prior to submission to the Consultant, the Contractor shall review all shop drawings. By this review the Contractor represents acknowledgement that all field measurements, field construction criteria, materials, catalogue numbers and similar data have been verified and shop drawings have been coordinated with the requirements of the work and of the contract documents.
- .1 The Contractor's review of each shop drawing shall be indicated by a "reviewed" stamp, with control number, project name, date and signature of reviewer.
- .2 Submittals not stamped, identified with a control number and project name, signed and dated will be returned without being examined and considered rejected.
- 4.4 The Contractor shall submit shop drawings to the Consultant for review in orderly sequence and sufficiently in advance to allow for the Consultant's proper review and so as to cause no delay to the Work.
- 4.5 Contractor shall prepare a schedule fixing the dates for submission and return of shop drawings.
- 4.6 Shop Drawings Processing Time: Allow time for submittal review, including time for re-submittals, as indicated below.
- 4.7 Time for review shall commence on Consultant's receipt of submittal. If a shop drawing is received after 12 noon, it will be considered as received the next working day for the purposes of the processing time.
- .1 For scheduling purposes allow 5 working days following receipt of submittal and 5 working days following resubmission. Consultant will advise Contractor if additional time is required for technical or co-ordination review.
- .2 Concurrent Review: When concurrent review of submittals by Prime Consultant's Subconsultants, City, or other parties is required, allow a minimum of ten (10) working days for initial review of each submittal. Direct transmittal to Consultant's Subconsultants will not be permitted.
- .3 If at any time the Contractor submits unusually large number of shop drawings, the Consultant will, within 5 working days of receipt of such drawings, provide the Contractor with an estimate of time necessary for processing such shop drawings.
- .4 Failure to provide submittals in ample time in advance of Work to permit correct and accurate processing by the Consultant is not considered sufficient reason for extension of Contract Time and no claim for extension will be authorized.
- 4.8 Shop drawings shall be submitted in electronic format as a PDF or DWG file via the Project Website or other means of electronic file delivery. Scanned drawings will only be accepted if legible. Illegible drawings will be rejected.
- 4.9 Contractor shall identify primary contact to be added to the Website for shop drawings submission and receipt of reviewed drawings and notifications.
- 4.10 With prior approval of the Consultant, catalogue cuts showing all aspects, design, sizes, components and rough-in information for equipment may be submitted as shop drawings. Supplement standard information to provide details applicable to project.
- 4.11 The Contractor shall make changes in shop drawings which the Consultant may require consistent with the contract documents and resubmit unless otherwise directed by the Consultant. When resubmitting, the contractor shall notify the Consultant in writing of any revision other than those requested by the Consultant.

- 4.12 Shop drawings shall define the division of responsibility between different trades. Shop drawings shall show materials, methods of construction and attachment or anchorage, erection diagrams, connections and other details necessary to complete the work. Shop drawings shall show cross references to drawings and specifications.
- 4.13 The review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. The review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor, and such review shall not relieve the Contractor of its responsibility for errors or omissions in the shop drawings or of its responsibility for meeting all requirements of the contract documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of the work of all subtrades and work of other contractors.
- 4.14 Submittals received but not required by the Contract Documents or requested by the Consultant will not be reviewed by the Consultant and will be marked 'NOT REVIEWED' by the Consultant and returned to the Contractor.
- 4.15 Any adjustments made on the shop drawings by the Consultant are not intended to change the Contract Price. If the Contractor deems that such adjustments affect the value of the work, he shall so state in writing before proceeding with the fabrication and installation of the work.
- 4.16 Make shop drawings accurately to a scale sufficiently large to show pertinent features of the item to be supplied and the method of connection to the work including attachments, reinforcing, anchorage and location of exposed fastenings.

5 **REPRODUCTION OF DRAWING ELECTRONIC FILES**

- 5.1 Reproduction of the Consultants drawings to serve as background for Shop Drawings will be permitted. The Contractor shall remove all identification or reference to the City or Consultants from the drawings that are used for this purpose.
- 5.2 Make payment to the Consultant for the cost of reproduction plus Harmonized Sales Tax (HST) based on the number of drawing electronic files as indicated below.
- .1 1 to 10 files: \$600.00
 - .2 11 to 20 files: \$700.00
 - .3 21 to 50 files: \$900.00
 - .4 51 to 100 files: \$1,200.00
 - .5 More than 100 files: \$6.00 per file, plus \$600.00 administration fee.
- 5.3 The release of electronic files by the Prime Consultant does not imply transfer of copyright or ownership to the Contractor. The Contractor shall be responsible for all liabilities and damages resulting from the use of these files.

6 **SAMPLES**

- 6.1 Submit Samples, when requested by the Consultant, showing material, colour and finish. Materials used in the construction shall correspond to the reviewed samples.
- 6.2 Submit samples in such quantities which are required to be returned plus one which will be retained by the Consultant.

- 6.3 Refer to individual sections for more particular requirements for specified samples.
- 6.4 At each stage, assemble and submit all relevant samples in context, at one time, in the following groups:
- .1 Interior Materials and Finishes
 - .2 Ceiling Systems and Light Fixtures
 - .3 Hardware
 - .4 Cover plates, grilles, and other items.
- 6.5 Identify each sample with Project Number, Job Name, Date of Submittal, Type of Material, Names of Contractor, Subcontractor and Manufacturers.
- 6.6 Reviewed samples will become standard of workmanship and material against which installed Work will be verified.
- 7 COLOURS**
- 7.1 Unless the precise colour and pattern is specifically described in the Contract Documents, whenever a choice of colour or pattern is available in a specified product, submit accurate colour charts from the manufacturer's standard range of colours and pattern charts to the Consultant for review and selection.
- 7.2 Unless all available colours and patterns have identical costs and identical wearing capabilities and are identically suited for the installation, completely describe the relative costs and capabilities of each.
- 8 PROGRESS PHOTOGRAPHS**
- 8.1 Submit typical photographic sample in digital format to Consultant for review.
- 8.2 Upon commencement of the Work, and thereafter at monthly intervals, supply to the Consultant, photographs in digital format with sufficient views from 4 locations of the progress of all parts of the Work.
- 8.3 Photographs shall be taken from locations as determined by the Consultant.
- 8.4 Each photograph shall be dated and locations noted on digital files.
- 8.5 Cost of all progress photographs, including site photographs in Heritage sensitive areas, shall form part of the Contract Price.
- 8.6 Provide Site Photographs in Heritage sensitive areas as described below.
- 8.7 Contractor shall document the work in Heritage sensitive areas prior to the start, during and after finishing, especially any work requiring the dismantling of stone or marble. This procedure is required by Parks Canada.
- .1 Site Photographs:
 - .1 Submit typical photographic sample in printed and digital format to Consultant for review, prior to commencement of Work.
 - .2 Prior to removing heritage fabric, photograph the following:
 - .1 General view of the Work.

- .2 Detail shots of design elements, patterns, and ornamental features.
- .3 Submit photographs for areas of heritage fabric to be dismantled, replaced or to receive surface treatment. Record all sides and entire faces and arrange as a montage.
- .4 Details or items deemed exceptional by Consultant.
- .5 Submit photographs as part of weekly report.
- .3 On completion of work, photograph areas for final comparison.
- .4 Photograph quality: Well-illuminated, proper exposure, on professional quality film and printed on archival quality photographic paper.
- .5 Provide 227 x 184 mm photographs in archival mountings assembled in a binder and submitted in 3 copies to the Consultant.
- .6 Include copy of photographs on portable digital storage media. Minimum 9 megapixel quality, RAW format.

9 **IDENTIFICATION OF SUBMITTALS**

- 9.1 Completely identify each submittal and re-submittal by showing at least the following information:
- .1 Project Number and Title.
 - .2 Date of Submittal.
 - .3 Name of Subcontractor.
 - .4 Control Number.
 - .5 Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
 - .6 Drawing Number and Specification Section number to which the submittal applies.
 - .7 Whether this is an original submittal, or re-submittal.
 - .8 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

10 **COORDINATION OF SUBMITTALS**

- 10.1 Prior to submittals for Consultant's review, use all means necessary to fully coordinate material, including the following procedures:
- .1 Determine and verify field dimensions and conditions, materials, catalogue numbers and similar data.
 - .2 Coordinate as required with the trades and with public authorities involved.
 - .3 Secure necessary approvals from public authorities and others and signify by stamp, or other means, that they have been secured.
 - .4 Clearly indicate deviations from the Contract Documents.

- 10.2 Unless otherwise specifically permitted by the Consultant, make submittals in groups containing associated items; the Consultant may reject partial submittals as not complying with the provisions of the Contract Documents.
- 10.3 Make submittals far enough in advance of scheduled dates of installation to provide required time for reviews, for securing necessary reviews, for possible revision and re-submittal, and for placing orders and securing delivery so as to cause no delay in the work or in the work of other contractors.
- 10.4 Do not proceed with Work affected by a submittal until review is complete.
- 10.5 Costs of delays occasioned by tardiness in making submittals will not be borne by the City.

End of Section

PART - 1 GENERAL

1.1 REFERENCES

- .1 National Fire Protection Association (NFPA): NFPA 241 - Standard for safeguarding Construction, Alteration, and Demolition Operations.
- .2 Parks Canada: Standards and Guidelines for the Conservation of Historic Places in Canada, published by Parks Canada (2003).

1.2 PERFORMANCE REQUIREMENTS

- .1 The Contractor is responsible for any damage to or loss of Heritage Materials occurring as a result of site, handling, transport and storage activities.
- .2 Ensure materials, equipment and procedures safely support existing structure and construction live loads;
- .3 Apply methods that minimize the risk of damage to Heritage Materials.
- .4 All methods and techniques utilized in the protection of heritage material, or materials that may have an impact on heritage materials, must conform to requirements of this Section and protection details on drawings.

1.3 DEFINITIONS

- .1 Zones of Heritage Character: Areas containing or potentially containing Heritage Materials, as designated on the Drawings.
- .2 Heritage Materials: Existing materials located in the Zones of Heritage Character deemed essential to the heritage value of the building. These include but are not limited to:
 - .1 Interior masonry (Zumbro, Wallace Sandstone, terracotta backup wall for marble)
 - .2 Marble floors and wall panels
 - .3 Terrazzo floors
 - .4 Plaster ceilings
 - .5 Wood trim, doors
 - .6 Metal windows, and frames, grilles

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit detailed plans, sections and details of protective barrier assemblies. Show both typical and atypical configurations. Identify each assembly and locate all items in plan drawings.
- .3 Submit Product data for fasteners, waterproofing and soft padding materials used in protective barrier assemblies.

1.5 PROCEDURES

- .1 Submit detailed demolition procedures indicating tools used inside or near heritage areas. Describe additional measures to be implemented to ensure vibration control and protection

of heritage fabric. Refer to Article "Vibrations and Displacements" in Part 3 of this Specification Section.

- .2 Submit plan describing procedures to be followed in the event that undocumented or concealed heritage materials systems are discovered.

1.6 **MOCK-UPS**

- .1 Erect mock-ups in-situ for protective and shoring measures for each condition containing heritage elements and materials to be protected.

1.7 **ZONES OF HERITAGE CHARACTER**

- .1 Apply heritage protection measures in Zones of Heritage Character.
- .2 Both sides of terracotta walls supporting heritage stone or other heritage materials are to be protected.

1.8 **SCHEDULING**

- .1 Submit schedule of activities, showing dates and estimated duration to Consultant not later than 10 working days before protection activities begin in Zones of Heritage Character.
- .2 Work Plan Review:
 - .1 Submit a protection and schedule work plan for all work in the Zones of Heritage Character to the Consultant for review in a timely manner. Follow the approved work schedule, heritage protection may be required at different times for different areas.
 - .2 Inform the Consultant in a timely manner of upcoming milestone reviews as identified in the schedule and work plans.
 - .3 Once pre-demolition protective measures are completed, advise the Consultant and schedule a visit of the heritage areas and associated facilities for review.
- .3 Submit schedule of activities, showing dates and estimated duration to Consultant not later than 10 working days before dismantling/demolition of area immediately adjacent the Zones of Heritage Character.
- .4 Unless otherwise indicated, all protective barriers shall remain in place for duration of the Contract.
- .5 When work of the Contract is deemed sufficiently complete by Consultant, carefully remove protective barriers for final review. Ensure that all barriers are removed and that view of all previously concealed materials is unobstructed before advising Consultants to begin review.

1.9 **SCHEDULING SEQUENCE: GENERAL**

- .1 Perform protective measures in accordance with the scheduling sequence below:
 - .1 Installation of heritage protection.
 - .2 Review of protective measures by Consultant.

1.10 **QUALITY ASSURANCE**

- .1 Perform work in accordance with The Standards and Guidelines for the Conservation of Historic Places in Canada, published by Parks Canada.

- .2 Accepted mock-ups must be maintained, and remain accessible throughout and for the duration of the project. Accepted mock-ups may become part of the final work.
- .3 Workers Abilities
 - .1 All heritage workers must be pre-qualified to work on this scope.
 - .2 Unless specifically permitted by the Consultant, only accepted procedures and the personnel that performed them during the mock-ups may be utilized to do that procedure throughout the duration of the project.
 - .3 No approved specialized workers shall be changed during the progress of the work without written acceptance by the Owner, following addition procedural mock-ups.
 - .4 Workers may be trained by the appropriate project conservator to perform new tasks, subject to the approval of the Owner, following additional procedural mock-ups.

PART - 2 PRODUCTS

2.1 MATERIALS

- .1 Material grades – general
 - .1 Conform to material grades prescribed in the following paragraphs for protective barriers.
 - .2 Lumber: spruce, pine or fir to CAN/CSA-O141, NLGA #2 grade, S4S, moisture content 19% (S-dry) or less. Where pressure treated lumber is required, treat lumber with Alkaline Copper Quaternary to CSA O80-Series.
 - .3 Plywood: exterior grade softwood plywood to CSA O151, thickness as indicated. Where pressure treated plywood is required, treat plywood with Alkaline Copper Quaternary to CSA O80-Series.
 - .4 Acceptable dust, dirt, liquid barriers, including:
 - .1 Vapour-permeable sheeting: made with flashspun high-density polyethylene fibers.
 - .2 6 mil clear construction grade polyethylene film.
 - .3 Polyethylene fastening tape compatible with sheeting.
 - .5 Acceptable soft padding:
 - .1 Compressible polychloroprene rubber, minimum 25 mm.
 - .2 Polychloroprene rubber foam sheeting, 13 mm thickness.
 - .3 Resilient medium-density closed-cell Polyethylene foam sheeting
 - .4 Low-density extruded polystyrene, minimum 25mm.
 - .6 Accessories:
 - .1 Use only low impact and low vibration fasteners, including bolts with nuts and washers, wood screws, liquid adhesives, adhesive strips or tapes and removable, non-residue adhesive strips and tapes.
 - .2 No high impact attachment systems are permitted, including spikes, nails, staples, explosive actuated fastening devices and masonry anchoring fastener systems.

PART - 3 EXECUTION

3.1 PROTECTIVE MEASURES – GENERAL

- .1 Provide protective measures for any and all heritage conditions.
- .2 Anchoring or attachment to historic materials:
 - .1 The use of any mechanical fasteners into or onto any heritage material is prohibited.
 - .2 In the event that dust, dirt, and liquid barriers require attachment to historic materials, only non-permanent removable, non-residue adhesive tapes may be used on the heritage material.
 - .3 No other attachments to historic materials are permitted.

3.2 PROTECTIVE BARRIERS

- .1 Provide protective barriers and coverings as indicated to protect heritage stairs, ceilings, walls and floors from abrasion, impact, dust, dirt and liquids.
- .2 Protective barriers shown on Drawings illustrate examples of acceptable construction assemblies. Final design of protective barriers is the responsibility of the Contractor and is subject to review by the Consultant.

3.3 VIBRATIONS AND DISPLACEMENTS

- .1 Protect sensitive heritage items from vibrations and sudden movements by combining bracing, rigid paneling and full-surface padding as required.
- .2 Use of high-impact mechanical demolition tools is prohibited within 10 m of Zones of Heritage Character.

3.4 PREVENTION OF WATER / LIQUID / PARTICULATE DAMAGE

- .1 Maintain proper water-shedding conditions at all times to ensure that rainwater does not infiltrate inside the building.
- .2 Provide waterproofing sheeting and wrapping to cover heritage materials so that in the event that failed or damaged mechanical equipment, equipment being dismantled and removed, or any other demolition or abatement procedure does not cause liquids and/or allow particulates and/or airborne humidity or airborne particulates to come into contact with the heritage materials.
- .3 Water or any aqueous mixtures may produce significant damage to heritage items. Protect heritage items to remain in place from all contact with water or other aqueous mixture.

3.5 UNKNOWN HERITAGE MATERIALS

- .1 If undocumented or concealed materials or systems which are potentially heritage in nature are discovered anywhere within the building inside or outside of identified Zones of Heritage Character, cease activities in the immediate vicinity, tape off and protect the items, materials, and systems, and alert the Consultant immediately.

- .2 Areas similar in nature under which similarly undocumented or concealed materials or systems could exist shall also be immediately identified by the Contractor of potential hidden items.

END OF SECTION

1 **DEFINITIONS**

- 1.1 Mockups: Site constructed, full size physical assemblies used by Consultant to:
- .1 Review and verify selections made under sample and shop drawing submittals of specification Sections.
 - .2 Demonstrate aesthetic effects and, where indicated, qualities of materials and execution.
 - .3 Review construction, coordination, and operation.
 - .4 Certify qualifications of the workers performing the job in Heritage sensitive areas.

2 **QUALITY ASSURANCE**

- 2.1 Notify Consultant and Owner seven working days in advance of dates and times when mockups will be constructed.
- 2.2 Allow minimum seven working days for initial review and each subsequent review of each mockup.
- 2.3 Mock-ups for Heritage work might require approval from Parks Canada. Provide advance notice through Consultant to allow Parks Canada to plan their visits and assign the appropriate man power.
- 2.4 Make adjustments as required by the Consultant until acceptance.
- 2.5 Accepted mockups establish the standard of remaining Work.
- 2.6 Obtain Consultant's acceptance of mockups prior to commencement of material fabrication and construction of assemblies.

3 **MOCKUPS REQUIRED**

- 3.1 Construct the mockups of type and sizes specified in individual sections. Mockups will form part of the completed Work, unless otherwise indicated.

4 **MATERIALS AND FABRICATION**

- 4.1 Fabricate materials and construct mockups using materials and methods specified and reviewed under sample submittals of specification Sections.

5 **INSTALLATION**

- 5.1 Construct mockups in location and of size indicated or, if not indicated, as directed by Consultant, using installers who will perform same tasks for Project.
- 5.2 Review with Consultant installation methods different from reviewed shop drawings and manufacturers' recommendations.
- 5.3 Demonstrate the proposed range of aesthetic effects and workmanship.
- 5.4 Maintain and protect mockups during construction in an undisturbed condition.

- 5.5 Modify and alter prototype as necessary to obtain the required test results at no cost to the Owner. Cost of re-testing shall be paid by the Contractor.
 - 5.6 Allow sufficient time for testing evaluations, alterations and re-testing to prevent delays to the project construction progress.
 - 5.7 Demolish and remove mockups when directed.
- End of Section

1 **GENERAL REQUIREMENTS**

- 1.1 Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
- .1 Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of products.
- .2 Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality control procedures that facilitate compliance with the Contract Document requirements.
- .3 Requirements for Contractor to provide quality assurance and quality control services required by Consultant, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

2 **DEFINITIONS**

- 2.1 Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- 2.2 Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Consultant.
- 2.3 Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
- 2.4 Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- 2.5 Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- 2.6 Product Testing: Tests and inspections that are performed by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- 2.7 Source Quality Control Testing: Tests and inspections that are performed at the plant, mill, factory, or shop.
- 2.8 Field Quality Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- 2.9 Testing Agency: An entity engaged to perform specific tests, inspections, or both.

2.10 Experienced: An entity having successfully completed previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

3 **CONFLICTING REQUIREMENTS**

3.1 General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Consultant for a decision before proceeding.

3.2 Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Consultant for a decision before proceeding.

4 **SUBMITTALS**

4.1 Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

4.2 Schedule of Tests and Inspections: Prepare in tabular form and include the following:

- .1 Specification Section number and title.
- .2 Description of test and inspection.
- .3 Identification of applicable standards.
- .4 Identification of test and inspection methods.
- .5 Number of tests and inspections required.
- .6 Time schedule or time span for tests and inspections.
- .7 Entity responsible for performing tests and inspections.
- .8 Requirements for obtaining samples.
- .9 Unique characteristics of each quality-control service.

4.3 Reports: Prepare and submit four copies of certified written reports that include the following:

- .1 Date of issue.
- .2 Project title and number.
- .3 Name, address, and telephone number of testing agency.
- .4 Dates and locations of samples and tests or inspections.
- .5 Names of individuals making tests and inspections.
- .6 Description of the Work and test and inspection method.

- .7 Identification of product and Specification Section.
 - .8 Complete test or inspection data.
 - .9 Test and inspection results and an interpretation of test results.
 - .10 Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - .11 Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - .12 Name and signature of laboratory inspector.
 - .13 Recommendations on retesting and reinspecting.
- 4.4 Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
- 5 **QUALITY ASSURANCE**
- 5.1 General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
 - 5.2 Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
 - 5.3 Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
 - 5.4 Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
 - 5.5 Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
 - 5.6 Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated. Requirement for specialists shall not supersede requirements of authorities having jurisdiction.
 - 5.7 Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated, and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

- 5.8 Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- 5.9 Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
- .1 Contractor responsibilities include the following:
- .1 Provide test specimens representative of proposed products and construction.
- .2 Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
- .3 Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
- .4 Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
- .5 Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
- .6 When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
- .2 Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Consultant with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- 5.10 Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
- .1 Build mockups in location and of size indicated or, if not indicated, as directed by Consultant.
- .2 Notify Consultant seven working days in advance of dates and times when mockups will be constructed.
- .3 Demonstrate the proposed range of aesthetic effects and workmanship.
- .4 Obtain Consultant's approval of mockups before starting work, fabrication, or construction.
- .1 Allow seven working days for initial review and each re-review of each mockup.
- .5 Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- .6 Demolish and remove mockups when directed, unless otherwise indicated.
- 5.11 Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in the Specifications.

6 **QUALITY CONTROL**

- 6.1 Owner's Testing: The Owner may require during progress of the Work, testing and inspection by an independent testing company as directed by the Consultant, or as required in these Specifications, to determine if materials provided for the Works meet the specified requirements.
- .1 Where independent inspection and testing are required by the Contract Documents, the cost of these services shall be paid for by the Owner, except where cash allowances have been included for the specific inspection and testing. In this case, the Contractor shall pay independent inspection and testing company charges authorized by the Owner from the cash allowances included for these services.
 - .2 Retesting and Reinspection: When initial tests indicate non-compliance with the Contract Documents, costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be deducted by the Owner from the Contract Price. Retesting and resinpsection shall be performed by the same testing agency as the initial tests.
 - .3 Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
- 6.2 Code Compliance and Contractor's Convenience Testing
- .1 Code Compliance Testing: Inspection and tests required by codes or ordinances, or by an authority having jurisdiction shall be the responsibility of the Contractor and shall be paid for by the Contractor.
 - .2 Contractor's Convenience Testing: Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor and paid for by Contractor as part of the Contractor 's overhead expenses.
 - .3 Engage a qualified testing agency to perform these quality-control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - .4 Submit a certified written report, in triplicate, of each quality-control service.
 - .5 Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
 - .6 Retesting/Reinspecting: Provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- 6.3 Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field-assembled components and equipment installation, including service connections.
- 6.4 Testing Agency Responsibilities
- .1 Cooperate with Consultant, Contractor and Subcontractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - .2 Notify Consultant, Contractor and Subcontractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

- .3 Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - .4 Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - .5 Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - .6 Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - .7 Do not perform any duties of Contractor or Subcontractor.
- 6.5 Contractor Responsibilities
- .1 Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - .1 Access to the Work.
 - .2 Incidental labour and facilities necessary to facilitate tests and inspections.
 - .3 Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - .4 Facilities for storage and field curing of test samples.
 - .5 Delivery of samples to testing agencies.
 - .6 Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - .7 Security and protection for samples and for testing and inspecting equipment at Project site.
 - .2 Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - .1 Schedule times for tests, inspections, obtaining samples, and similar activities.
 - .3 Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality assurance and quality control services required by the Contract Documents. Submit schedule within 30 calendar days of date established for commencement of the Work.
 - .1 Distribution: Distribute schedule to Owner and Consultant, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.
 - .2 Establishing Schedule: By advance discussion with the selected testing and inspection agencies, determine the time required for the agencies to perform their duties and the time required for the issuance of resulting reports. Allow for the times in the construction schedule.
 - .3 Schedule Revisions: Co-ordinate revisions with the testing and inspection agencies when changes to the construction schedule are necessary.

- .4 Schedule Adherence: Provide advance notice to the testing laboratory and to the inspection company of when testing of the Work is required. If the testing laboratory is ready to perform its functions according to the schedule and is prevented from doing so due to incompleteness of the work, extra costs for testing attributable to the delay will be back charged to the Contractor.

7 **TEST AND INSPECTION LOG**

- 7.1 Prepare a record of tests and inspections. Include the following:
 - .1 Date test or inspection was conducted.
 - .2 Description of the Work tested or inspected.
 - .3 Date test or inspection results were transmitted to Consultant.
 - .4 Identification of testing agency or special inspector conducting test or inspection.
- 7.2 Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Consultant's reference during normal working hours.

8 **REPAIR AND PROTECTION**

- 8.1 On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
- 8.2 Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
- 8.3 Protect construction exposed by or for quality-control service activities.
- 8.4 Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

End of Section

1 UTILITY HOOK-UP AND EXISTING SERVICES

- 1.1 The Contractor is to be aware of existing services supporting operations of the station for City of Toronto, GO Transit, VIA Rail, and retail operations. All services are to be identified and removal/relocation on re-feed plans must be made and reviewed and accepted by stakeholders before proceeding with work.

2 UTILITY CONSUPTION COST

- 2.1 Contractor shall be responsible for paying utility (water, gas, electricity, etc.) Consumption cost.

3 PRODUCT HANDLING

- 3.1 Protection: use all means necessary to maintain temporary facilities and controls in proper and safe condition throughout progress of the work.
- 3.2 Replacements: In the event of loss or damage, immediately make all repairs and replacements necessary to the approval of the consultant and at no additional cost to the owner.

4 TEMPORARY WATER SUPPLY

- 4.1 Contractor shall provide an adequate pure water supply for the use of all Subcontractors.
- 4.2 Contractor shall run the supply pipes from the nearest available sources. Maintain in good condition until the permanent system is installed and ready for use.

5 TEMPORARY FIRE PROTECTION

- 5.1 Contractor shall provide all temporary fire protection required and maintain in good order throughout the work as per all regulations and Authorities having Jurisdiction.
- 5.2 Contractor shall maintain fire protection in temporary public corridors and add fire protection as required.
- 5.3 Fire protection in the construction area shall include without being limited to, stand-pipe system and water supply as required by the local authorities.
- 5.4 Implement and manage a Hot Work Permit process for the project for all Trades.
- 5.5 Refer to Section 01 14 00, Work Restrictions, for additional requirements related to Fire and Life Safety.

6 TEMPORARY LIGHTING

- 6.1 Contractor shall provide temporary service for general safety lighting. Subcontractors shall provide task lighting.
- 6.2 Contractor shall provide temporary lighting in public corridors to conform with code requirements.

7 **TEMPORARY ELECTRICAL SERVICE**

7.1 Provide temporary service for the operation of electric pumps, motors, vibrators and other power tools during the work.

8 **TEMPORARY HEATING AND VENTILATING**

8.1 Provide temporary heating required during the work, including attendance, maintenance and fuel.

9 **TEMPORARY SANITARY FACILITIES**

9.1 Contractor shall provide and maintain, in compliance with local by-laws, sanitary temporary toilets and washbasins for the use of the workers on the project.

9.2 Contractors are not allowed to use the existing Union Station sanitary facilities.

10 **PROTECTION DEVICES**

10.1 Erect barricades, covered ways, tarpaulins, steps, bridges, platforms, notice and warning boards, and maintain all lights, signals and protection of all kinds for the protection of the workmen engaged on the project, for the protection of adjoining property and for protection of the public in accordance with local regulations.

11 **TEMPORARY ENCLOSURES / PARTITIONS**

11.1 Interior enclosures: erect interior dust-proof temporary enclosures. Enclosure to be complete with door, fastenings, lock and two keys for construction, constructed as follows:

- .1 38 mm x 89 mm wood framing
- .2 Gypsum Board Walls: Extend walls from floor to slab ceiling if suspended ceiling are to be removed.
- .3 Install slab door opening toward the Work.

11.2 Properly close and lock enclosures at nights, Sundays, holidays and other occasions when the Work is not in progress.

11.3 Vacuum the area above false ceilings, including duct work and pipes prior to construction. Be aware of and take precautions with contaminated dust.

11.4 Establish traffic control patterns which prevent construction dust from being tracked into occupied areas. Adhesive strips on floors to catch dust on shoes may be useful.

11.5 Ventilate construction areas with negative pressure with respect to adjacent areas. Exhaust air from construction areas directly outside the building.

11.6 Clean construction areas before occupancy.

11.7 Maintain protection until such work is complete.

11.8 Protective Barriers for zones of heritage character: Refer to drawings and Section 01 35 91.

12 **TEMPORARY PORTABLE FIRE EXTINGUISHERS**

- 12.1 Provide portable fire extinguishers throughout construction areas; conform with fire authority requirements regarding location. Provide and maintain extinguishers in each temporary office or storage room.
- 12.2 Maintain extinguishers to requirements of Canadian Fire Underwriters' Association. Use pressurized water type extinguishers of 11.365 litres capacity; anti-freeze type if subject to low temperatures; pressurized dry chemical extinguishers in vicinity of gasoline, oil or grease or where electrically operated equipment is used with minimum 2.27 kg capacity.
- 12.3 Extinguishers shall remain the property of the Contractor. Remove at Substantial Performance of the work.

13 **SIGNS ON PROPERTY**

- 13.1 No signs on the property are allowed without Owner's written permission.

14 **TEMPORARY USE OF ELEVATORS**

- 14.1 The existing elevators are not allowed to be used without written permission of Owner.

15 **SCAFFOLDING, PLANT AND MACHINERY**

- 15.1 Provide form work, scaffolding, equipment, tools and machinery for the proper execution of the Work.
- 15.2 Construct and maintain scaffolding in a rigid, secure and safe manner. Erect scaffolding without damage to the structure or the finishes independent of walls. No anchorage to exterior or interior of the building will be allowed.
- 15.3 Use scaffolding in such a manner as to interfere as little as possible with other trades. When not in use, move scaffolding as necessary to permit installation of other work.
- 15.4 Remove scaffolding promptly when no longer required. Scaffolding in use over finished floor surfaces shall be mounted on rubber tired wheels.

16 **CONVEYING EQUIPMENT**

- 16.1 Provide and maintain conveying equipment such as cranes, hoists, derricks and the like as required for the proper execution of the project.
- 16.2 Assume complete responsibility for construction, strength, placing, anchoring and operation of derricks, cranes, hoists, guy and operating cables and any other mechanical contrivance used for the work, to ensure that any load carried thereon can be safely supported and be free from accidents to persons.
- 16.3 Make the use of accessory equipment and conveying systems available to all trades as required and make necessary arrangements in connection therewith.
- 16.4 Remove immediately such equipment when no longer required.
- 16.5 Where local by-laws and regulations or any authorities having jurisdiction require drawings and specifications on accessory and conveying equipment, obtain and pay for same and assume responsibility for their adequacy.

17 **STORAGE AREA**

- 17.1 No storage areas are available on the project site.
- 17.2 Delivery of materials to the job shall be carefully organized and coordinated by the Contractor to permit continual progress of construction.

18 **PARKING**

- 18.1 Parking will not be allowed on site.

19 **CONTRACTOR OFFICES**

- 19.1 There is no space allocated for Contractors Offices on the premises. Contractor is responsible to provide own temporary office in the construction area and associated services or temporary offices offsite.

20 **NOISE LIMITATIONS**

- 20.1 Keep construction noise to a minimum.
- 20.2 Work requiring significant cutting, drilling, coring and other loud/noisy work to be completed after hours.
- 20.3 Comply with local city by-laws for noise.

21 **ACCESS**

- 21.1 Provide and maintain free access to permanent or temporary fire extinguishing equipment.
- 21.2 Maintain full exit facilities at all times.
- 21.3 Keep existing egress free from materials, equipment and obstructions of all kinds.

22 **DEBRIS**

- 22.1 Contractor shall clean up and remove from the premises rubbish, surplus materials and equipment resulting from work. Remove debris daily as the work proceeds and on completion
- 22.2 Dampen debris and put in containers and remove by means of material hoist or put in sealed containers and removed through the designated egress routes.

23 **REMOVAL**

- 23.1 Maintain all temporary facilities and controls as long as needed for the safe and proper completion of the work; remove all such temporary facilities and controls as rapidly as progress of the work will permit or as directed by the consultant and repair the damaged surfaces.

24 **SAFETY**

24.1 Contractor is responsible for safety on site.

24.2 Contractor is to provide an electronic card system for monitoring the trades and all staff on site and provide weekly statistics on numbers of workers of each trade on site.

24.3 Contractor is to update and maintain fire evacuation plans for public areas affected by construction and for construction areas. Review fire evacuation plans with Toronto Fire Department and City Operations Staff as updates are prepared.

End of Section

1 **STANDARDS AND CODES**

- 1.1 Contract forms, codes, specifications, standards, manuals and installation, application and maintenance instructions, referred to in the Specifications unless otherwise specified and unless otherwise stated in the governing building code, shall be the latest published editions at the date of the Tender submission.
- 1.2 Conform to standards, in whole or in part, as stated in the Specifications.
- 1.3 If there is question as to whether any product or system is in conformance with applicable standards, the Owner reserves the right to have such products or systems tested at the Contractor's cost to prove conformance.
- 1.4 The cost for such testing will be borne by the Owner in the event of conformance with the Contract Documents or by the Contractor in the event of non-conformance.

2 **SPECIFIED OPTIONS**

- 2.1 When only one manufacturer's catalogued trade name is specified, provide only that catalogued trade name, material or product.
- 2.2 When more than one manufacturer's trade name is specified for a material or product, the choice is the Contractor's.
- 2.3 When more than one manufacturer's catalogued trade name is specified along with a referenced standard, the choice is the Contractor's on condition the material or product complies with the referenced standard.
- 2.4 When a material or product is specified by reference to a standard only, the Contractor may select any material or product that meets or exceeds the specified standard.
- 2.5 When a material or product is specified by prescriptive or performance specification, the Contractor may select any material or product meeting or exceeding the specification.
- 2.6 When a material or product is specified by reference to a standard or by prescriptive or performance specification, upon request of the Consultant, obtain from the manufacturer, an independent testing laboratory reporting, showing that the material or product meets or exceeds the specified requirements.

3 **QUALITY**

- 3.1 Products, materials, equipment and articles, referred to as Products throughout the specifications, incorporated into the Work shall be new, not damaged or defective, and of the best quality comparable with the specifications for the purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- 3.2 Defective products, whenever identified prior to the completion of work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- 3.3 Should any dispute arise as to the quality or fitness of products, the decision rests strictly with the Consultant based upon the requirements of the Contract Documents.

3.4 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the work.

4 **AVAILABILITY**

4.1 Immediately upon award of Contractor, review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify the Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of work.

4.2 In the event of failure to notify the Consultant at commencement of work and should it subsequently appear that work may be delayed for such reason, the Contractor shall, as determined by the Consultant and at no increase in Contract Price, temporarily install another product until such time as specified product becomes available, at which time the temporarily installed product shall be removed and the specified product installed.

5 **PRODUCT DELIVERY, STORAGE, HANDLING AND PROTECTION**

5.1 Handle and store products in a manner to prevent damage, adulteration, deterioration and soiling to the products, other building components, assemblies, other products, the structure, the site and surrounding property and in accordance with manufacturer's instructions when applicable.

5.2 Remove and replace damaged products at own expense and to the satisfaction of the Consultant .

5.3 Delivery and Handling:

- .1 Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
- .2 Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
- .3 Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
- .4 Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

5.4 Storage:

- .1 Store packaged or bundled products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in the work, except where otherwise specified for a specific item.
- .2 Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

- .6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in a heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

6 **TRANSPORTATION**

- 6.1 Pay costs of transportation of products required in the performance of the work.
- 6.2 Transportation cost of products supplied by the Owner will be paid for FOB curb side at the site by the Owner. Unload, handle and store such products.

7 **WORKMANSHIP**

- 7.1 Workmanship shall be the best quality, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Consultant if required work is such as to make it impractical to produce the required results.
- 7.2 Do not employ any unfit person or anyone unskilled in their required duties.
- 7.3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Consultant whose decision is final.

8 **SPECIAL PROTECTION AND PRECAUTIONS**

- 8.1 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).

9 **FASTENINGS**

- 9.1 Provide metal fastenings and accessories in the same texture, sheen, colour and finish as adjacent materials, unless indicated otherwise.
- 9.2 Use noncorrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected specification section.
- 9.3 Prevent electrolytic action between dissimilar metals and materials.
- 9.4 Space anchors within their load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- 9.5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- 9.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

10 **MANUFACTURER'S INSTRUCTIONS**

- 10.1 Unless otherwise indicated in the 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.
- 10.2 Notify the Consultant in writing, of conflicts between the specifications and manufacturer's instructions, so that the Consultant may establish the course of action.
- 10.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Consultant to require removal and re-installation at no increase in the contract price.

11 **TRADEMARKS AND LABELS**

- 11.1 Trademarks and labels, including applied trademarks and labels are not acceptable in the finished work, except those required for operating instructions, or when located in mechanical, electrical and control rooms.
- 11.2 Remove trademarks and labels by grinding, if necessary, painting out where the particular surface is being painted, or if on plated parts, replace with new plain plated or non-ferrous metal parts.

12 **CONCEALMENT**

- 12.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- 12.2 Before installation, inform the Consultant if there is a contradictory situation. Install as directed by the Consultant.

End of Section

1 DESCRIPTION OF WORK

- 1.1 Provide labour, material and equipment, fees and permits, necessary to install the equipment and supports as indicated on the equipment schedule, drawings, and specifications.
- 1.2 Comply with all rules, regulations, and by-laws of authorities having jurisdiction.
- 1.3 Equipment requiring power shall have the hydro electric power commission's certificate or label of approval and shall be complete with proper disconnect switches.
- 1.4 The requirements of each item of equipment are based on manufacturers' or suppliers' information. Before proceeding with work involving equipment, verify the actual equipment to be installed, and ascertain the criteria for services and supports actually required.

2 DEFINITIONS

- 2.1 **Install:** Includes labour, material, and equipment necessary for off-loading on delivery of equipment, handling, storing, breaking down into parts if required, transferring to the proper location in the building, making connections to building services, covering and protecting, final removal of covering and protections and making ready as required to form equipment which is fully operative, approved and in accordance with reviewed shop drawings and manufacturer's instructions.
- 2.2 **Supply:** Includes labour, materials, and equipment necessary for the purchase and delivery to the site of the equipment.
- 2.3 **Provide:** Supply and install.
- 2.4 **Remove:** Includes labour, materials, and equipment necessary for disconnecting from building services and capping services, detaching the equipment from its supports and connections to the building structure, detaching of existing supports and hangers which are not being relocated and turning all equipment over to the Owner. Any equipment being removed to be reviewed with Owner prior to disposal.

3 EQUIPMENT ITEM NUMBERS

- 3.1 Mechanical Equipment is listed and locations are shown on Mechanical Drawings.

4 SCHEDULING

- 4.1 Arrange schedules for the expeditious delivery of new equipment in co-operation with the Owner. Advise the Owner, in writing and in reasonable time of the required delivery date for each item of equipment supplied.
- 4.2 Arrange schedules in co-operation with the Owner for the removal of existing equipment in order to minimize interruption of operation of facility.

5 INSPECTION

- 5.1 Prior to disconnection of existing equipment which is to be removed, inspect the equipment in operation. Advise the Consultant, in writing, of any apparent malfunction or damage observed, before commencing work. Take care and provide such protection required to avoid damage to this equipment while carrying out the Work.

6 EQUIPMENT HANDLING

- 6.1 Make up the new equipment and break down the existing equipment, if necessary, into sections which can be handled into and through the building to its new location without alteration or damage to the building or fitments. Assemble this equipment when located in place of use.

7 SUPPORTS

- 7.1 Provide all supports, brackets, spring isolators, vibration and noise attenuation, hangers, connections and fasteners required to attach the equipment to the building.

8 INSTALLATION

- 8.1 Before installation commences, ensure that mounting devices, members, and surfaces are satisfactory for fitting, and adequate for securing of work.
- 8.2 Install work to meet manufacturer's recommended specifications, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation.
- 8.3 Work shall include rough hardware, fastenings, and other items necessary for secure installation.
- 8.4 Use only fastenings suitable for materials. Do not use through fastenings at roofs, floors, or walls.
- 8.5 Install work straight, plumb, level, and secured to prevent distortion or displacement, or both. Shim as necessary with concealed shims. Where required, use grout on which iron oxide deposits will not form.
- 8.6 Secure fixed equipment to building structure or construction as required to maintain it permanently in place and so that it functions properly with no damaging vibration to the building or itself.
- 8.7 Install equipment with connections provided as required for mechanical and electrical services. Make mechanical and electrical service connections in accordance with requirements of Divisions 21, 22, 23, 26, 27, and 28.

9 ADJUSTING AND CLEANING

- 9.1 Verify under work of this section that installed products function properly, and adjust them accordingly to ensure satisfactory operation.
- 9.2 Lubricate equipment as specified by equipment manufacturer.
- 9.3 Clean and polish all surfaces that are exposed to view from any location on completion of installation.

9.4 Remove packaging materials and debris from installation from the site.

10 **OPERATING INSTRUCTIONS**

10.1 Demonstrate to the Owner the functioning of the equipment supplied under this Contract at a time convenient to the Owner prior to acceptance of the facilities.

10.2 Fully explain all operating and maintenance procedures.

11 **EQUIPMENT SCHEDULE**

11.1 The equipment schedule in the detail drawings shall form part of the work of this Section.

End of Section

1 **DEFINITIONS**

- 1.1 Cutting: Removal of in-place construction necessary to permit installation or performance of other Work. Cutting does not include mere drilling of holes to accommodate screws, anchors, bolts or other fasteners, such drilling is part of each Section's installation function.
- 1.2 Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

2 **SUBMITTALS**

2.1 Submit written request in advance of cutting or patching which affects:

- .1 Structural integrity of any element of Work and of Project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of any operational element.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Owner or other Contractor.

2.2 Include in request:

- .1 Identification of Project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or patching.
- .4 Description of proposed work, and Products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on work by Owner or separate contractor.
- .7 Written permission of affected separate contractor.
- .8 Date and time work will be performed.

3 **PREPARATION**

- 3.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- 3.2 After uncovering, inspect conditions affecting performance of Work.
- 3.3 Beginning of cutting or patching means acceptance of existing conditions.
- 3.4 Provide supports to assure structural integrity of surroundings; devices and methods to protect other portions of Work from damage.
- 3.5 Provide protection from elements for areas which may be exposed by uncovering Work; maintain excavations free of water.

4 EXECUTION

- 4.1 Execute cutting, fitting, and patching including excavation and fill, to complete the Work.
- 4.2 Do not cut, drill or sleeve load-bearing members without obtaining written approval for each condition.
- 4.3 Fit the several parts together, to integrate with other work.
- 4.4 Uncover Work to install ill-timed work.
- 4.5 Remove and replace defective and non-conforming work.
- 4.6 Remove samples of installed Work for testing if directed by the Consultant.
- 4.7 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- 4.8 Perform work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing.
- 4.9 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- 4.10 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- 4.11 Restore Work with new Products in accordance with requirements of Contract Documents.
- 4.12 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and with suitable allowance for deflections and expansions and contractions.
- 4.13 Enclose pipes, ducts, conduit and wires passing through floors at areas where penetrations occur on suspended floors in a 100 mm high metal sleeve and make air and watertight with water resistant firestopping.
- 4.14 Completely seal voids of penetrations of fire rated wall, ceiling, and floor constructions with firestopping material, full thickness of the construction element.
- 4.15 Refinish surfaces to match adjacent finishes. Refinish continuous surfaces to nearest intersection. Refinish entire assembly.

5 HERITAGE RESTORATION WORK

- 5.1 Cutting and patching of heritage materials shall be performed in accordance with Section 01 73 30, Heritage Cutting and Patching.

End of Section

1 **GENERAL**

1.1 Summary

.1 Section Includes:

- .1 Administrative and procedural requirements for cutting and patching of Heritage Materials.

1.2 Precedence

- .1 Cutting and patching work of heritage materials shall be performed in accordance with this Section's requirements.
- .2 Requirements of this Section apply to all trades, including Structural, Mechanical, and Electrical trades.

1.3 Quality Assurance

- .1 Cutting and patching work governed by this Section shall be performed exclusively by qualified workers specialized in Heritage restoration work, according to type of Heritage Material involved.
- .2 Related trades requiring cutting and patching of Heritage Materials to perform their work shall coordinate closely with specialized Contractor executing the cutting and patching for scheduling and sequencing of the work.
- .3 Cutting and patching work, locations and dimensions of openings, are shown on the drawings cannot be changed or modified in any way unless approved by Consultant.
- .4 No changes or deviation from original cutting and patching layout will be permitted unless they are indicated and documented in the required cutting and patching proposal.
- .5 Consultant may require a mock-up of cutting and patching work.

1.4 Submittals

- .1 Prior to any cutting and patching in Heritage Materials, submit a Cutting and Patching Proposal.
- .2 Mandatory Cutting and Patching Proposals: specialized Contractor performing cutting and patching in Heritage Materials shall submit a proposal for each area describing procedures sufficiently in advance of the time cutting and patching will be performed so that Consultant can approve these procedures before proceeding.
- .3 Include the following information, as applicable, in the proposal:
 - .1 Extents of cutting and patching required, and as indicated on the drawings.
 - .2 Photograph of area where cutting is required.
 - .3 Show modifications and deviations from original design and justify reason for modification.
 - .4 Show how work will be performed indicating tools, methods, and materials.
 - .5 Indicate dates when cutting and patching will be performed.

- .6 Approval by Consultant to proceed with cutting and patching does not waive the Consultant's right to later require complete removal and placement of unsatisfactory work.

End of Section

1 INSPECTION/TAKEOVER PROCEDURES

- 1.1 Prior to application for Segment Acceptance or the certificate of Substantial Completion, the Contractor shall carefully inspect the Work and ensure it is complete, that the applicable Deficiencies List is complete, defects are corrected and the Segment of the Building, as applicable, is clean and in condition for occupancy. Notify Consultant in writing, of satisfactory completion of the applicable Work and request an inspection.
- 1.2 During Consultant inspection, the Deficiencies List will be adjusted based on the Consultant's observations.
- 1.3 When Consultant considers deficiencies and defects have been corrected and it appears that the requirements of the Contract have been performed, the Contractor may make application for Segment Acceptance or the certificate of Substantial Completion, as applicable.

2 CLEANING

- 2.1 The Contractor shall:
 - .1 Remove stains, paint, plaster, labels, caulking compound, spots, marks and dirt from decorative work, electrical and mechanical fixtures and equipment, fitments, walls, floors, ceilings, doors, windows, partitions.
 - .2 Vacuum, dust, clean and polish surfaces.
 - .3 Touch-up damaged painted areas.
 - .4 Clean and polish glass, mirrors, hardware, stainless steel, chrome, porcelain enamel, baked enamel and plastic laminate.
 - .5 Vacuum clean and dust behind grilles, louvres and screens.
 - .6 Clean concrete floors exposed in the finished work, including concrete floors with special finishes. Remove building paper, stains and debris. Scrub floors with rotary brush and water.
 - .7 Clean tiles of mortar splashes and grout haze.
 - .8 Clean other floors in a manner to be approved by the Consultant.
 - .9 Obtain Consultant's authorization before commencing with final cleaning.
 - .10 The cleaning in White Zones and of heritage materials shall be performed as per the Consultant's instructions and shall be submitted for approval prior to the commencement of the Work.
 - .1 The cleaning in the white zones and of heritage materials shall be performed by the qualified Trades that have been approved via mock-ups to complete the work.

3 **AS-BUILT RECORDS**

- 3.1 Keep an accurate record of 'as-built' conditions. Record clearly as the Work progresses, using industry standard drafting procedures, any variations from work, engineering or shop drawings, particularly underground services, footings and foundations.
- 3.2 Maintain documents in clean, dry, legible condition.
- 3.3 Before commencing any backfilling in service line, obtain measurements and information from plumbing and drainage, heating ventilating and air conditioning, electrical and sprinkler Subcontractors concerning correct location and depth of services.
- 3.4 As-built drawings are in addition to any 'as-built' drawings that may be required of Subcontractors under various trade specification sections.
- 3.5 In addition to the information provided from the various Subcontractors as-built drawings shall include revisions arising from approved Change Directives, Change Orders and Site Instructions.
- 3.6 These drawings will remain on the Project Site, available for the periodic review of the Owner and Prime Consultant.
- 3.7 At time of application for Substantial Completion of the Work, deliver to the Consultant 'marked-up' sets, reflecting such variations.

4 **OPERATION AND MAINTENANCE MANUALS (DATA BINDERS)**

- 4.1 Collect and assemble all manufacturer's data in logical order and insert in suitable hard cover, loose leaf binders approximately 215 mm x 280 mm (8-1/2" x 11"). Mark each section with a labelled tab protected with a celluloid cover.
- 4.2 Organize contents into applicable sections of work to parallel project specification breakdown using broad scope headings: Architectural, Mechanical and Electrical, etc.
- 4.3 Binders shall be submitted to Consultant in triplicate with at least the following:
 - .1 Identification on, or readable through, the front cover stating general nature of the Data Binder.
 - .2 Neatly typewritten index near the front of Data Binder, furnishing immediate information as to location in the Data Binder of emergency data regarding the installation.
 - .3 Complete instructions regarding operation and maintenance of equipment involved.
 - .4 Complete nomenclature of replaceable parts, their part numbers, current cost, and name and address of manufacturer and nearest vendor of parts.
 - .5 Cleaning and maintenance instructions for surfaces and materials.
 - .6 Description of equipment, operation and maintenance instructions for mechanical, electrical and sprinkler equipment.
 - .7 Copy of hardware schedule, paint schedule and name of Contractor and names of Subcontractors.
 - .8 Warranties.
 - .1 Contractor's Warranty: two (2) years as per Conditions of the Contract.

- .2 Extended Warranties: as specified in the Contract Documents.
- .3 Commencement of Warranty Periods: date of Ready-for-Takeover to be date for commencement for warranty period.
- .9 Complete list of mechanical and sprinkler equipment supplied and installed under the contract. Include name tag information such as make, type, size, capacity, serial number, etc.
- 4.4 Where contents of Data Binder include manufacturers' catalogue pages, clearly indicate the precise items included in this installation and delete, or otherwise clearly indicate, manufacturers' data with which this installation is not concerned.
- 4.5 Notes shall be typed.
- 4.6 Two (2) complete sets of final reviewed shop drawings (bound separately) indicating corrections and changes made during fabrication and installation.
- 4.7 Submit Data Binders in triplicate to Consultant at time of application for 'Substantial Performance of the Work'.
- 4.8 In addition to the hardcopies, submit three softcopies in pdf format (3 CDs) of the operation and maintenance manuals.

5 **DEMONSTRATION OF SYSTEMS**

- 5.1 Demonstrate to and instruct the City's personnel in operation and maintenance of all systems.
- 5.2 The demonstration to the City's operation team shall be in addition to the required demonstration of system operation to the Contract and should be part of the training program.
- 5.3 Refer to the various sections of the Specifications for the specific testing and training requirements.

End of Section

1 General

1.1 **SUMMARY**

- .1 This section describes the commissioning process and the responsibilities of the Contractor, the Consultant, Commissioning Authority and the City.

1.2 **DESCRIPTION**

- .1 The commissioning process provides the City with a high level of assurance that the building systems, including but not limited to the mechanical and electrical systems, have been installed in accordance with the Contract Documents, and operate within the design intent.
- .2 The process does not take away or reduce the responsibility of the Contractor to provide a finished product. Commissioning is intended to enhance the quality of the system start-up and aid in the orderly transfer of beneficial use and knowledge from the Contractor to the City.
- .3 The Commissioning Authority shall be Third Party hired and paid by Contractor.
 - .1 The Contractor and the Commissioning Authority shall coordinate with the Consultant, throughout the commissioning process, to fulfil the requirements of this section.

1.3 **SYSTEMS TO BE COMMISSIONED**

- .1 Refer to technical specifications for equipment and systems to be commissioned.

1.4 **COMMISSIONING PROGRAM**

- .1 The Commissioning Program is divided into four parts:
 - .1 Part 1: Verification Testing
 - .2 Part 2: Performance Testing
 - .3 Part 3: Systems Operating Manuals and Maintenance Schedules
 - .4 Part 4: Operator Training

1.5 **SUBSTANTIAL COMPLETION**

- .1 Substantial Completion of the trades work requires the following parts of the Commissioning Program to be completed and accepted by the City:
 - .1 Part 1: Verification Testing
 - .2 Part 4: Operator Training
- .2 Part 3 – Performance Testing may begin before Substantial Completion and extend upwards of nine (9) months minimum after Substantial Completion, based on seasonal conditions required to obtain test load conditions.

1.6 **ROLES AND RESPONSIBILITIES**

- .1 The following provides an overview of the expectations for each of the participants of the Commissioning Team.

- .2 City
 - .1 Assign maintenance and operations personnel and schedule them to participate in meetings, witnessing of demonstrations, and training.
 - .2 Designate a person(s) to sign-off and accept test reports.
 - .3 Provide any utilities required for the commissioning process.
- .3 Commissioning Authority
 - .1 Commissioning authority (CA) is responsible to be a primary point of responsibility to inform the City about the status of commissioning process & performance of the systems within the facility. CA will review construction documentations, prepare key commissioning documentations such as master commissioning progress management plan, tests & commissioning process table, template test forms, performance tests forms.
 - .2 Schedule regular commissioning coordination meetings.
 - .3 Scheduling – review the commissioning schedule prepared by the Contractor. Coordinate City’s commissioning personnel to be available at appropriate times for witnessing the tests. Schedule and conduct performance operational tests. Coordinate with City, Consultant and Contractor to schedule the training and its requirements.
 - .4 Information – receive and review the information including site instructions, change notices, progress reports, meeting minutes, etc.
 - .5 Observation of tests – observe selective tests, review installations, review test results and provide recommendations/observations.
 - .6 Provide template format for tests to applicable trade contractors. Document/Receive test results and review for completeness.
 - .7 Prepare tracking list showing all equipment and the various tests to be performed.
- .4 Acceptance Authority
 - .1 The Acceptance Authority shall be the building inspector, the Consultant, the Commissioning Agent, or the Project Manager as designated by the City.
 - .2 Witness demonstration tests of equipment and systems, and have the authority to sign-off on the test forms to accept the test results.
 - .3 Coordinate and schedule additional operations and maintenance personnel to witness the test if required.
- .5 Consultant
 - .1 Conduct periodic construction reviews to determine that the work is in general conformance with the Contract Documents.
 - .2 Responsible for the system evaluation, adequacy of the system to meet design intent, capacity of the system, and review of shop drawings.
 - .3 Attend the systems training sessions.
 - .4 Participate in operations staff orientation tours, and final construction reviews.
 - .5 Attend initial meeting with TAB or similar testing contractor(s) to review testing methodology and acceptance criteria.
 - .6 Review verification and performance testing sheets and procedures prepared by the Contractor.

- .7 Review testing documentation for system conformance to Contract Documents. Issue a report noting deficiencies requiring corrective work.
- .8 Review as-built records as required to the Contract Documents.
- .9 Review and comment on the final commissioning report.
- .6 Contractor
 - .1 Hire and pay for the services of suitably trained personnel to perform the functions of Commissioning Authority.
 - .2 Participate in the commissioning process by assigning suitably trained personnel to perform the functions.
 - .3 Be responsible for construction means, methods, site safety and construction management functions of the job site.
 - .4 Lead the coordination and scheduling of installation work and commissioning work.
 - .5 Ensure deficiencies are corrected.
 - .6 Include requirements for submittal data, start-up and testing, O&M data, and training in each purchase order or sub-contract written.
 - .7 Ensure cooperation and participation of Subcontractors.
 - .8 Ensure participation of major equipment manufacturers in appropriate training and testing activities.
 - .9 Hold regular commissioning coordination meetings.
 - .10 Prepare schedules for systems orientation and review, O&M manual submission, training sessions, systems testing, flushing and cleaning, equipment start-up, specialty testing, and completion of deficiency work. Prepare schedule in MS Project. Submit schedule on agreed revision cycle.
 - .11 Provide detailed schedule and notification for up-coming tests, a minimum of two weeks before the anticipated test data.
 - .12 Conduct system orientation and inspection at the equipment placement completion stage. Do not make connections to equipment until acceptance has been given by the City.
 - .13 Schedule vendors and Subcontractors to participate in the training sessions.
 - .14 Gather O&M manuals and data on all equipment, and assemble in binders as specified.
 - .15 Shop drawings, which are to be included in the O&M manuals, which are marked as "Reviewed" (or similar) by the Consultant or City, are to be marked on the front page as "ISSUED FOR MANUALS".
 - .16 Shop drawings, which are to be included in the O&M manuals, which are marked as "Reviewed as Noted" (or similar) by the Consultant or City, are to be revised by the manufacturer to incorporate comments and marked on the front paged as "REVISED FOR MANUALS".
 - .17 Shop drawings which are marked as "Revised and Resubmit" (or similar) shall not be included in the O&M manuals.
 - .18 Provide a final commissioning report as described below.

- .19 The Contractor shall prepare the test forms / use templates for every test identified in this specification. The Contractor shall complete each form as tests are completed and forward a copy to the Consultant for review on a monthly basis.
- .7 Equipment Suppliers and miscellaneous Subcontractors
 - .1 Provide submittals and appropriate O&M manuals.
 - .2 Attend initial commissioning coordination meetings scheduled.
 - .3 Participate in training sessions as scheduled by the Contractor.
 - .4 Demonstrate performance of equipment as applicable. This includes in-season and out-of season testing depending on time of year of Substantial Performance.
 - .5 Provide written and signed start-up reports and submit to the Contractor.
- 1.7 **COMMISSIONING PROCESS ALLOCATION**
 - .1 The Contractor's Schedule of Values submitted prior to payment request, is to identify general progress and commissioning payment line items for each of the following:
 - .1 For provision of as-built drawings, O&M manuals and warranties covering all sub-contracts, the following rule will apply:
 - .1 2.5% of total Contract value of the first \$1 Million;
 - .2 1.5% of total Contract value of the next \$4 Million;
 - .3 0.5% of total Contract value of the balance.
 - .2 5% of Mechanical sub-trade value for work comprising Commissioning process including submission of completed testing forms and commissioning reports;
 - .3 3% of Electrical sub-trade value for work comprising Commissioning process including submission of completed testing forms and commissioning reports.
 - .2 Contractor shall submit all test, balancing reports (air and hydronic) and verification forms. The Consultant will use these forms to calculate a percentage completion.
 - .3 Contractor may claim up to 60% of the value for commissioning through monthly progress payment requests leading up to performance testing. The remaining 40% of the value for commissioning shall not be paid out until the performance testing, and training have been completed.
- 2 Products
- 2.1 **GENERAL**
 - .1 Refer to technical specifications for each affected Division of the Work.
- 3 Execution
- 3.1 **COMMISSIONING PLAN AND SCHEDULE**
 - .1 Develop and submit an integrated commissioning progress plan and tests & commission process table. Contractor shall prepare the commissioning schedule in conjunction with construction schedule. Consultant will review the commissioning schedule.
 - .2 Contractor shall assist in the development and coordination of the overall commissioning schedule and plan.

3.2 VERIFICATION AND PERFORMANCE TESTING

- .1 Personnel
 - .1 Develop and document each commissioning test and procedure using personnel experienced in this type of work.
- .2 Test Reports
 - .1 Provide a verification test report for each piece of equipment.
 - .2 Provide a verification test report for each system.
 - .3 Provide a performance test report for each system.
 - .4 If template documents are used, modify document to suit the specific requirements of the system being tested.
 - .5 Submit test reports for review to the City and Consultant. Each report is to be reviewed for technical depth, clarity of documentation and completeness.
- .3 Safety Interlocks
 - .1 Test safety or permissive interlocks in a real or closely simulated condition of failure.
 - .2 Provide details of proposed method of testing each device.
 - .3 As a result of initial testing results, testing plans and procedures may need to be repeated or revised until results are satisfactory.

3.3 OPERATING AND MAINTENANCE MANUALS/SYSTEMS OPERATING MANUALS

- .1 Provide Operating and Maintenance Manuals (O&M) in accordance with the specific requirements of each Division of the Work and the Contract requirements.
- .2 Systems Operating Manuals (SOM) are to be provided.
- .3 Submit the O&M manuals for review at least two (2) months prior to the start of operator training.

3.4 TRAINING

- .1 Assist in scheduling and coordinating training sessions for the operations and maintenance staff for each system.
 - .1 Coordinate with the City and the O&M Staff to schedule each training session.
 - .2 The Contractor shall schedule training sessions with their Subcontractors and equipment manufacturer service representatives.
 - .3 Provide sign off sheet for training, to verify staff attendance.
- .2 Training is to be conducted in a classroom setting with the appropriate system schematics, hand-outs, and any audio/visual training aids on-site with the equipment.
- .3 Equipment vendors shall provide training on the specifics of each major equipment item including design intent, troubleshooting, and repair techniques.
- .4 Refer to each Division commissioning specification for training details.

3.5 RECORD DRAWINGS

- .1 The Contractor shall maintain and provide as-built drawings in accordance with Section 01 77 00 Contract Closeout.
- .2 The Commissioning Authority and Consultant shall review as-built Contract Documents to verify incorporation of both design changes and as-built construction details.

3.6 ACCEPTANCE PROCEDURES

- .1 The final acceptance procedures will be determined by the Acceptance Authority, and will include but not be limited to the following:
 - .1 Demonstration and acceptance of systems in full automatic control: BMS – Building Management System.
 - .2 All I/O points individually verified for proper function, calibration, and operation. The Consultant will audit report results and witness sufficient field tests to confirm all I/O have been tested.
 - .3 All control sequence of operation strategies have been tested, including alarm generation, graphics, remote reporting functions, and part load operation, change over.
 - .4 All graphic display devices are operating correctly.
 - .5 Mass storage of retrieved data is functioning correctly.
- .2 Witness Testing
 - .1 Request for witness testing only after already completing initial testing based on the accepted procedures and test sheet criteria. Where deficiencies are found by the Contractor during these initial tests, these deficiencies will be corrected before scheduling a demonstration (witness) test.
 - .2 If during a witness test, a deficiency is discovered that in the opinion of the Consultant prevents the safe operation of the equipment or system, the test shall be abandoned. The Contractor shall then correct the deficiency and reschedule the test(s).
- .3 Hands-On Work
 - .1 The Contractor shall provide all services requiring tools or the use of tools to start-up, test, adjust, or otherwise bring equipment and systems into a fully operational state.
 - .2 The Commissioning Authority & Consultant shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing and control functions.
- .4 The Contractor is responsible for the safe operation of the equipment and systems until such time as the equipment and systems have been accepted by the City. Once accepted by the City, the City may require the Contractor to maintain and operate the system until such time the City is prepared to operate the facility, and such work will be paid for by the City as a separate contract.

3.7 **FINAL COMMISSIONING REPORT**

- .1 Upon completion of all four phases of the commissioning program, provide a final Commissioning Report for each Division of the Work describing the following:
 - .1 General Summary – a listing of each system and date of Acceptance.
 - .2 System Summary – a general description of the state of operation of each system, including any noted operating problems which were discovered and corrected during the commissioning process, as well as those problems which were discovered but were not resolved.
 - .3 Documentation Index – Document Type – a table index listing all commissioning documents, arranged alphabetically by type of document (Verification Test, Performance Test, O&M, SOM, Training).
 - .4 Documentation Index – Alphabetic – a table index listing all commissioning documents, arranged alphabetically only by system name and/or equipment name.

End of Section

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 WORK INCLUDED

- .1 This section of the work covers the requirements for demolishing, salvaging and removing wholly or in part the various items designated on the drawings or required to be removed or partially removed for the receipt of the work of this Contract.
- .2 Items to be demolished or removed are to be based on their condition on date that tender is accepted.
- .3 Demolition and preparatory work includes, but is not necessarily limited to:
 - .1 Alteration and renovations to existing building.
 - .2 Cutting and removing of walls, floors, ceilings, etc., in the existing building.
 - .3 Patching, making good walls, floors, ceilings, etc., after the installation of the work of the mechanical and electrical trades, including finishes and painting.
 - .4 Removal of rubbish, debris, demolished fixtures, fitments and items not scheduled to remain the Owner's property, resulting from the demolition and preparatory work.
 - .5 Dust Control during the operations of the work of this section.
 - .6 Coordinate all demolition work with the abatement scope and include for protective measures as required in the Contract Documents.
 - .7 Coordinate all demolition work with the heritage salvage and removal scope performed by the appropriate trade, and include for Historic protective measures as required in the Contract Documents.
 - .8 Be responsible for relocation of Contractors and Subtrade facilities, furniture and temporary infrastructure relocation.
 - .9 Signage
 - .1 Remove and legally dispose of all directional and information Signage unless noted otherwise.
 - .10 Mechanical Demolition
 - .1 Removal and relocation of existing piping, ductwork, equipment valves, fire protection systems and appurtenances: as shown on Mechanical Demolition drawings and as determined by site surveys of existing areas.
 - .2 Remove ductwork firelines, domestic water, hydronic piping, sanitary vents and drains, and storm drains and install new piping as shown on the drawings to meet base building standards and existing pipe sizes. All work is required to meet the requirements of the Authority Having Jurisdiction.
 - .3 Survey the site prior to pricing the demolition work, to determine amount of demolition scope.

- .4 Provide temporary/new duct and pipe installations complete with insulation and reconnect to existing as shown on Mechanical drawings and where necessary to maintain uninterrupted operation of systems already in place.
- .5 Re-insulate existing pipe and duct sections and insulate new to a standard specified in these specifications.
- .6 Shut-down the steam piping prior to asbestos abatement and during asbestos abatement.
- .7 Prior to shutting down and/or removal of any system, give 4 business days notice to the Owner's Representative and Consultant. Obtain written permission prior to starting any work.
- .8 When sections of existing systems need to be removed, provide temporary provisions to maintain system operation. These provisions include, but are not limited to the following: all necessary pipe by-passes & valves, sumps with pumps, ductwork, insulation and all other appurtenances as required. After work is complete, reinstate the system piping to its original functioning state.
- .11 Electrical Demolition
 - .1 Refer to section 26 05 04, Existing Building – Modifications, and drawings.

1.3 **WORKS UNDER OTHER SECTIONS**

- .1 Remediation work: Refer to Designated Substances Survey Report and Division 02 for complete list of hazardous materials abatement.
- .2 Protection of heritage fabric during demolition: Refer to Section 01 35 91 Historic Protective Measures, and Section 01 73 30 Heritage Cutting and Patching.
- .3 Capping, diverting, cutting-off or removal of water, gas, electricity and other services in areas being altered which are affected by the changes - under Mechanical and Electrical trades.

1.4 **QUALITY ASSURANCE**

- .1 Comply with pertinent codes, regulations and insurance carriers providing coverage for this work.
- .2 Execute the work in strict accordance with "The Occupational Health and Safety Act and Regulations for Construction Projects" latest addition. Keep copy of the Act at the place of the Work at all times.
- .3 Carry out demolition work in accordance with CSA-S350.
- .4 Submit fire safety plan in accordance with Owner's requirements.
- .5 Site Meetings: Convene pre-installation meeting two (2) weeks prior to beginning work of this Section to verify and confirm understanding of project requirements, examine existing site conditions, and co-ordinate with other building sub trades. Any issues or site conditions discovered during this time which may be considered out of scope or unclear must be presented to Consultant for confirmation or exclusion. Items not brought forward during this window will be deemed to be accepted by the Contractor.

1.5 **CONTAMINANT INVESTIGATION DATA**

- .1 The following documents, prepared by Pinchin, are issued as an Appendix:
 - .1 Hazardous Building Materials Assessment (Pre-Construction) Report, dated September 16, 2024.
- .2 These documents were prepared and furnished in good faith for the information of the Contractor. They do not cover all conditions of the site or other localized conditions. Be satisfied with regard to all matters relating to the designated substances which may affect methods or cost of construction before commencing work.
- .3 Neither the Owner nor the Consultant guarantee the accuracy or completeness of the report. The Owner and the Consultant assume no responsibility for any interpretation or deduction that the Contractor may make from the report.
- .4 Removal of Hazardous Wastes
 - .1 Remove contaminated or dangerous materials as defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.
 - .2 Refer to the Report and specifications for general locations of hazardous materials throughout the area and removal procedures.

1.6 **SUBMITTALS**

- .1 Submit demolition and cutting schedule to Consultant for review. Schedule to show timing and phasing of the Work in the various areas of the existing building. Deviation from schedule will not be permitted without prior approval.
- .2 Submit drawings to Consultant for review of demolition of structural elements.
 - .1 Make sure drawings bear the seal and signature of a licensed Professional Engineer, registered to practice in the Province of Ontario.
 - .2 Drawings to indicate extent of demolition and method of temporary shoring of existing structure where required.

1.7 **PROTECTION**

- .1 Use all means necessary to protect existing objects designated to remain and in the event of damage, immediately make all repairs and replacements necessary to the approval of the Consultant and at no additional cost to the Owner.
- .2 Provide protection required to enable existing building and equipment to remain in continuous and normal operations, and maintain construction schedule.
- .3 Erect and maintain barricades, covered ways, barriers, scaffolding, screens, notice and warning boards, lights and signals of all kinds for protection of workmen, adjoining property and public. Public access and continuity of traffic flow must be maintained at all times or re-routed. Professional signage and way finding directions to be posted to accommodate same.

1.8 **TEMPORARY ENCLOSURES / PARTITIONS**

- .1 Erect partitions prior to demolition. Construct partitions in accordance with Section 01 50 00.
- .2 Prevent dust, dirt and water from demolition operations entering operational areas.

- .3 Adjust and relocate partitions as required for various operations of Work.
- .4 Upon completion of Work, remove and dispose of partitions from Site.

1.9 **EXISTING CONDITIONS**

- .1 Reference drawings showing services indicate general location only and do not indicate every existing service. Prior commencing work, locate and identify each service and arrange for protection with the service owner.

PART - 2 PRODUCTS

2.1 **MATERIALS**

- .1 Temporary braces, tie-rods, clamps, supports and cratings, temporary partitions: constructed in accordance with plans prepared by Contractor.

PART - 3 EXECUTION

3.1 **PREPARATION**

- .1 Notify the Consultant at least seven (7) days prior to commencing of the work.
- .2 The drawings do not purport to show all objects existing on the site.
- .3 Before commencing the work, carefully check drawings and verify with the Consultant regarding all objects to be removed and all objects to be preserved.
- .4 Schedule all work in a careful manner with all necessary consideration for the requirements of the Owner, his employees and the public.
- .5 Avoid interference with the use of, and passage to and from, adjacent buildings and facilities. No loading/unloading of tools or material in public spaces without prior approval of submitted work plan at least five (5) days in advance of requirement.
- .6 Before shutting-down any system verify with the Owner and schedule acceptable shut-down date with minimum 7 days notice.
- .7 Before starting the operations, arrange with the appropriate trade concerned for the disconnection of all utility services, affecting the work.
- .8 Preserve in operating condition all active utilities to remain.

3.2 **PROTECTION**

- .1 Obtain written permission from Consultant to proceed with demolition work.
- .2 Prevent movement, settlement or damage of adjacent structures, services, walks, adjacent grades and parts of existing building to remain.
 - .1 Provide bracing, shoring and underpinning as required.
 - .2 Repair, as directed by Consultant, damage caused by demolition at no additional cost to the Contract.
- .3 Ensure materials, equipment and procedures safely support existing structure and construction live loads. Assume responsibility for structure and related components. Maintain continued structural stability.

- .4 Support affected structures and, if safety of structure being demolished or adjacent structures or services appears to be endangered, take preventative measures, stop Work and immediately notify Consultant.
- .5 Prevent debris from blocking surface drainage system, sumps, sewers, doorways, hallways, stairs, elevators, mechanical and electrical systems which must remain in operation.
- .6 Protect work in the existing building, such as floors, finishes, trim, etc., as completely as possible to hold the replacing of damaged work to a minimum. For heritage areas refer to Section 01 35 91.

3.3 **HERITAGE AREAS WORK**

- .1 Contact Consultant without delay, if the demolition of existing mechanical and electrical equipment and their scope of work, or the installation of new mechanical and electrical equipment and their scope of work involves removal, damage or modification to any of the existing heritage fabric. All Work in the immediate areas is to cease pending further instruction by Consultant.

3.4 **DEMOLITION AND PREPARATORY WORK**

- .1 In order to afford the least interference with the efficient operations of the existing building and to keep the risk of fire to a minimum at all times, the Contractor shall ensure that demolished materials are continuously removed from the buildings and grounds as they accumulate, that no hazard condition is left during non-working hours and that full measures are taken by sprinkling and other means to keep dust to a minimum and to confine what dust there is within the working area.
- .2 Maintain, with approval of authorities having jurisdictions, proper and safe means of fire exit from all zones of the existing building to the approval of the authorities having jurisdiction.
- .3 Confine operation to those parts of the buildings which are to be altered or renovated. Do not damage existing construction beyond that necessary for performance of new work and repair such damage as required.
- .4 Materials arising from the demolition and preparatory work shall become the property of the Contractor unless indicated otherwise and be removed from the site.
- .5 Materials and equipment to be relocated for reuse in the new work shall be carefully removed in re-usable condition, transported and stored on the site where directed by the Consultant and protected against damage.
- .6 Existing footings, foundations, pipe lines, electrical conduit and wiring shall not be undermined, damaged, or endangered by digging, cutting or any other operation in the performance of the work. Undermined, damaged or endangered work to be made good at no additional cost to the Owner.
- .7 Cut openings through existing walls, partitions, and floors. Maintain fire separation and fire stopping as applicable. Establish exact location of steel reinforcing in existing concrete slabs or walls before holes are made. Be responsible for damage to existing steel reinforcing and be liable for structural failure. Make good surfaces disturbed with materials to match existing.
- .8 Cut existing gypsum board and drywall to expose existing masonry, studs or other rough wall face to accommodate new work.

- .9 Sawcut floors, walls, ceiling and roof before demolition is started, where necessary to minimize damage. Make cuts with clean, true, smooth edges.
- .10 Where items are to be removed from existing structure or surfaces that are to remain in place, remove those items complete with hangers, brackets and other readily removable supports and fastenings:
 - .1 Remove bolts, but not inserts embedded in concrete or masonry.
 - .2 Remove bolt and rivet fastenings from steel structure.
- .11 Demolish work into sections of practical size for removal without alteration or damage to the existing building remaining in place.
- .12 Upon completion of demolition, leave interior surfaces broom clean.
- .13 New openings required in existing walls and partitions shall be carefully cut and formed to blend into existing work. Provide lintels. New masonry used to close off openings shall be toothed into existing masonry.
- .14 Join and make good new work to existing in such a manner that joints are structurally sound and inconspicuous.
- .15 Cuts, breaks and other temporary openings into existing surfaces, which are required for installation or application of new fixtures, fitments, materials or services shall be, at completion of work, patched and/or made good and finished to blend with surrounding finishes. Openings to allow passage of ducts shall be closed tight to perimeters of duct at all locations where fire dampers are required.
- .16 Where fireproofing membranes or coverings to existing structural steel members and open web steel joists are disturbed, restore the fire protection with materials and methods acceptable by the authorities having jurisdiction.
- .17 Materials and other equipment not required for re-use shall not be stored or sold from the site.
- .18 Maintain the existing building in a weather and watertight condition at all times.
- .19 Maintain security of existing building.

3.5 **CUTTING AND PATCHING**

- .1 Perform cutting, fitting, and patching to complete the Work in accordance with Section 01 73 29.
- .2 Cutting and patching of heritage items must be performed by a qualified trade in strict accordance with the Section 01 73 30.

3.6 **STRUCTURAL DEMOLITION**

- .1 Structural elements shall only be demolished as part of an overall demolition plan which ensures the continued safety of the structure and the construction activities.
- .2 Demolition plan shall include considerations of preparatory work, temporary shoring, jacking, other load transfer procedures, reinstatement of permanent load bearing members and any other parameters that will render the demolition safe and the permanent condition safe and conforming to Project Drawings.

- .3 Demolition plan and all associated methodologies, material selection and shop drawings shall be designed, detailed and executed by a Professional Engineer licensed to practice in the Province Ontario.
 - .1 Contractor to engage and pay for services of Professional Engineer responsible for work of this Section.
- .4 Demolition plan and all associated methodologies, material selection and shop drawings shall be submitted for review by the Consultant prior to commencement of such activities.
- .5 Openings in walls and slabs shall be done as per details on drawings where shown, otherwise consult with NORR Structural Engineer for any new openings.

3.7 **REMOVAL FROM SITE**

- .1 Demolished materials become Contractor's property. Remove materials from site, unless such materials are identified by the Owner or shown on Contract Documents to be reused or turned over to Owner.
- .2 Contractor responsible for Work of this Section must present a path of travel for the demolition work debris from the work area to the disposal area.
 - .1 Contractor responsible for Work of this Section is also responsible for protection of heritage materials in that path of travel even if it does not fall within their work area.
 - .2 Damage to heritage materials in that path of travel will be evaluated by the Consultant and the repair costs, including but not limited to the material replacement will be deducted from the Contractor's final payment.
- .3 Transport material designated for alternate disposal using approved haulers and in accordance with applicable regulations.
- .4 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.

3.8 **MAKING GOOD**

- .1 Make good finishes and restore areas damaged or disturbed during demolition to conditions that existed prior to beginning of Work.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

- .1 Labour, Products, equipment and services necessary to complete the work of this Section for fire stop systems intended to fill gaps between fire separations, between fire separations and other construction assemblies, or used in or around items which fully or partially penetrate a fire separation, to restrict the spread of fire and smoke, and to maintain the integrity of a fire separation.
- .2 This Section includes firestopping work for entire Project including selection, installation and inspection of all required firestops and smoke seals.

.2 Related Requirements

- .1 Comply with Conditions of the Contract and Division 01 - General Requirements.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM):

- .1 ASTM E119-20, Standard Test Methods for Fire Tests of Building Construction and Materials.
- .2 ASTM E595-21, Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment.
- .3 ASTM E2032-21, Standard Guide for Extension of Data From Fire Resistance Tests Conducted in Accordance with ASTM E119.
- .4 ASTM E2174-20a, Standard Practice for On-Site Inspection of Installed Fire Stops.
- .5 ASTM E2393-20a, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

.2 Firestop Contractors International Association (FCIA)

- .1 FCIA Firestop Industry Manual of Practice (MOP), 8th Edition.

.3 Factory Mutual Approvals (FM)

- .1 FM 4991, Approval Standard for Firestop Contractors.

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

- .1 Safety Data Sheets (SDS).

.5 International Accreditation Service (IAS)

- .1 IAS AC291, Accreditation Criteria for Special Inspection Agencies.

.6 International Firestop Council (IFC)

- .1 IFC Guidelines for Evaluating Engineering Judgments, Rev 2018-10.
- .2 IFC Guidelines for Evaluating Engineering Judgments - Perimeter Fire Barrier Systems, Rev 2007-02, Reaffirmed 2018-04.
- .3 IFC Handbook, Firestopping Inspection Manual.
- .4 IFC Inspection Guidelines for Penetration Firestop Systems and Fire Resistive Joint Systems in Fire Resistance Rated Construction, 5th Edition.

- .7 Intertek Testing Services/Warnock Hersey International Inc. (ITS/WH):
 - .1 Intertek Online Directory of Listed Products bearing the WH-ETL mark.
- .8 Underwriters' Laboratories of Canada (ULC):
 - .1 CAN/ULC-S102-2018, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S115-2018, Standard Method of Fire Test of Firestop Systems.
 - .3 ULC Qualified Firestop Contractor Program.

1.3

DEFINITIONS

- .1 Fire Blocking: materials, components or system installed in a concealed space in the building to restrict the spread of fire and smoke in that concealed space or from that concealed space to an adjacent space.
- .2 Fire Stop: a material, component or system, and its means of support, used to protect gaps between fire separations, between fire separations and other construction assemblies, or used in openings where penetrating items wholly or partially penetrate fire separations, to restrict the spread of fire and smoke thus maintaining the fire-resistance continuity of a fire separation.
- .3 Fire Stop System: the combination of specific materials and/or devices required with the penetrating item(s), the assembly and the opening to assemble the fire stop.
- .4 Intumescent: materials that expand with heat to prevent fire spread through fire separations.
- .5 Listed Fire Stop System: a specific field erected construction consisting of the assembly, fire stop materials, any penetrating items and their means of support which have met the requirements for an F, FT, FH, FTH and/or L rating when tested in a fire-resistance rated assembly in accordance with CAN/ULC-S115, Standard Method of Fire Tests of Firestop Systems.
 - .1 F-Rating: the amount of time a fire stop system can remain in place without the passage of flame through the opening or the occurrence of flaming on the unexposed face of the fire stop.
 - .2 FT-Rating: a fire stop system with an F-Rating for the required time period which can also resist the transmission of heat through the fire stop during the same period and limit the rise in temperature on the unexposed face and/or penetrating item of the fire stop.
 - .3 FH-Rating: a fire stop system with an F-Rating for the required time period which can also resist the force of a hose stream without developing openings for a prescribed period.
 - .4 FTH-Rating: a fire stop system with an FT-Rating for the required time period which also passed the hose stream test for a prescribed period.
 - .5 L-Rating: largest test sample leakage rate, determined in accordance with the optional air leakage test of CAN/ULC-S115.
- .6 Multi-penetration: two or more service penetrations through an opening in the fire separation.
- .7 Non-rated Fire Separation: fire separation acting as a barrier to the spread of smoke until a response is initiated such as the activation of a fire suppression system.
- .8 Single-penetration: single service penetration through an opening in the fire separation.

- .9 System Design Listing: document providing proof of testing with technical details, specifications and requirements that leads to the application of a specific listed fire stop system.

1.4 **SYSTEM DESCRIPTION**

- .1 Work of this Section is inclusive of all firestopping specified herein and indicated on Drawings except for firestopping and smoke seal within mechanical assemblies (i.e. inside ducts, dampers, intumescent pipe sleeves) and electrical assemblies (i.e. inside bus ducts) shall be provided as part of work of the Mechanical and Electrical Divisions respectively. Firestopping and smoke seals around outside of such mechanical and electrical assemblies, where they penetrate fire rated separations, shall be part of work of this Section.
- .2 Fire stopping materials and/or systems intended to act as firestop and smoke seal for any through-penetrating items, termination devices, receptacles or any cut-out openings or joints, including openings and spaces at perimeter edge conditions, with wall and floor assemblies having fire-resistance rating.
- .3 Fire stop and seal (draft-tight) gaps, expansion joints and penetrations in fire separations and fire walls against passage of fire, smoke, gasses, fire fighter's hose stream and, where designated, passage of liquids. Smoke seal at angle support at fire dampers.
- .4 Materials and systems capable of providing effective barrier against passage of fire, smoke, gasses, and where specifically indicated passage of liquids.
- .5 Ensure firestopping system provides fire-resistance rating (flame and temperature) not less than fire resistance rating of surrounding floor, wall or assembly, in accordance with requirements of the Building Code.
- .6 Firestop system rating: Comply with F, FH, FT, FTH or L ratings as required by authorities having jurisdiction.
- .7 Firestopping seals except for wall joints in visible areas must be of easily identifiable colour, such as red or yellow to be clearly distinguished from other building materials.
- .8 Supply asbestos-free and PCB-free materials and systems tested in accordance with CAN/ULC S115, be ULC listed, or be acceptable by authorities having jurisdiction.
- .9 Ensure suitability of products for application and compatibility of materials with surfaces to which it will be applied.
- .10 Site system assemblies shall be in accordance with ULC listed system design. If there are no listed systems available, submit an Engineering Judgment in accordance with the requirements described in Article "Action and Informational Submittals".

1.5 **PRE-INSTALLATION MEETINGS**

- .1 Convene pre-installation meeting minimum two weeks prior to beginning work of this Section with Consultant and the trade performing the work to:
 - .1 Verify Project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordinate with other building trades.
 - .4 Review system design listings, manufacturer's installation instructions and warranty requirements.
- .2 Convene pre-installation meetings with other trades to review:
 - .1 Installation procedures and precautions.

- .2 Location, scheduling and sequencing of other work around fire stops that can affect the outcome of the installation.
 - .3 Requirements for annular opening sizes.
 - .4 Requirements and preparations for wall/floor single and multi-penetrations.
 - .5 Requirements for construction and perimeter joints.
 - .3 Submit copies of applicable listed fire stop system details to each trade for opening preparation. Include installation details required for the listed system.
 - .4 Meeting minutes: Contractor to take minutes of pre-installation meetings and distribute to Consultant and each affected trades.
- 1.6 **ACTION AND INFORMATIONAL SUBMITTALS**
- .1 Qualification Statement: Submit qualification statements and certificates demonstrating compliance with the qualification requirements of this Section, as described in Article "Quality Assurance", within 10 working days after award of contract and before starting Work.
 - .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet prior to ordering materials. Submit complete product data for each individual component and include:
 - .1 Product name and product number.
 - .2 Product characteristics and performance criteria.
 - .3 Physical size, finish and limitations.
 - .4 Technical data on out-gassing, off-gassing and age testing.
 - .5 Curing time.
 - .6 Chemical compatibility to other construction materials.
 - .7 Shelf life.
 - .8 Life expectancy.
 - .9 Temperature range for installation.
 - .10 Humidity range for installation.
 - .11 Sound attenuation STC-Rating.
 - .2 For each individual component, Submit copies of WHMIS Safety Data Sheets (SDS).
 - .3 Submit a comprehensive list of all products and components included in submittal.
 - .3 Shop Drawings: Submit complete and detailed Shop Drawings for each condition encountered on Site. Indicate following:
 - .1 Submit shop drawings showing system design listings for Project including proposed materials, primers, reinforcement, anchorage, fastenings and method of installation.
 - .2 Construction details to accurately reflect actual job conditions for each product and assembly.
 - .3 Submit details for materials and prefabricated devices.

- .4 Submit electronic copy of shop drawings and include:
 - .1 Title page, labelled "Fire and Smoke Stop System Listings". Include project name, date and the names of the installation company and the manufacturer of proposed products.
 - .2 Table of Contents.
 - .3 List of each proposed listed fire stop system and corresponding service penetration type or joint type in a matrix spreadsheet schedule, indicating floor and wall system, including rating for each, size of opening, and adjacent materials.
 - .4 Location of penetrations.
 - .5 System Design Listings.
- .4 Samples: At the time of shop drawing submission, provide to Consultant duplicate 300 x 300 mm samples of each type of label proposed for the identification of fire and smoke stop systems.
- .5 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, substrate preparation, installation sequence, and cleaning procedures.
- .6 Engineering Judgments:
 - .1 Where there is no specific tested listed fire stop system available from the manufacturer for a particular fire stop configuration, review systems from other manufacturers to obtain a listed fire stop system.
 - .2 Submit Engineering Judgment from the system manufacturer if there are no listed systems available from other manufacturers.
 - .3 Prepare and submit an Engineering Judgment in accordance with best practices established in the following documents:
 - .1 IFC Guidelines for Evaluating Engineering Judgments.
 - .2 IFC Guidelines for Evaluating Engineering Judgments - Perimeter Fire Barrier Systems.
 - .4 For each Engineering Judgment submitted, include:
 - .1 Project name, number and location.
 - .2 A description of the proposed system with detailed drawing.
 - .3 Installation instructions.
 - .4 Complete descriptions of critical elements for the fire stop configuration.
 - .5 Copies of all referenced system design listings on which the Engineering Judgment is based on.
 - .6 Engineering Judgment issuer's name and contact information.
 - .7 Date of issue of Engineering Judgment with seal and signature of a registered Professional Engineer, licensed to practice in the Province of Ontario.
 - .8 Manufacturer letter stating their opinion, with supporting justification, that the Engineering Judgment will perform as a fire stop system were it to be subjected to the appropriate standard fire test method for the required fire rating duration.

- .5 Once the Engineering Judgment has been reviewed by Consultant, submit the Engineering Judgment to the authority having jurisdiction for final approval.
 - .6 Include the cost of Engineering Judgment in the work of this Section.
 - .7 Engineering Judgment shall be prepared only by fire stop manufacturer's qualified technical personnel or jointly with the manufacturer by a knowledgeable registered Professional Engineer, a Fire Protection Engineer or an independent testing agency that provides testing and listing services for fire stop systems similar to the Engineering Judgment being contemplated.
 - .1 Engineering Judgment must be stamped, signed and dated by a registered Professional Engineer, licensed to practice in the Province of Ontario.
 - .8 Engineering Judgment shall be based upon interpolations of previously tested fire stop systems that are either sufficiently similar in nature or clearly bracket the conditions upon which the Engineering Judgment is to be given. Additional knowledge and technical interpretations based upon accepted engineering principles, fire science and fire testing guidelines (e.g.: ASTM E2032) may also be used as further support data.
 - .9 Engineering Judgment shall be based upon knowledge of the elements of the construction to be protected and understanding of the probable behaviour of that construction and the recommended fire stop system protecting it were they to be subjected to the adequate standard fire test method for the required fire rating duration.
 - .10 Engineering Judgment shall be limited to the specific conditions and configurations upon which Engineering Judgment was rendered and should be based upon reasonable performance expectations for the recommended fire stop system under those conditions.
 - .11 Engineering Judgment shall be accepted only for a single specific job and location and should not be transferred to any other job or location without thorough and appropriate review of all aspects of the next job or location's circumstances.
- .7 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Part 3 - Field Quality Control.

1.7 **CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual. Include:
 - .1 WHMIS Safety Data Sheets (SDS).
 - .2 Product data and manufacturer's installation and maintenance instructions for each product/system used on this project.
 - .3 Approved system design listings and Engineering Judgments.
 - .4 Matrix schedule listing all system design listings and Engineering Judgments with a description of their penetration or joint type.
 - .5 Certifications:
 - .1 Proof of training for each worker that performed installation on the Project.
 - .2 Proof of company as a FCIA - Member in Good Standing.
 - .3 Certification of company as a ULC Qualified or FM 4991 Approved Firestop Contractor, including the Designated Responsible Individual (DRI) certificate.

- .4 Accreditation of third-party inspection firm.
- .6 Manufacturer's field reports.
- .7 Third-Party Inspection reports.
- .8 Warranty information on fire stop installations.
- .9 Life expectancy of each product installed as part of Project. For each system, list the installation date of products and the expected expiration date (month/year).
- .2 Record Documentation:
 - .1 Maintain a daily log of all activities on site during the course of construction. Submit a copy of all daily logs after completion of fire stopping work.
 - .2 As-built Drawings:
 - .1 Submit marked-up set of drawings to provide referencing system identifying the location of each fire stop.
 - .2 Identify each penetration type fire stop with their penetration identification number.
 - .3 Provide detailed drawings of system design listings for each type of fire stop (i.e.: through-penetration, blank opening, construction joint, building perimeter).
 - .3 Fire Stop Schedules:
 - .1 Submit complete fire stop schedules for floors, walls and ceilings, and slab edge conditions.
 - .2 Indicate all penetration fire stops and joint fire stops through each reference wall, floor and ceiling in the schedules.
 - .3 Cross-reference fire stop schedules with as-built drawings and indicate design listing numbers associated to each penetration fire stop and joint fire stop.

1.8 **QUALITY ASSURANCE**

- .1 Provide systems selection and analysis, installation and inspection of fire stop systems in accordance with the recommended practices detailed in the following guides:
 - .1 FCIA Firestop Manual of Practice (MOP).
- .2 Qualification Requirements:
 - .1 Contractor specializing in selection and installation of fire stops with five years documented experience approved by manufacturer. If requested, submit a list of five successfully completed projects of similar scale and type.
 - .2 Company recognized as a Member in Good Standing with the Firestop Contractors International Association (FCIA). Submit written proof of current membership.
 - .3 Training: workers, including site supervisor, to have completed:
 - .1 Manufacturer training on the products/systems installed as part of this Section.
 - .4 Certified Firestop Contractor: company certified with one of the following programs:
 - .1 ULC Qualified Firestop Contractor Program. Submit signed copy of ULC Qualified Firestop Contractor Program certificate.

- .2 FM 4991 Approved Firestop Contractor. Submit signed copy of FM 4991 Approval certificate.
- .5 Third-Party Inspection Firm: IAS AC291 Accredited inspection agency with inspectors who have passed the ULC Firestop Exam or FM Firestop Exam.
- .3 Manufacturer Site Visits: as part of Manufacturer's Services described in PART 3 - Field Quality Control, schedule site visits, to review Work, at stages listed. Confirm exact dates to with Contractor.
 - .1 After delivery of products, and when preparatory work is complete, but before installation begins.
 - .2 At least one time during progress of Work.
 - .3 Upon completion of Work, after cleaning is carried out.
- 1.9 **COORDINATION**
 - .1 Coordinate with trade work involved and advise dates where work will take place throughout various areas of Work.
- 1.10 **DELIVERY, STORAGE AND HANDLING**
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .2 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC/cUL or WH-ETL markings, manufacturing date, shelf life expiry date.
 - .3 Coordinate delivery of materials with scheduled installation dates to allow minimum storage time on site.
 - .4 Storage and Protection:
 - .1 Store materials indoors for 24 hours minimum prior to use.
 - .2 Store indoors in clean, dry, well-ventilated area.
 - .3 Comply with recommended procedures, precautions and measures described in WHMIS Safety Data Sheets (SDS).
 - .5 Protect materials from damage and detrimental environmental conditions.
 - .6 Replace defective, expired or damaged materials with new as no extra cost to the Owner.
- 1.11 **ENVIRONMENTAL CONDITIONS**
 - .1 Install fire stops when ambient and substrate temperatures are within the limits prescribed by the manufacturer and when the substrate is dry and without risk of condensation.
 - .2 Maintain manufacturer's recommended ambient and substrate temperatures, and relative humidity for 48 hours before installation, during application and until application is fully cured.
 - .3 Ventilate fire stops in accordance with manufacturers' instructions by natural means or where this is inadequate using forced air circulation.
 - .4 Protect water-soluble material from wetting until fully cured.

1.12 **EXTENDED WARRANTY**

- .1 Warrant work of this Section against defects and deficiencies for period of 5 years commencing at the date of Substantial Performance.
 - .1 Manufacturers shall warrant work of this section against defects and deficiencies in the product material. Promptly correct any defects or deficiencies, which become apparent within warranty period at no expense to the Owner.
 - .2 Contractor shall warrant workmanship on materials and installation. Promptly correct any defects or deficiencies which become apparent within warranty period at no expense to the Owner.
- .2 Defects shall include but shall not be limited to cracking, breakdown of bond, failure to stay in place or bleeding.

PART - 2 PRODUCTS

2.1 **MANUFACTURERS**

- .1 To maintain control and integrity of the firestop applications supply and install products from a single manufacturer, to the greatest extent possible, to perform all fire stopping work. Materials of different manufacturers will not be permitted without written authorization of Consultant.
- .2 Where there is no specific tested listed fire stop system available from the manufacturer for a particular fire stopping application, obtain authorization from Consultant to supply and install a listed system from an alternative manufacturer to avoid providing an Engineering Judgment.

2.2 **DESIGN / PERFORMANCE CRITERIA**

- .1 Fire stop and smoke stop systems and systems providing a barrier to smoke spread consisting of a material or combination of materials installed to maintain the integrity of the fire resistance rating of a fire separation in accordance with the requirements of NBC 2015.
- .2 Non-rated fire separations: provide L-Rated smoke protection firestop system for application on both sides of separation.
- .3 Dynamic joints: where required, fire and smoke stop systems to be designed to accommodate a defined amount of movement to account for expansion or contraction in construction joints and mechanical piping, for movement in structural elements and to accommodate for movement and sound and vibration control in mechanical installations.
- .4 Insulated pipes and ducts: listed fire stop system designed and tested with actual insulation materials penetrating the fire separation, as indicated on the system design listing.
- .5 Use in wet areas: water based products are unacceptable in wet areas or areas that may be subject to occasional water exposure or flooding during and after construction.
- .6 Architectural considerations: when exposed to view, fire stop system to consider architectural finish, potential traffic, and exposure to moisture and heat.
- .7 Environment considerations: materials selected to consider the environment in which they will be used during and after curing as well as the intended use of space.
 - .1 Fire stop manufacturer to confirm compatibility of the proposed materials/products for the following cases:
 - .1 Spaces containing sensitive electronic equipment.
 - .2 Building perimeter firestop systems to be water-resistant.

2.3 **MATERIALS**

- .1 Primer: As recommended by firestopping material manufacturer for specific substrate and use.
- .2 Fire stop and smoke stop systems: in accordance with CAN/ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against the passage of flame, smoke and water, and the transmission of heat in compliance with requirements of CAN/ULC-S115 and not to exceed opening sizes for which they are intended, as indicated on System Design Listing.
 - .2 Fire stop system rating: to match fire resistance rating of fire separation, in accordance with requirements of NBC.
 - .3 Service penetration assemblies and fire stop components: certified by test laboratory to CAN/ULC-S115.
- .3 Damming and backup materials, support and anchoring devices: Non-combustible, in accordance with tested assembly and as recommended by manufacturer. Combustible material for damming purpose may be permitted only if they are removed after permanent firestop materials are cured. Sheet steel covers over temporarily unused sleeves shall be minimum 0.8 mm thick galvanized steel sheet.
- .4 Pipe and duct insulation and wrappings: Compatible with firestopping material; as recommended by manufacturer.
- .5 Fire stopping and smoke seals at opening intended for ease of re-entry such as cable: Elastomeric seal. Do not use cementitious or rigid seal at such locations.
- .6 Fire stopping and smoke seals at opening around penetrations for ductwork and other mechanical items requiring sound and vibration control: Elastomeric seal. Do not use cementitious or rigid seal at such locations.
- .7 Firestop insulation: pre-formed, semi rigid, non-combustible mineral wool.
- .8 Junction box / outlet sealing putty: intumescent putty, pre-formed in pads.
- .9 Sealants: good adhesion without use of primer, high visibility safety colours.
 - .1 For vertical joints: non-sagging.
 - .2 For horizontal joints: single component, self-levelling.
 - .3 For building perimeter joints: to act as fire, smoke, gas, and water seal.

2.4 **FIRE STOP IDENTIFICATION**

- .1 Identification labels and markings to be indelible for the expected service life of the installation.
- .2 Fire Stopped Penetrations:
 - .1 Provide identification labels at each penetration.
 - .2 Identification labels: pressure-sensitive, self-adhesive, printed vinyl labels.
 - .3 Attach labels permanently to surfaces of penetrated construction on both sides of each firestopping system installation where labels will be visible to anyone seeking to remove penetrating items or firestopping and smoke seal systems.
 - .4 Label shall state, in both official languages, that the fill material around the penetration is a fire stop system and it shall not be disturbed except by authorized personnel.

- .5 In addition, include the following information on labels:
 - .1 Penetration number.
 - .2 Floor number.
 - .3 Room number.
 - .4 Product name and number.
 - .5 Manufacturer's name.
 - .6 System Design number or Engineering Judgment number.
 - .7 Fire Rating Required: in hours.
 - .8 Fire Stop Contractor's Name and phone number.
 - .9 Installer's Name.
 - .10 Date of Installation.
 - .11 Re-penetrated by: Company, Installer and Date.
- .6 Label shall state that the fill material around the penetration is a fire stop system and it shall not be disturbed except by authorized personnel.
- .3 Fire Separation (Barrier) Markings:
 - .1 Provide identification for all vertical fire separations.
 - .2 Identification markings: adhesive stickers with lettering at least 75 mm in height with a minimum 10 mm stroke in contrasting colour.
 - .3 Marking to incorporate the assembly's fire-resistance rating and the following suggested wording in both official languages, "FIRE AND/OR SMOKE BARRIER – PROTECT ALL OPENINGS", or other accepted wording.

PART - 3 EXECUTION

3.1 PREPARATION

- .1 Verify substrate conditions are acceptable for product installation in accordance with manufacturer's instructions and approved system design listings for each condition.
- .2 Remove combustible material and loose material detrimental to bond from edges of penetration. Clean, prime or otherwise prepare substrate material to manufacturer's recommendation.
- .3 Verify that the proposed fire stop system is composed of components that are compatible with each other, the substrates forming the openings, and the items, if any, penetrating the fire stop under conditions of application and service, as demonstrated by the fire stop manufacturer based on testing and field experience.
- .4 Do not apply firestop material to surfaces previously painted or treated with sealer, curing compound, water repellent or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .5 Verify openings, dimensions and surfaces conform to fire and smoke seal assembly.
- .6 Comply with manufacturer's recommended requirements for temperature, relative humidity, moisture content and presence of any sealer or release agents on substrate during application and curing of materials. Surfaces shall be dry, dust and frost free.
- .7 Fully protect walls, windows, floors and other surfaces around areas to be firestopped from marring or damage.

- .8 Prime surfaces in accordance with manufacturer's directions. Mask where necessary to avoid spillage on to adjoining surfaces. Remove stains on adjacent surfaces as required.
- .9 Remove insulation from area of insulated pipe and duct where such pipes or ducts penetrate fire separation unless ULC certified assembly permits such insulation to remain within assembly.
- .10 Provide temporary forming, packing and bracing materials necessary to contain firestopping. Upon completion, remove forming and damming materials not required to remain as part of system.
- .11 Mix materials at correct temperature and in strict accordance with manufacturer's directions.

3.2 **INSTALLATION**

- .1 Install damming and firestopping materials as per manufacturer's instructions.
- .2 Seal penetrations through and gaps in fire rated separations. Fill gap in accordance with ULC details for tested system selected.
- .3 Coordinate with other sub-trades to ensure that all pipes, conduits, cables, and other items, which penetrate fire separations, have been permanently installed before installation of fire stop systems.
- .4 Schedule work to ensure that fire separations and all other construction that conceals penetrations are not erected before installation of fire and smoke stop systems
- .5 Protect holes or gaps made by through penetrations, poke through termination devices, and un-penetrated openings or joints to ensure that both continuity and integrity of fire separation are maintained.
- .6 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing per manufacturer's instructions.
- .7 Apply firestopping materials in strict accordance with manufacturer's written instructions and tested designs to provide required temperature and flame rated seal. Apply with sufficient pressure to properly fill and seal openings to ensure continuity and integrity of fire separation. Tool or trowel exposed surfaces as required.
- .8 Remove excess compound promptly as work progresses and upon completion.
- .9 Examine sizes, anticipated movement and conditions of opening and penetration to establish correct system and depth of backup materials and of firestopping material required. Use firestopping and smoke seals best suited for specific application as required, indicated or specified. Use only components specified in fire test of system. Do not eliminate any component for firestop system that was present in fire tests.
- .10 Do not cover materials until full cure has taken place.
- .11 Do not use damaged or expired material.
- .12 Joint Fire Stops:
 - .1 For sealant applications, install joint fillers to support fire stop materials during application. Position joint fillers to ensure fire stop material cross-sectional shape and thickness relative to the joint width allows for optimum sealant movement, while developing the required fire-resistance rating.
 - .2 Install fire stops using techniques recommended by the manufacturer:
 - .1 Fully wetting joint substrates to optimize adhesion.
 - .2 Completely filling recesses provided for each joint configuration.

- .3 Providing uniform, cross-sectional shapes and thickness relative to joint width that optimize movement capability.
- .4 Tooling non-sag fire stop materials immediately after their application and prior to the time skinning begins. Form smooth, uniform beads of configuration indicated or required to:
 - .3 Joint Systems and Perimeter Fire Containment Systems:
 - .1 For systems with dynamic joints, ensure movement capabilities of the installation meet or exceed the movement expectations of the system design listing and manufacturer's installation instructions.
- .13 Provide firestop systems at following locations, without being limited to:
 - .1 At openings, voids and penetrations through floor slabs except openings within shafts constructed with a fire resistance rating and slabs on granular fill.
 - .2 At openings, voids and penetrations through fire rated masonry, concrete and gypsum board walls, partitions and shaft walls.
 - .3 At openings, voids and penetrations installed for future use through fire rated masonry, concrete and gypsum board walls, partitions and shaft walls.
 - .4 Joints at top and bottom of fire-resistance rated walls where they meet non-rated fire separation assemblies.
 - .5 Intersection of fire-resistance rated masonry, concrete and gypsum board partitions.
 - .6 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - .7 Openings and sleeves installed for future use through fire separations.
 - .8 Around mechanical and electrical assemblies/devices penetrating fire separations.
 - .9 Mechanical and electrical recessed boxes in walls and partitions.
 - .10 Between tops of fire rated walls and partitions and underside of floor or roof slabs.
 - .11 At all expansion joints in fire-rated walls, floors, ceilings and roof assemblies.
 - .12 At building perimeter for the space between a fire-resistance rated floor assembly and the curtain wall or other exterior wall assembly (e.g.: safig slot gaps).
- .14 Refer to all other sections of Specifications and the Drawings to ascertain where firestops are to be used and, if noted, type of firestop required.
- .15 Cure materials in accordance with manufacturer's directions.

3.3

IDENTIFICATION

- .1 General:
 - .1 Clean substrate prior to applying identification.
 - .2 Final location of identification to be determined on site.
 - .3 Refer to drawings for locations of fire separations and rating required.
- .2 Fire Stopped Penetrations:
 - .1 Install identification label adjacent to each wall/floor service penetrations fire stopped. Provide one identification label per single opening or per grouping cluster.
 - .2 Securely apply identification to substrate by providing adequate adhesive.

.3 Identification shall be completely filled out and installed prior to requesting Substantial Performance.

.3 Fire Separations (Barriers):

.1 Provide identification at least 4500 mm of the end of each wall and at intervals not exceeding 9000 mm along wall/floor joint fire stops.

.2 Markings to be installed within ceiling spaces, 600 mm below horizontal fire separation or roof structure unless otherwise indicated.

.3 For occupied areas with exposed ceilings: review location of identification with Consultant before proceeding.

3.4 **REPAIRS AND MODIFICATIONS**

.1 Identify damaged or re-entered seals requiring repair or modification.

.2 Remove loose or damaged materials. If penetrating items are to be added, remove sufficient material to insert new elements and to avoid damaging the balance of the seal.

.3 Ensure that surfaces to be sealed are clean and dry.

.4 Use only materials that are suitable for repair of original seal, as approved by manufacturer. Do not mix products from different manufacturers.

.5 Repair all damage resulting from fire stop destructive testing.

3.5 **FIELD QUALITY CONTROL**

.1 Inspections: notify Consultant when ready for inspection and prior to concealing or enclosing fire stop 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 **INSPECTIONS**

.1 Third-Party Inspection Firm carried by the Contractor: Contractor shall hire and pay for the services of a third-party inspection firm to conduct random inspections and direct exploratory review (i.e.: destructive testing) during the course of construction and prior to closing off any concealed areas. Inspections and destructive testing shall be performed in compliance with ASTM E2174 and ASTM E2393.

.1 Include for a minimum of 2% for each area of 900 square meters for exploratory reviews for each approved system design listing and each trade involved. Perform cut tests at perimeter joints every 15 meters. Perform cut test at bottom and top of wall joints and wall to wall joints and building expansion joints every 15 meters.

.2 Perform exploratory review as directed by Third-Party Inspection Firm. Cut out fire stop and remove to ensure fire stop system installation meets or exceeds the system design listing as identified.

.3 After review is completed and acceptance is obtained, replace fire stop system with new materials.

- .2 Progressively, provide the Consultant with the Inspection Reports.
- .3 Upon completion of construction and before requesting Substantial Performance review, Contractor and manufacturer's representative shall inspect all fire stopping work and prepare a deficiency list. Submit deficiency list to Consultant for review. Repair any deficiencies and re-inspect work to ensure that all deficiencies have been completed.
- .4 Submit formal request for Substantial Performance review of work once all work is completed, deficiencies repaired, quality control has been performed and all fire stop installations have been inspected and identified with the approved fire stop identification labels.
- .5 Third-Party Inspection Firm shall conduct the Substantial Performance review in the presence of the Contractor, and provide final report.
- .6 At the end of the work, include all reports in the Close-out Documents.

3.7

CLEANING

- .1 Remove excess materials and debris and clean adjacent surfaces immediately after application to satisfaction of Consultant. Remove and/or correct staining and discolouring of adjacent surfaces as directed.
- .2 Remove temporary combustible damming materials after initial set of firestopping materials. Such dams may be required to remain in place if flame spread rating is below 25, in accordance with CAN/ULC-S102.
- .3 Protect fire stops during and after curing period from contact with contaminating substances. Repair all damage.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Labour, Products, equipment and services necessary to complete the work of this Section for joint sealants as indicated on drawings and as required.
 - .2 This Section specifies sealing work not specified in other Sections. Refer to other Sections for other sealants.

1.2 RELATED REQUIREMENTS

- .1 Read and comply with Conditions of the Contract and Division 01 - General Requirements.

1.3 REFERNCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C719, Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
 - .2 ASTM C920, Standard Specification for Elastomeric Joint Sealants.
 - .3 ASTM C1248, Standard Test Method for Staining of Porous Substrate by Joint Sealants.

1.4 ACTION SUBMITTALS

- .1 Product Data: Submit to Consultant Product information from sealant manufacturer prior to commencement of work of this Section verifying:
 - .1 Selected sealant materials are from those specified.
 - .2 Composition and physical characteristics.
 - .3 Surface preparation requirements.
 - .4 Priming and application procedures.
 - .5 Suitability of sealants for purposes intended and joint design.
 - .6 Test report on adhesion, compatibility and staining effect on samples of adjacent materials used on Project.
 - .7 Sealants compatibility and adhesion with other materials and Products with which they come in contact including but not limited to sealants provided under other Sections, insulation adhesives, bitumens, membranes, stone, concrete, masonry, metals and metal finishes, ceramic tile, plastic laminates and paints.
- .2 Samples: Submit duplicate samples of each colour.

1.5 INFORMATION SUBMITTALS

- .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.6 QUALITY ASSURANCE

- .1 Single source responsibility: Use sealants from single manufacturer for each different product required to ensure compatibility.

1.7 **DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact.
- .2 Protect from freezing, moisture and water.

1.8 **PROJECT CONDITIONS**

- .1 Do not proceed with installation of joint sealants under the following conditions:
 - .1 When joint substrates are wet.
 - .2 Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - .3 Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART - 2 PRODUCTS

2.1 **MATERIALS - GENERAL**

- .1 Provide joint sealants establishing and maintaining water tight, water resistant and air tight continuous joint seals without staining or deteriorating joint substrates.
- .2 Ensure joint sealants comply with specified type, grade, class and uses.
- .3 Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- .4 Provide Products with capability, when tested, for adhesion and cohesion under maximum cyclic movement in accordance with ASTM C719, to withstand required percentage change in joint width existing at time of installation and remain in compliance with other requirements of ASTM C920 for uses indicated.
- .5 VOC Content of Interior Sealants: Sealants and sealant primers used inside shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - .1 Architectural Sealants: 250 g/L.
 - .2 Sealant Primers for Nonporous Substrates: 250 g/L.
 - .3 Sealant Primers for Porous Substrates: 775 g/L.
- .6 Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- .7 Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- .8 Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.

- .9 Sealants, cleaning solvents and primers: Compatible with each other.
- .10 Colours of Exposed Joint Sealants: As selected by Consultant from manufacturer's full range. Allow for special colours as selected by the Consultant.

2.2 **JOINT SEALANTS**

- .1 Sealant Type 1: Single-component, non-sag, polyurethane joint sealant meeting specified requirements of ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
- .2 Sealant Type 2: Acrylic latex or siliconized acrylic latex joint sealant meeting specified requirements of ASTM C 834, Type OP, Grade NF.
- .3 Sealant Type 3: Mildew-resistant, single-component, acid-curing silicone joint sealant, meeting specified requirements of ASTM C 920, Type S, Grade NS, Class 25, for Use NT, G, A and O.
- .4 Sealant Type 4: Self-levelling, multi-component, chemically curing polyurethane joint sealant, meeting specified requirements of ASTM C920, Type M, Grade P, Class 25, Use T, M, and O.
- .5 Sealant Type 5: Provide 1 of following:
 - .1 Multicomponent, non-sag, polyurethane joint sealant, meeting specified requirements of ASTM C 920, Type M, Grade NS, Class 50, for Use NT.
OR
 - .2 Multicomponent, non-sag, polyurethane joint sealant, meeting specified requirements of ASTM C 920, Type M, Grade NS, Class 25, for Use NT.

2.3 **MISCELLANEOUS MATERIALS**

- .1 Joint primer: As recommended by sealant manufacturer for substrates, conditions and exposures indicated.
- .2 Bond breaker: Polyethylene tape or other adhesive faced tape as recommended by sealant manufacturer to prevent sealant contact where it would be detrimental to sealant performance.
- .3 Joint backer: Polyethylene foam rod or other compatible non-waxing, non-extruding, non-staining resilient material in dimension 25 percent to 50 percent wider than joint width as recommended by sealant manufacturer for conditions and exposures indicated. Ensure backing is compatible with sealant, primer and substrate.
- .4 Masking tape: Non-staining, non-absorbent tape product compatible with sealants and adjacent joint surfaces that is suitable for masking.
- .5 Cleaning Material: Non-corrosive, non-staining, solvent type, xylol, MEK, toluol, IPA or as recommended by sealant manufacturer and acceptable to material or finish manufacturers for surfaces adjacent to sealed areas free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants with joint substrates.

PART - 3 EXECUTION

3.1 EXAMINATION

- .1 Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Prepare surfaces to receive work in accordance with sealant manufacturer's instructions and recommendations except where more stringent requirements are indicated.
- .2 Thoroughly clean joint surfaces using cleaners approved by sealant manufacturer whether primers are required or not.
- .3 Remove all traces of previous sealant and joint backer by mechanical methods, such as by cutting, grinding and wire brushing, in manner not damaging to surrounding surfaces.
- .4 Remove paints from joint surfaces except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer.
- .5 Remove wax, oil, grease, dirt film residues, temporary protective coatings and other residues by wiping with cleaner recommended for that purpose. Use clean, white, lint-free cloths and change cloths frequently.
- .6 Remove dust by blowing clean with oil-free, compressed air.
- .7 Joint backer: Provide joint backer uniformly to depth required for proper joint design using a blunt instrument. Fit securely by compressing backer material 25 percent to 50 percent so no displacement occurs during tooling. Avoid stretching or twisting joint backer.
- .8 Bond breaker: Provide bond-breaker recommended by sealant manufacturer, adhering strictly to the manufacturer's installation requirements.
- .9 Priming: Prime joint substrates where required. Use and apply primer to sealant manufacturers recommendations. Confine primers to sealant bond surfaces; do not allow spillage or migration onto adjoining surfaces.
- .10 Taping: Use masking tape, where required, to prevent sealant or primer contact with adjoining surfaces that would be permanently stained or otherwise damaged by such contact or the cleaning methods required for removal. Apply tape so as not to shift readily, and remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

- .1 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.
- .2 Install sealants immediately after joint preparation.
- .3 Mix, apply and cure sealants in accordance with manufacturer's printed instructions.
- .4 Install sealants to fill joints completely, without voids or entrapped air, using proven techniques, proper nozzles and sufficient force that result in sealants directly contacting and fully wetting joint surfaces.

- .5 Install sealants to uniform cross-sectional shapes with depths relative to joint widths that allow optimum sealant movement capability as recommended by sealant manufacturer.
- .6 Dry tool sealants in manner that forces sealant against back of joint, ensures firm, continuous full contact at joint interfaces and leaves a finish that is smooth, uniform and free of ridges, wrinkles, sags, air pockets and embedded impurities.
 - .1 Tooling liquids that are non-staining, non-damaging to adjacent surfaces and approved by sealant manufacturer may be used if necessary when care is taken to ensure that the liquid does not contact joint surfaces before the sealant.
 - .2 Provide concave tooled joints unless otherwise indicated to provide flush tooling or recessed tooling.
 - .3 Provide recessed tooled joints where the outer face of substrate is irregular.
- .7 Remove sealant from adjacent surfaces in accordance with sealant and substrate manufacturer recommendations as work progresses.
- .8 Do not cover up sealants until proper curing has taken place.
- .9 Protect joint sealants from contact with contaminating substances and from damages. Cut out, remove and replace contaminated or damaged sealants immediately, so that they are without contamination or damage at time of Substantial Performance.

3.4 **LOCATION SCHEDULE**

- .1 Refer to Drawings for sealing work not specifically listed in this Section.
- .2 Use one of the sealants specified for each type in following locations. Ensure sealant chosen from several specified types listed under Part 2 Materials, and recommended by manufacturer for use for conditions encountered:
- .3 Seal following joints with Sealant Type 1 one component modified polyurethane sealant:
 - .1 Interior masonry and gypsum board control joints.
- .4 Seal following joints with Sealant Type 2 acrylic sealant:
 - .1 Joints between interior metal and/or wood frames and adjacent construction in interior partitions.
 - .2 Interior joints to receive paint finish.
- .5 Seal following joints with Sealant Type 3 mildew resistant silicone sealant:
 - .1 Joints in ceramic tile walls where joints occur over control joints in masonry back-up and where joints occur over control joints between cast-in-place concrete and masonry back-up.
- .6 Seal following joints with Sealant Type 4 self-levelling sealants:
 - .1 Static joints in horizontal surfaces where self-levelling sealants are required.
 - .2 Interior horizontal tile control joints.

- .7 Seal following joints with Sealant Type 5 multicomponent, non-sag, polyurethane sealant:
 - .1 Typically used in joints between metal frames and adjacent masonry and/or concrete construction in exterior walls, exterior and interior sides; control and expansion joints in exterior and interior surfaces of poured-in-place concrete walls, and unit masonry walls; sealing of joints between underside of floor slabs and masonry; and other locations where sealant is required or noted on Drawings except where sealant is specified in other Sections.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

.1 Fire rated assemblies: Labelled and listed by a nationally recognized testing agency having factory inspection service in conformance with CAN4 S104M and CAN4 S105M for ratings indicated.

.2 Install fire rated assemblies to NFPA 80 except where specified otherwise.

1.3 SUBMITTALS

.1 Shop drawings: Indicate each type of door and frame, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, and arrangement of hardware.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Brace and protect assemblies to prevent distortion during shipment. Store in a secure dry location.

.2 Store doors vertically, resting on planks, with blocking between to allow air to circulate.

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Galvanized steel sheet: ASTM A653/653M, Commercial Steel (CS), Type B, coating designation A40 (ZF120).

.2 Minimum thickness:

.1 Door frame: 1.6 mm.

.2 Door face, hollow steel construction: 1.6 mm, unless otherwise indicated.

.3 Door face, honeycomb construction: 1.6 mm, unless otherwise indicated.

.4 Lock and strike reinforcements: 1.6 mm.

.5 Hinge reinforcements: 3.4 mm.

.6 Anchors: 0.9 mm.

.7 Closer and magnetic lock reinforcements: 2.7 mm.

.8 Glazing stops: 1.6 mm (16 gauge).

.3 Door Core:

.1 Honeycomb: structural core consisting of kraft paper having 20 mm cell size to thickness indicated.

.4 Resilient bumpers: Round, black rubber, stud mount.

.5 Materials for fire rated doors and frames: Complying with labelling authority requirements.

.6 Primer: Zinc rich primer.

2.2 FABRICATION - GENERAL

- .1 Blank, reinforce, drill and tap doors and frames for mortised hardware. Reinforce doors and frames for surface mounted hardware.
- .2 Apply, at factory, touch up primer to doors and frames manufactured from galvanized steel where coating has been removed during fabrication.
- .3 Make provisions in doors and frames to suit requirements of Section providing security devices.
- .4 Fabricate fire rated assemblies to ULC requirements and bearing ULC, ULI or Warnock-Hersey International Ltd., label, as acceptable to authorities having jurisdiction.
- .5 Locate fire rating labels on the inside of the frame hinge jamb and door hinge edge midway between the top hinge and the head of the door.

2.3 FABRICATION - DOORS

- .1 Fabricate doors with longitudinal edges seamless, continuously welded, filled and sanded flush.
- .2 Make provision for louvres and glazing as indicated and provide necessary glazing stops.
- .3 Provide honeycomb core construction for interior locations, laminate honeycomb core to both inside faces of door, completely filling the inside hollow of the door.
- .4 Fabricate doors with top and bottom steel channels full width of door and welded to both faces.

2.4 FABRICATION - FRAMES

- .1 Cut mitres and joints accurately and weld continuously on inside of frame profile.
- .2 Grind welded corners and joints to flat plane, fill with metallic paste filler and sand to uniform smooth finish.
- .3 Knock down frames will not be allowed.
- .4 Provide jamb anchors for fixing at floor.
- .5 Provide 3 bumpers on strike jamb for each single door. Provide 2 bumpers at head for double doors.

PART - 3 EXECUTION

3.1 INSTALLATION - GENERAL

- .1 Touch up with primer galvanized finish damaged during installation.

3.2 INSTALLATION - FRAMES

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Provide suitable anchors to suit construction. Use one base anchor and two wall anchors per jamb side for frames up to 1500 mm and one additional wall anchor per jamb side for each additional height of 750 mm or fraction thereof.
- .3 Secure anchorages and connections to adjacent construction.
- .4 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Remove temporary spreaders after frames are built-in.
- .5 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

3.3 **INSTALLATION - DOORS**

- .1 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows:
 - .1 Hinge side: 3 mm.
 - .2 Latchside and head: 3 mm.
 - .3 Finished floor for non-rated assemblies: 12 mm.
 - .4 Finished floor for rated assemblies: 6 mm.

END OF SECTION

DOOR HARDWARE

08 71 00

PROJECT:



City of Toronto – Union Station
3rd Floor Security Office Reno
Toronto, ON

ARCHITECT:

NORR

175 Bloor Street East
North Tower, 15th Floor.
Toronto, ON

Prepared By: Alex Bekmansourov

Date: September 18, 2024

Revised:

Architectural Hardware Finishes

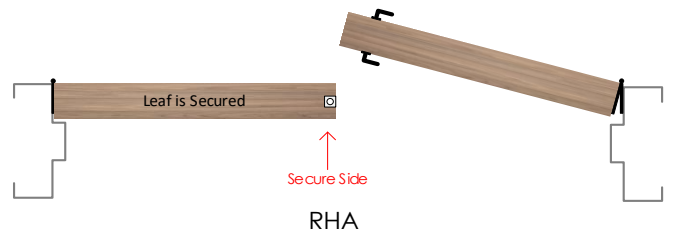
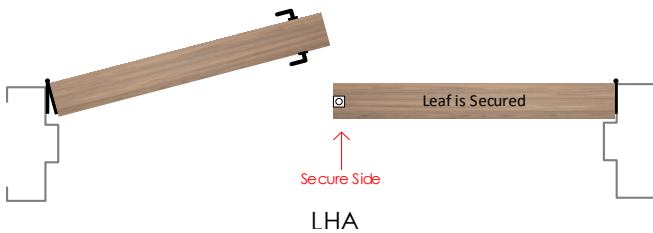
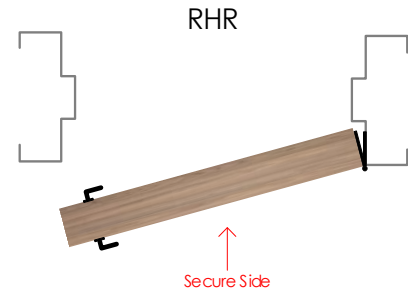
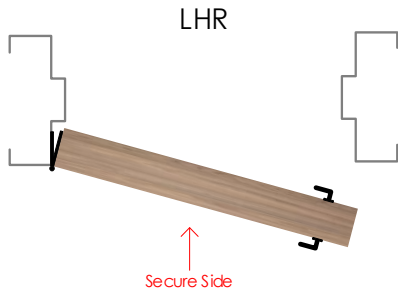
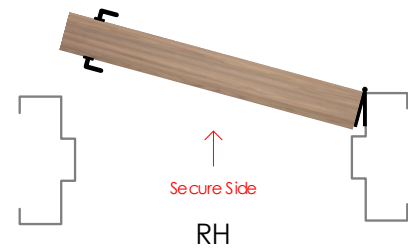
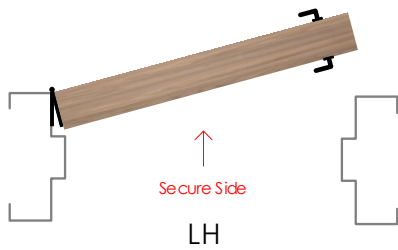
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Clear Anodized				628	689	US28
Satin Nickel	646		619	670		US15
Polished Nickel	645		618	669		US14
Satin Stainless Steel		630				US32D
Polished Stainless Steel		629				US32
Satin Chrome	652		626	702		US26D
Polished Chrome	651		625	672		US26
Satin Brass	633		606	667	678	US4
Polished Brass	632		605	666	677	US5
Satin Bronze	639		612	668	680	US10
Oil Rubbed Bronze	640		613	703	695	US10B
Flat Black / Anodized Black	631		622	671	693	US19

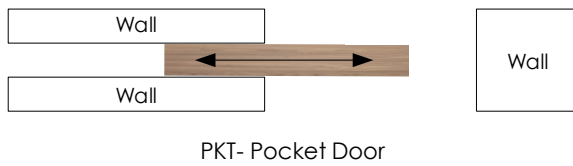
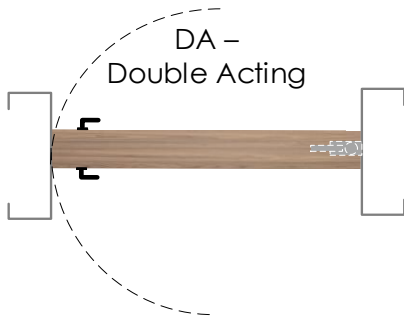
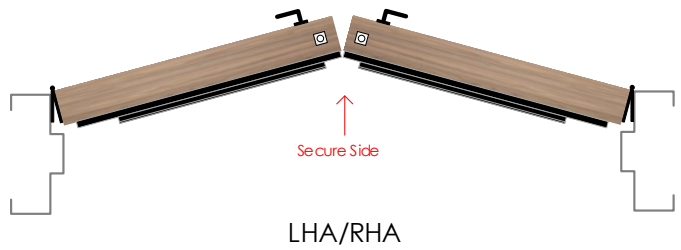
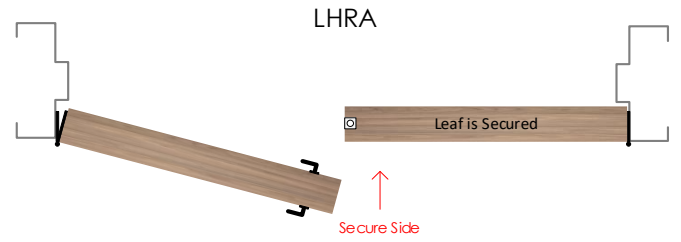
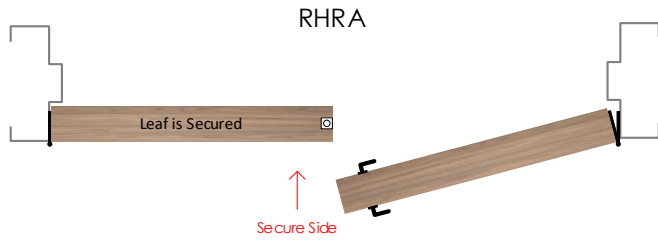
Door Handing's

Abbreviations

RH = Right Hand	RHA = Right Hand Active	SS = Single Slider
LH = Left Hand	LHA = Left Hand Active	BP = Bi-Parting Slider
RHR = Right Hand Reverse	RHA/LHA = Right & Left Hands Active	BF = Bi-Folding Slider
LHR = Left Hand Reverse	RHRA/LHRA = Right & Left Hand Reverse Active	TS = Telescopic Slider
RHRA = Right Hand Reverse Active	DA = Double Acting	PKT = Pocket Slider
LHRA = Left Hand Reverse Active	DE = Double Egress	

NOTE: The handing of a swing door is determined by placing yourself on the secured or keyed side of the door.





Symbols



- Door has a fire rating and all associated hardware must have a fire label to suit. Must comply with local requirements.



- Door is automatic and is equipped with an auto operator. Door must meet local barrier free codes



- Door has an electrical requirement and requires power to be brought to the appropriate location above the door or to the latch, for either security or barrier free applications. Refer to security & electrical drawings for further information.



- Door requires security card access. Refer to security / electrical drawings for further information.

Abbreviations

Door:

HMD = Hollow Metal Door
 IHMD = Insulated Hollow Metal Door
 ALD = Aluminum Door
 IC-ALD = Insulated Clad Aluminum Door
 SCWD = Solid Core Wood Door
 HCWD = Hollow Core Wood Door
 FGD = Frameless Glass Door
 FRP = Fiberglass Reinforced Plastic Door
 OHD = Overhead Door

Frame:

HMF = Hollow Metal Frame
 ALF = Aluminum Frame
 Cased Open HMF = Cased Open Hollow Metal Frame
 WDF = Wood Frame
 Cased Open WDF = Cased Open Wood Frame
 Cased Open Drywall = Cased Open Drywall

Fire Ratings:

0 HR – Zero Hour Fire Rating / Smoke Barrier
 20 MIN – 20 Minute Fire Rating
 ¼ HR – 45 Minute Fire rating
 1 ½ HR – 90 Minute Fire Rating
 2 HR – 120 Minute Fire Rating
 3 HR – 180 Minute Fire Rating

Disclaimer

Weblinks:

Weblinks do change from time to time as manufacturers move around their websites, please inform us if you have a none functioning weblink.




HARDWARE SCHEDULE

Heading# 1

Opening Information				
Opening Type:	Single	Opening Size:	650 x 2150 x 45 (CONFIRM)	STC Rating
Door Material:	HMD	Frame Material:	HMF	Fire Rating: None

1	Total Openings							
1	Door#	3-C925	Location:	Corridor	From	Janitor Closet 3-C925	Handing:	RHR

Web Link
Site Verified

By Hardware Supplier					
3	Butt Hinge	TA714 – 102 x 114 x NRP	613 / US10B / Oil Rubbed Bronze	McKinney	 <input type="checkbox"/>
1	Storeroom Lockset	8204 x CE x R(Rockport) x 613	613 / US10B / Oil Rubbed Bronze	Corbin	 <input type="checkbox"/>
1	Overhead Stop	2-226(with Hold Open)	695 / US10B / Painted Dark Bronze	Rixson	 <input type="checkbox"/>
1	Closer	1431-P9	695 / US10B / Painted Dark Bronze	Sargent	 <input type="checkbox"/>
1	Kick Plate	K10A 200 x 612 (Confirm) Tape	613 / US10B / Oil Rubbed Bronze	Standard Metal	 <input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5265	Black	KN Crowder	 <input type="checkbox"/>
1	Auto Door Bottom	CT-54 x 650	719 Milled Aluminum	KN Crowder	 <input type="checkbox"/>
By Owner					
1	Permanent Cylinder	By City Locksmith	613 / US10B / Oil Rubbed Bronze		<input type="checkbox"/>

.....End of Heading.....

END OF SCHEDULE

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section Includes: Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 ACTION SUBMITTALS

- .1 Product Data: Submit product data for each type of product.

1.3 COORDINATION WITH EXISTING CONDITIONS

- .1 Coordinate location of new partitions with existing overhead ducting, piping and conduits. Request written confirmation from the Consultant on final locations prior commencing the installation.

1.4 QUALITY ASSURANCE

- .1 Install work level to tolerance of 3 mm in 3000 mm.
- .2 Select studs with maximum deflection of L/360 at lateral force of 240 Pa for maximum heights indicated.
- .3 Fire test response characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install work in any area unless satisfied that work in place has dried out, and that no further installation of damp materials is contemplated.
- .2 Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - .1 Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - .2 Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- .2 Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

PART - 2 PRODUCTS

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Single source responsibility: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.
- .2 Fire resistance rating: Where gypsum board systems with fire resistance ratings are indicated or required, provide materials and installations that are identical with those of applicable assemblies tested by fire testing laboratories acceptable to authorities having jurisdiction.

- .3 Follow applicable requirements of ASTM C754 for installation of steel framing.
- .4 Design system members to withstand own dead load, super-imposed dead loads, to maximum allowable deflection of L/240, without permanent deformation.
- .5 Sheet metal thicknesses indicated herein pertains to the “minimum base steel thickness exclusive of coating”.

2.2 **MATERIALS**

- .1 Gypsum board: ASTM C1396/C1396M, paper faced, regular and fire rated Type X core, 1200 mm wide x maximum practical length, ends square cut, square edged base layer and taper edged face layer, thickness as indicated.
- .2 Steel studs at door jambs and where indicated: 1.720 mm (0.0677”) minimum thickness.
- .3 Steel studs: ASTM C645, minimum 0.46 mm base metal thickness, hot-dipped galvanized to ASTM A653/A653M G60 (Z180) zinc coating, roll formed, widths as indicated, with knock-out holes for mechanical and electrical services. Use 20 gauge studs for tile backer and fiber reinforced panels.
- .4 Floor and ceiling tracks: ASTM C645, minimum 0.46 mm base metal thickness, hot-dipped galvanized to ASTM A653/A653M G60 (Z180) zinc coating, roll formed, width to suit studs.
- .5 Furring runners and channels: ASTM C645, minimum 0.46 mm base metal thickness, hot-dipped galvanized to ASTM A653/A653M G60 (Z180) zinc coating, roll formed.
- .6 Resilient steel furring channels: ASTM C645, 12.7 mm x 65 mm, 0.46 mm base metal thickness, hot-dipped galvanized to ASTM A653/A653M G60 (Z180) zinc coating, roll formed; Hat shaped resilient furring channel for direct wall furring where resilient channels are indicated.
 - .1 Resilient Channels: 1mm thick, 13 mm high, D1007 by Bailey Metal Products or approved equivalent, with stud to match spacing.
- .7 Channel bridging: 1.37 mm bare steel thickness, 38 mm deep with minimum 12.7 mm wide flange.
- .8 Backing plate: Galvanized steel sheet for blocking and bracing in length and width indicated, minimum base metal 0.45 mm 0.7 mm 0.8 mm thick.
- .9 Attachment clips: Sized to suit acoustical ceiling grid members, complete with screws and other fastening system, similar to Revoe Clips by Revoe Building Products.
- .10 Hangers, tie wires, inserts, anchors: Manufacturer's standard.
- .11 Insulating strip: Rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.
- .12 Casing beads, corner beads: 0.48 mm hot dipped galvanized steel, perforated flanges, designed to be concealed with joint compound; one piece length per location.
- .13 Wood Trim: to match existing.
- .14 Acoustical sealant: single component, sound damping, non-skinning, non-hardening synthetic rubber sealant.
- .15 Acoustical insulation (Sound Attenuation Batts): CAN/ULC-S702, mineral wool fibre, flame spread and smoke developed in conformance with OBC requirements and other authorities having jurisdiction in accordance with CAN/ULC-S102. Non-combustible in accordance with requirements of CAN/ULC-S114. Sufficient thickness to meet required STC rating for sound-rated partitions and of width to suit metal framing spacing and other miscellaneous spacings.

- .16 Acoustic putty pads: asbestos free gypsum based synthetic rubber moldable putty pad, 177.8 mm x 177.8 mm x 3 mm, non-conductive, of 1.6 kg/l density, tested to UL 263, in red colour, to match Hilti CP 617L Firestop Putty Pad by Hilti (Canada) Corp., for covering electrical boxes in acoustic partitions.
- .17 Joint and laminating compounds: As recommended by gypsum board and cement board manufacturer, high bond, low shrinkage and asbestos-free.
- .18 Joint tape: 50 mm wide reinforced tape.
- .19 Light Lens and Support: Injection moulded 100% white translucent acrylic louvres, 12 mm x 12 mm x 12 mm cell dimension, complete with prefinished extruded aluminum support trim 25 mm exposed face, white.
- .20 Ceiling and Wall Access Panels:
 - .1 16 gauge steel door and 14 gauge steel mounting frame. Finish, grey baked enamel prime coat, size 610 mm x 610 mm, unless noted otherwise. Recessed access doors designed for flush installation in gypsum ceilings and walls, recessed to receive gypsum board. Flange of door is textured galvanized steel taping bead with prepunched holes. Concealed rod type pivoting hinge and flush to finished surface. Seal door to frame with continuous neoprene gaskets. Provide finish paint to match the adjacent substrate.
 - .2 Fire-rated access panels: ULC classified and labelled for the application, 16 gauge steel door and mounting frame, flush to frame with reinforced edges, flange to be 25 mm wide, concealed hinges, complete with galvanized steel drywall taping bead flange, sizes and fire-rating as indicated on the drawings. Steel Finish: baked enamel prime coat. Provide finish paint to match the adjacent substrate.
 - .3 Provide keyed tampered-proof hardware.

PART - 3 EXECUTION

3.1 EXAMINATION

- .1 Examine areas and substrates including welded hollow-metal frames and framing for compliance with requirements and other conditions affecting performance.
- .2 Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged. Remove rejected panels from site and replace with undamaged panels at no additional cost to the Owner.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION - GENERAL

- .1 Comply with ASTM C840, Standard Specification for Application and Finishing of Gypsum Board.

3.3 INSTALLATION - PARTITION AND WALL FRAMING

- .1 Align partition top and bottom tracks and secure by screws at 600 mm o.c. maximum.
- .2 Place studs vertically at 400 mm oc, unless otherwise noted, and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in top and bottom tracks.
- .3 Screw attach end studs to top and bottom tracks. Screw attach intermediate studs to bottom tracks. Secure intermediate studs to top tracks by crimping or by other means of fastening acceptable to Consultant.

- .4 Continuously cross brace steel studs at 1500 mm on center to provide rigid installation to manufacturer's instructions.
- .5 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.
- .6 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using clips or other approved means of fastening placed alongside frame anchor clips.
- .7 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.
- .8 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .9 Provide stud, furring channel, and backing plates secured between studs for attachment of fixtures, electrical boxes, grab bars, washroom accessories, and other items. Comply with details indicated and with stud and gypsum board manufacturers' written recommendations.
- .10 Terminate partitions at ceiling height except where indicated otherwise.
- .11 Install continuous insulating strips to isolate studs from exterior window framing.
- .12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .13 Apply two continuous beads of acoustical sealant at junctions of metal framing and structure, including bottom and top tracks, where partitions abut fixed building components. Fill junction completely and continuously from floor to ceiling, or to structure for full height partitions.
- .14 Acoustic putty pads: Apply acoustic putty pads to the exterior of electrical boxes in acoustic partitions, completely sealing pads against the stud within the stud cavity and fitting around conduit and cables, in accordance with manufacturer's recommendations.
- .15 Frame for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .16 Secure light lens support trims to substrate at 300 mm centers. Loose lay light lens on support trims.
- .17 Mechanically fasten resilient channels perpendicular to wall framing starting at 50 mm up from floor and end with 150 mm to the underside of structure at no more than 610 mm o.c. Install where indicated.

3.4 **INSTALLATION – ATTACHMENT CLIPS**

- .1 Place attachment clips over acoustic ceiling main/cross tee from top. Line up pre-drilled hole on clip with hole on main/cross tee and screw clip to main/cross tee with 1/2" wafer screw.
- .2 Screw through pre-drilled holes in attachment clip into top track of stud partition. Do not screw through ceiling grid.
- .3 Do not damage ceiling grid system during installation of these clips.

3.5 INSTALLATION - WALL FURRING

- .1 Space wall furring runners vertically at 600 mm o.c., and secure through alternate flanges of runners. Shim runners as required to present a true, plumb line for application of gypsum board.
- .2 Locate furrings not more than 50 mm away from all openings, interior corners, intersections, frames, jambs, control joints and the like.
- .3 At windows, doors or similar openings having returns, and around corners, install lengths of mitred and bent pieces of furring horizontally spaced approximately 600 mm o.c. Form mitres by cutting the flanges and bending the web. Do not cut web to form corners.
- .4 Mechanically fasten resilient channel perpendicular to wall framing starting at 50 mm up from floor and end within 150 mm to the underside of structure, at no more than 600 mm o.c. Install where indicated.

3.6 INSTALLATION - SUSPENDED CEILING FRAMING

- .1 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840 except where specified otherwise.
- .2 Provide additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of light fixtures and diffusers.
- .3 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

3.7 INSTALLATION - GYPSUM PANELS

- .1 Do not apply gypsum panels until bucks, anchors, blocking, electrical and mechanical work are approved.
- .2 Apply gypsum panels to furring or framing using screw fasteners, at 300 mm oc., and at closer spacings as required for fire resistance rated assemblies. Space fasteners in tile baker boards a maximum of 200 mm o.c.
- .3 Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- .4 Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1.6 mm of open space between panels. Do not force into place.
- .5 Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- .6 Attach gypsum panels to framing provided at openings and cutouts.
- .7 Control Joints
 - .1 Prior to installation review exact locations of control joints with the Consultant. Install purpose made control joint metal trim at following locations:
 - .1 Where partition, wall, or ceiling traverses a construction joint (expansion, seismic, or building control element) in the base building structure.
 - .2 Furring or partition abuts a structural element or dissimilar wall or ceiling.
 - .3 Ceiling abuts a structural element, column or dissimilar wall, partition, or other vertical penetration.

- .4 Construction changes within a partition or ceiling.
- .5 Partition or furring runs exceeding 9100 mm and total area between control joints exceeding 84 m²
- .6 Partition and ceiling runs on column lines or at joints in ceiling runs.
- .7 In interior ceilings without perimeter relief exceeding 9100 mm in either direction and total area between control joints exceeding 84 m²
- .8 In interior ceilings with perimeter relief exceeding 15000 mm and total area between control joints exceeding 230 m²
- .2 Install control joints full height floor to ceiling or door header to ceiling in partitions and furring runs.
- .3 Install control joints from wall to wall in ceiling areas.
- .8 Cover both faces of steel stud partition framing with gypsum panels in concealed spaces.
 - .1 Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 0.7 sq.m. in area.
 - .2 Fit gypsum panels around ducts, pipes, and conduits.
 - .3 Where partitions intersect open joists and other structural members projecting below underside of slabs and decks, cut gypsum panels to fit profile formed by joists and other structural members; allow 6 mm to 10 mm wide joints to install sealant.
- .9 Gypsum board single layer application:
 - .1 On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 - .2 On partitions and walls, apply gypsum panels parallel to framing, unless otherwise indicated or required by fire resistance rated assembly, and minimize end joints.
 - .3 Stagger abutting end joints not less than one framing member in alternate courses of board.
- .10 Gypsum board multilayer application - ceilings: Apply gypsum board indicated for base layers before applying base layers on partitions and walls; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face layer joints one framing member, 400 mm minimum, from parallel base layer joints, unless otherwise indicated or required by fire resistance rated assembly.
- .11 Gypsum board multilayer application – partitions and walls: Apply gypsum board indicated for base layers and face layers parallel to framing with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - .1 Furring members: Apply base layer parallel to framing and face layer either vertically parallel or perpendicular to framing with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
- .12 Single layer fastening method: Fasten gypsum panels to supports with steel drill screws.
- .13 Multilayer fastening method: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners, unless otherwise indicated or required by fire resistance rated assembly.

- .14 Laminating to substrate: Where gypsum panels are indicated as directly adhered to a substrate, comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- .15 Tile backer board: Apply tile backer board where scheduled. Comply with manufacturer's written installation instructions. Maintain 6 mm gap where panels abut other construction or penetrations.

3.8 INSTALLATION - ACOUSTICAL INSULATION

- .1 Install acoustical insulation to partitions indicated. Provide continuous coverage between studs and run continuously from floor to ceiling, or to structure for full height partitions, over door frames and openings and around corners.
- .2 Pack acoustical insulation around cut openings in gypsum board, behind outlet boxes around plumbing, heating or structural items passing through the system and at abutting walls.
- .3 Secure acoustical insulation to one interior face of gypsum board with adhesive or mechanical fasteners or by other approved means.
- .4 For partitions receiving acoustical insulation, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919, Standard Practice for Use of Sealants in Acoustical Applications, and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings
- .5 Sound flanking paths:
 - .1 Where sound rated partition walls intersect non-rated gypsum board partition walls, extend sound rated construction to completely close sound flanking paths through non-rated construction.
 - .2 Seal joints between face layers at vertical interior angles of intersecting partitions.

3.9 INSTALLATION - FIRE RATED ASSEMBLIES

- .1 Construct fire rated assemblies where indicated, to requirements of authorities having jurisdiction.

3.10 INSTALLATION - ACCESSORIES

- .1 Erect casing beads, corner beads straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured by screw fasteners. Fit corners accurately, free from rough edges.
- .2 Provide corner beads at external corners of gypsum board partitions and where indicated.
- .3 Provide casing beads at gypsum board terminations, at gypsum board wall/ceiling junctions, where gypsum board butts against surfaces having no trim concealing junction and where indicated.
- .4 Construct control joints of two back-to-back casing beads set in gypsum board facing and supported independently on both sides of joint. Provide continuous polyethylene dust barrier behind and across control joints.

- .5 Install access doors to electrical and mechanical fixtures, and other building services specified in respective Sections.
 - .1 Install access panels in locations to be determined by coordination with trades installing mechanical, electrical and other building services and consultation with Consultant.
 - .2 Rigidly secure frames to furring or framing systems.
- .6 Install wood trim in locations indicated on the drawings.

3.11 **INSTALLATION - TAPING AND FILLING**

- .1 Fill joints, casing beads, corner beads, screwholes and depressions on gypsum board surfaces exposed to view to provide smooth seamless surfaces and square neat corners.
- .2 Apply joint compounds and reinforcing tapes in accordance with manufacturer's specifications.
- .3 Fill joints and apply joint compounds by three-coat method. Apply cover coat 175 mm wide, level coat 250 mm wide, and skim coat 300 mm wide.
- .4 Embed reinforcing tape in a cover coat of joint compound. Apply level coat of joint compound when cover coat has dried. Apply skim coat of compound when level coat has dried.
- .5 Feather edges of compounds into surfaces of gypsum boards. After skim coat has dried for at least 24 hours sand to leave smooth for decoration. Do not sand paper face of gypsum board.
- .6 At internal corners: First fill gaps between boards with joint compound. Imbed creased reinforcing tape into a thin coat of joint compound applied 50 mm wide at each side of corner. Apply cover coat. Apply skim coat to one side of joint, and when dry apply skim coat to other side.
- .7 At external corners: Fill to nose of corner bead with joint compound and sand smooth.
- .8 At screwheads and nailheads: Fill holes and depressions with a two coat application of joint compound and sand smooth.
- .9 Finish gypsum board joints above finished ceiling with tape and first coat of joint compound.

3.12 **EXISTING BASE BUILDING GYPSUM WALL PARTITIONS**

- .1 All existing Base Building gypsum wall partitions must be repaired, patched, taped, filled and sanded prior to receiving new finishes.
- .2 Patching and Repair:
 - .1 Gypsum panel product patch must be mechanically secured; attachment with joint compound material only is not acceptable. The patching material should be cut from gypsum panel product of a type and thickness equal to the original materials so that the patching material is in the same geometric shape as, but slightly larger than, the damaged area. The damaged area is then further enlarged to match exactly the size of the patching material. Restore thermal insulation, if present.
 - .2 Metal runner track is secured to the inside edges of the damaged area. The patching material is screw attached to the exposed face of the runner track with fasteners a maximum of 8 in. (200 mm) apart. The patch should be treated with tape and joint compound to restore appearance to Level 5 gypsum board finish, fire resistance qualities, and acoustical performance.
 - .1 Apply skim coat of topping or all-purpose drying-type compound over the entire wall where patching and repair was performed.

3.13 **FINISHING OF GYPSUM BOARD**

- .1 Finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:
 - .1 Level 1:
 - .1 In plenum areas above ceilings, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings;
 - .1 Level 2:
 - .1 surfaces permanently hidden or concealed in their final arrangement
 - .2 Level 4:
 - .1 Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and completely free of tool marks and ridges.
 - .2 Use this level of finish where paint to be applied, and where other level of finishes is not specified.

3.14 **INSTALLATION TOLERANCES**

- .1 Provide and install studs, framing, shimming, and furring to provide proper support for gypsum board to achieve the following installation tolerances:
 - .1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane.
 - .2 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.
 - .3 Install each framing member so fastening surfaces vary not more than 3.2 mm (1/8") from the plane formed by faces of adjacent framing.
- .2 Suspended and furred ceilings:
 - .1 Level cross furring channels to maximum tolerance of 3 mm in 3 m (1/8" in 10 ft).
- .3 Installation tolerances gypsum panels:
 - .1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane in exposed surfaces, except at end joint between gypsum board panels.
 - .2 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.
 - .3 Surface flatness shall not exceed 1.5 mm (1/16") within 305 mm (12") straight edge. For non-tapered-edge end joints between boards, measure flatness tolerance with end of straight end at centreline of joint.
- .4 Installation tolerances accessories:
 - .1 Alignment with board panels shall not exceed tolerances specified above.
 - .2 End joints shall be flush aligned to maximum offset of 0.5 mm (0.020").

3.15 **PROTECTION**

- .1 Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- .2 Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

- .3 Remove and replace panels that are wet, moisture damaged, and mold damaged at no additional cost to the Owner.
 - .1 Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - .2 Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 QUALITY ASSURANCE

- .1 Installer: Trained and approved by the manufacturer and having a minimum three years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.
- .2 Finish ceiling system: Square with adjoining walls and level within 1:1000, in true plane, free from distorted, warped, soiled or damaged panels or grid.
- .3 Comply with ASTM C635/C635M Intermediate Duty and C636/C636M except as otherwise specified herein.
- .4 Maximum deflection of completed ceiling system: 1/360 of span.
- .5 Design suspended ceiling system for adequate support of electrical fixtures as required by Electrical Safety Authority.
- .6 Maintenance seminars: Provide, to the Owner, training seminars and recommendations on Product maintenance procedures.
- .7 Pre-installation meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Consultant of the date and time of the meeting.
- .8 Manufacturer's site inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

1.3 SUBMITTALS

- .1 Product Data: Prior to ordering Products or materials, submit manufacturer's printed Product datasheets for each type of Product. Include Product characteristics, performance criteria, physical size, finish and limitations for Products listed in selected designs.
- .2 Samples: Duplicate full size samples of each type acoustical units and 300 mm long grid members.

1.4 ENVIRONMENTAL CONDITIONS

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

PART - 2 PRODUCTS

2.1 MATERIALS

- .1 Acoustic Tile Products: to match existing.
- .2 Exposed main tee: Hot dipped galvanized steel to ASTM A653/A653M minimum Z90 coating designation, 24 mm exposed face and 38 mm high bulb tee design with double web and separate exposed cap piece, maximum length, with reversible and integral splice. Prefinish tee in baked enamel, standard colour.
- .3 Exposed cross tee: Hot dipped galvanized steel to ASTM A653/A653M minimum Z90 coating designation, exposed face to match main tees, 38 mm high bulb tee design of same fabrication as main tee, with override stepped ends to allow cross tee flange to sit on main tee flange providing flush exposed faces, and with positive interlock to main tee, grid module to suit acoustical panels. Finish to match main tees.
- .4 Main tee splices: Designed to lock lengths of main tees together so that joined lengths of tee function structurally as a single unit with tee faces at joint perfectly aligned and presenting a tight seam.
- .5 Hangers and wires: Galvanized hangers and 2.6 mm (12 gauge) minimum galvanized steel wire.
- .6 Hold-down clips: Spring steel clips by the grid system manufacturer.
- .7 Wall moulding: Prefinished galvanized steel, nominal 25 mm x 25 mm with nominal 25 mm exposed face, hemmed edges. Finish to match main tees.
- .8 Shadow wall moulding: Prefinished galvanized steel, 19 mm x 19 mm reveal with nominal 25 mm exposed face, hemmed edges. Finish to match main tees.
- .9 Adhesive: Recommended by acoustic unit manufacturer.

PART - 3 EXECUTION

3.1 INSTALLATION - GENERAL

- .1 Install work in accordance with ASTM C636/C636M and to manufacturer's instructions except where specified otherwise.
- .2 Do not commence installation until work above ceiling has been inspected by Consultant.
- .3 Lay out system in accordance with reflected ceiling plans.
- .4 Ensure work is co-ordinated with location of related components.

3.2 INSTALLATION - GRID SYSTEM

- .1 Centre acoustical ceiling suspension systems on room axis; install equal border pieces, unless otherwise indicated.
- .2 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
- .3 Install supplemental suspension system where ducts or other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support suspension system members. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- .4 Install hanger wires plumb and securely anchored to the building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.

- .5 Do not bend or twist hangers as a means of levelling. Form double loops tightly and lock to prevent vertical movement or rotation within the loop.
- .6 Install wall moulding at intersection of ceiling and vertical surfaces to provide correct ceiling height.
- .7 Provide additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of light fixtures and diffusers.
- .8 Use longest practical lengths of tees, furring and running channels to minimize joints. Make joints square, tight, flush and reinforced with concealed splines. Assemble framework to form a rigid and interlocking system.
- .9 Run main tees at right angles to length of light fixtures.
- .10 Interlock cross tees to main tees to provide rigid assembly.
- .11 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.

3.3 **INSTALLATION - ACOUSTICAL PANELS**

- .1 Neatly cut acoustic units for mechanical and electrical and other services.
- .2 Carefully fit acoustic units in place; no broken edges permitted.
- .3 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.
- .4 Provide hold-down clips at acoustical system to hold units tight to grid system within 6000 mm of an exterior door and an operable window.
- .5 Install adhesive bonded acoustic units to clean, dry and firm substrate.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

- .1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 SUBMITTALS

.1 Product data sheets: Submit manufacturer's Product data sheets for each type of Product.

- .1 Include manufacturer's written data on physical characteristics, durability, and fade resistance.

- .2 Include installation recommendations for each type of substrate.

.2 Samples:

- .1 Submit 3 samples of each type and colour of carpet and edge trim, for acceptance of colour and construction by Consultant. Obtain acceptance from Consultant prior to ordering material.

.2 Sample sizes:

- .1 Carpet tile: 500 mm x 500 mm (20" x 20") or full size of tile, whichever is greater.

- .2 Edge trim: 150 mm (6") lengths.

.3 Manufacturer's instructions:

- .1 Submit carpet and adhesive manufacturer's written installation recommendations for each type of substrate required.

- .2 Identify trowel notch size and shape, and required adhesive coverage rates for each specified carpet material for installation of specified materials.

.4 Maintenance Data:

- .1 Submit maintenance instructions in triplicate for insertion in maintenance manuals. Instructions shall give specific warning of maintenance or cleaning practices or materials which may damage carpeting.

1.3 QUALITY ASSURANCE

- .1 Installer: Trained and approved by the manufacturer and having a minimum five years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

- .2 Maintenance seminars: Provide, to the Owner, training seminars and recommendations on Product maintenance procedures.

- .3 Pre-installation meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Consultant of the date and time of the meeting.

- .4 Manufacturer's site inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. Submit, to Consultant manufacturer's inspection reports and verification that the work of this Section is correctly installed.
- .5 Products: Provide like Products from same production run. Install Products in sequence from sequentially numbered dye lots.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver cartons of carpet tile to Site clearly tagged to show installation location.
- .2 Store adhesive, carpet tapes and similar items in heated area maintained at minimum temperature of 10 deg C or at such temperature as recommended by product manufacturer.
- .3 Comply with adhesive and carpet manufacturer's directions for use of adhesive. Observe open time limits for adhesives and place lids on open cans when not being used. Under no circumstances contaminate or thin adhesives with water or solvents, unless specifically directed by manufacturer in writing.

1.5 **PROJECT CONDITIONS**

- .1 Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- .2 Provide ventilation system in area to be carpeted to ensure adequate (min 1 air change each hour) extraction of VOC's or other contaminants. In occupied buildings, existing ventilation system may not be used for this purpose.

PART - 2 PRODUCTS

2.1 **PERFORMANCE REQUIREMENTS**

- .1 Carpet tile products must comply with the following minimum performance requirements:
 - .1 To be commercial grade;
 - .2 To be tufted-loop construction
 - .3 Yarn must be 100% solution dyed nylon or a combination of maximum 30% yard dyed, with permanent status control, permanent soil-hiding fibre cross-section with a modification ratio no greater than 2.2 and stain resistance that must be permanent and able to resist trafficking and numerous hot-water extraction without losing its effectiveness;
 - .4 Carpet fibre must be a minimum pile weight of 576 g/m²;
 - .5 Carpet tile must be certified to Carpet and Rug Institute's and the Canadian Carpet Institute's IAQ requirements - be CRI Green Label Plus Certified, or GREENGUARD Gold Certified and must contain a minimum of 40% recycled material, use recovered materials, and be recyclable.
 - .6 Colour/pattern: matching existing carpet tiles
- .2 Tuft Bind: Lifetime of carpet.
- .3 Edge Ravel: none for Lifetime of carpet.
- .4 Delamination: none for Lifetime of carpet.

- .5 Stain Resistance: Lifetime stain warranty, 10-year Lightfastness and Atmospheric Contaminant Warranty.
- .6 Flammability: certified for flammability to Health Canada regulations under "Hazardous Products - Carpet Regulations", Part II of Schedule 1.
- .7 Flammability: to ASTM E648 flooring radiant panel class 1, smoke density less than 450.
- .8 Flame Spread: maximum flame spread rating 300, maximum smoke developed classification 500, when tested to CAN/ULC-S102.2.
- .9 Smoke Development: Maximum 450 to ASTM E662.
- .10 Static Resistance: permanent static control to AATCC 134, 3000 V maximum at 20% RH and 22 degrees C.

2.2

MATERIALS

- .1 Backing: premium PVC-free recyclable backing system, containing post industrial recycled content, made from a thermoplastic polyolefin compound with a high performance precoat and reinforcing layer.
- .2 Wall Base: to match existing.
- .3 Adhesive: Non-toxic, providing total Volatile Organic Compound (VOC) emission not exceeding 0.5 mg/sq.m. per hour. Quick release adhesive recommended and approved by carpet manufacturer.
- .4 Latex crack filler: Compatible with adhesive and recommended by carpet manufacturer.
- .5 Epoxy levelling compound and screed: to ANSI A118.3.
- .6 Subfloor patching compound:
 - .1 Cement base, acrylic polymer compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
 - .2 Have not less than the following physical properties:
 - .1 Compressive strength - 25 MPa.
 - .2 Tensile strength - 7 MPa.
 - .3 Flexural strength - 7 MPa.
 - .4 Density - 1.9.
 - .3 Capable of being brought to feather edge, and trowelled to smooth finish.
 - .4 Ready for use in 48 hours after application.
- .7 Primer for porous concrete, and patching / levelling compound: specific type and product name as recommended by the carpet manufacturer.
- .8 Transition / Reducer strips: first grade quality raw materials, one piece, smooth and free from imperfections.
- .9 Water vapour reduction system: 100% solids epoxy one coat system, 0 VOC, suitable for application to 100% RH floors per ASTM F2170, designed to protect moisture sensitive adhered flooring systems from the devastating effects of elevated moisture and alkalinity levels, warranted by manufacturer to cover subsequent flooring materials and labour, compatible with finish flooring products.
 - .1 ASTM E96/E96M, Water vapour transmission (wet methods) performance shall be documented by independent testing laboratory at a minimum 97% for water vapour transmission reduction compared to untreated concrete.

- .2 ASTM E96/E96M, Perm rating: shall not exceed a 0.10 Perm rating.
- .3 ASTM D1308; Insensitivity to alkaline environment up to, and including, pH 14 in a 14 day bath test.
- .4 Manufacturer certifies acceptance and exposure to continuous topical water exposure after final cure.
- .5 Water vapour reduction system shall be a single coat, stand-alone system with no requirements for additional components such as sand broadcast for adhesion of flooring systems.
- .6 System shall reduce Calcium Chloride readings of up to 25lbs/1000 ft²/24 hrs by 97% in one coat. System must be able to perform as required with RH Probe readings of 100%.

PART - 3 EXECUTION

3.1 EXAMINATION

- .1 Ensure that environmental conditions have been provided as specified.
- .2 Ensure that substrates have been provided as specified without holes, protrusions, bumps, cracks greater than 1.6 mm (0.06") wide, unfilled control joints, depressions greater than 3mm (0.125") deep, or other major defects to prevent telegraphing.
- .3 Pre-installation testing:
 - .1 Conduct the tests in accordance with ASTM F710 and the following:
 - .1 Test for moisture vapour transmission in accordance with ASTM F710 and ASTM F1869 or ASTM F2170 in accordance with manufacturer's written flooring installation instructions. Results must not exceed 170 µg/m² (3 pounds per 1,000 square feet) in 24 hours when tested to ASTM F1869, or exceed 75% when tested to ASTM F2170.
 - .2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710.
 - .3 For each test type: Conduct 3 tests for flooring applications up to 93 m² (1000 square feet) in area, and 1 additional test for each additional 93 m² (1000 square feet) of flooring area.

3.2 PREPARATION

- .1 Where concrete substrate exhibits higher than permitted moisture and alkalinity levels, Provide water vapour reduction system to protect moisture sensitive flooring system from the effects of elevated moisture and alkalinity levels.
 - .1 Shot blast floors to International Concrete Repair Institute (ICRI) Concrete Surface Profile (CSP) #3 or #4 and clean surfaces with an industrial vacuum cleaner and remove residues from the substrate. Grinding is allowed only in areas not accessible by shot blasting. Remove defective materials, and foreign matter such as dust, adhesives, levelling compounds, paint, dirt, floor hardeners, bond breakers, oil, grease, curing agents, form release agents, efflorescence, laitance, and other deleterious substances. Repair cracks, expansion joints, control joints, and open surface honeycombs and fill in accordance with water vapour reduction system manufacturer's recommendations.
 - .2 Reinforcing fibres that are visible after shot blasting shall be removed and vacuumed leaving no fibres left on the concrete surfaces.

- .3 Repair concrete prior to moisture vapour reduction system installation by using water vapour reduction system manufacturer's recommended bonding emulsion with approved concrete repair materials.
- .4 Shot blast a small test area and review surface profile with the finished flooring applicator. As the water vapour reduction system is not a levelling material, Provide feather finish or levelling material to "flatten" or level the water vapour reduction system treated concrete prior to the flooring installation.
- .5 Verify proper adhesion of flooring adhesives, coatings, and levelling compounds to the final vapour reduction coating system for acceptability.
- .2 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations and in accordance with CRI 104 Carpet Installation Standard.
- .3 Surfaces shall be smooth, clean and cured, with trowel finish, free from curing compounds or surface coatings.
- .4 Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods. Do not use solvents.
- .5 Alkalinity and adhesion testing: Perform tests and proceed with installation only after substrates pass testing. Document tests performed and submit in writing to Consultant.
- .6 Fill cracks, fissures and depressions in concrete with latex emulsion filler compatible with adhesive. Surfaces shall be smooth and free from defects that may telegraph through surface of carpet.
- .7 Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.
- .8 Remove chalking and dusting from concrete surfaces with wire brushes.
- .9 Prepare floor substrates to receive flooring including minor feathering of substrate adjacent floor materials of different thickness with cementitious bonding compound to make a flush transition between floor finishes.
- .10 Where flooring adjoins thicker floor materials, apply epoxy levelling screed, feather out to make up difference in level between materials.
- .11 Vacuum clean floors prior to installation.

3.3

INSTALLATION

- .1 Co-ordinate tile carpeting work with work of other trades, for proper time and sequence to avoid construction delays.
- .2 General:
 - .1 Install carpet tiles in accordance with manufacturer's written instructions, and CRI Carpet Installation Standard.
 - .2 Select the appropriate adhesive and trowel notch configuration recommended by the carpet, and adhesive manufacturers.
 - .3 Spread adhesive uniformly over the substrate areas with an appropriate trowel, leaving ridges of sufficient height to achieve full and complete coverage of the substrate and carpet backing, including penetration into the carpet tile backing's deepest recesses.
 - .4 Allow no traffic over installation until adhesives have fully cured.

- .5 Finish and adhere securely along the wall line; with a smooth, neat appearance where no wall base materials are indicated; and concealed beneath base materials where wall base materials are indicated. Base materials shall be installed after installation of carpet.
 - .6 Extend carpet tile into recesses and closets and around fixtures and service devices.
 - .7 Installed carpet shall be free from perceptible variance in colour, stains, baldness, tears, fraying, patchwork, and other defects detrimental to good performance and appearance.
 - .8 Install carpet accurately fitted at perimeter of rooms, cut with precision at columns, door frames and at other obstructions. At columns and other penetrations, cut carpet with maximum possible coverage.
- .3 Carpet Tile:
- .1 Install carpet tiles to achieve monolithic appearance.
 - .2 Commence work in centre of area. Accurately lay chalk lines in the length and width of area.
 - .3 Lay row of control tiles in adhesive along centre lines accurately and firmly in selected quadrant, in straight lines and square corners. Lay additional tiles within quadrant by "stair-step" technique.
 - .4 Measure areas to ensure tight installation. Measure over 11 tiles to attain cumulative space gained over 10 joints. The gain must not be greater than 6 mm. Utilize this method in continual check of installation.
 - .5 Frequently check tile joints for proper alignment. Do not install tiles that are out of true more than 1.5 mm.
 - .6 Avoid excessive pressure on joining tiles causing tiles to peak or buckle. Brush back face pile and tip tile into place to avoid any pile being caught in joint.
 - .7 Lay last whole tile closest to wall and perimeter cut tiles in adhesive. Accurately cut and tightly fit perimeter cut tiles against vertical fixed surface such as wall.
 - .8 Make cuts from back, using template for fitting around columns or at room perimeter.
 - .9 Terminate and lock tiles in place with fixed reducer strips anchored to floor for exposed tile edges.
 - .10 Set reducer strip in bed full adhesive, at interface of dissimilar floorings, where flooring terminates at concrete floors, at flooring exposed edges and where indicated. Set strips with top flush with adjacent floorings. Locate mouldings below centre of door when door is in closed position, where doors occur.
- .4 Transition Trim:
- .1 Install in longest lengths possible.
 - .2 Scribe and fit to obstructions and cope mitre corners.
 - .3 Fit joints tight with no gaps and not less than 610 mm (24") from corners.
 - .4 Set transition trims in bed full adhesive, at interface of dissimilar floorings, where flooring terminates at concrete floors, at flooring exposed edges and where indicated. Set strips with top flush with adjacent floorings. Locate transition trims below centre of door when door is in closed position, where doors occur.

3.4 **INSTALLATION TOLERANCES**

- .1 Transition strips: Install straight to maximum allowable variation of 1:1000.

3.5 **CLEANING**

- .1 Perform the following operations immediately after installing carpet tile:
 - .1 Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - .2 Remove yarns that protrude from carpet tile surface.
 - .3 Vacuum carpet tile using commercial machine with face-beater element.

3.6 **PROTECTION**

- .1 Restrict traffic during installation. Upon completion of installation, do not allow traffic or movement of furniture onto carpet surface until installed area has been anchored at perimeter.
- .2 Cover entire carpeted area with plastic covering held in place by masking tape at seams and stay-tacking around perimeter.
- .3 Do not remove carpet protection until directed by Consultant.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

- .1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 SYSTEM DESCRIPTION

.1 Loading requirements:

- .1 Uniform load: 12 kPa with maximum deflection of 2 mm and without damage. Ensure loads meet Part 4, Structural Requirements of the Building Code.
- .2 Concentrated load: CISCA A/F Section I; 6.9 MPa measured at centre of panel, 5.5 MPa measured at panel weakest point with maximum 2.5 mm top surface deflection and maximum 0.25 mm top surface permanent deformation.
- .3 Ultimate loading: CISCA A/F Section II; tested to failure, minimum 2 times concentrated load.
- .4 Rolling loads: CISCA A/F Section III; Fixed Paths A and B; 1250 lbs on Wheel 1 and 1000 lbs on Wheel 2 with maximum permanent panel surface deformation of 0.5 mm and a combination of local and overall surface deformation not to exceed 1mm.
- .5 Pedestal axial load test: CISCA A/F Section V; 22.24 kN.
- .6 Pedestal overturning moment: CISCA A/F Section VI, 113 Nm.
- .7 Impact load test: Supported to CISCA A/F Section I requirements; panels shall withstand an impact load of minimum 68 kg anywhere on the panel, dropped from a height of 900 mm onto 6.45 sq.cm. with a local indentation not to exceed 2 mm.

.2 Combustibility: CAN/ULC-S102.2-M, flame spread not to exceed 25.

.3 Allowable tolerances:

- .1 Floor panel flatness: plus/minus 0.5 mm in any direction.
- .2 Floor panel surface dimension: plus/minus 0.5 mm.
- .3 Floor panel squareness: Difference of diagonal measurements of not more than 0.25 mm.

.4 Make finished floor surface free of exposed metal edges, except as otherwise specified, and finished floor surface serves as an isolation pad for personnel safety.

.5 Design access flooring system components so they can be easily removed and replaced or dismantled, rearranged, interchanged and for cable outlets, air outlets and other services.

.6 Make complete access flooring system demountable by single person working with hand tools only, without cutting or damaging any part. Make bolts, screws and other fasteners are accessible from above.

.7 Make completed access flooring system sturdy, rigid, firm and free of vibration, rocking panels, rattles, squeaks and other noises.

.8 Electrical resistance: Chapter 3 NFPA 99, maximum 10 ohms, measured from top of bare panel, less covering, to pedestal base.

1.3 SUBMITTALS

- .1 Shop drawings: Clearly indicating floor panel layout, component details, anchorage methods, edge details, handrails, fascia, step and ramp details, and finishes.
- .2 Certification: Before delivering any materials submit certification of specified design strengths and fire resistance. Prepare certification by a nationally known independent testing organization.
- .3 Maintenance data: Submit maintenance data for maintenance of floor finishes of access flooring system, for incorporation into maintenance manual. Give warning of any maintenance materials or procedures which may damage access flooring. Provide detailed removal, replacement and adjustment instruction for access flooring components.
- .4 Tools: Provide at least three complete sets of special tools required for dismantling access flooring system. Each set includes one double cup lifter and any special keys or spanners required.

1.4 QUALITY ASSURANCE

- .1 Manufacturer: Having a minimum of five years experience in the manufacturing of the work of this Section of similar type and specified quality.
- .2 Installer: Trained and approved by the manufacturer and having a minimum three years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.
- .3 Manufacturer's site inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Coordinate deliveries to comply with construction schedule and arrange ahead for strategic off-the-ground, under-cover storage at locations designated by Consultant. Do not load any area beyond design limits.
- .2 Adequately protect components against damage, dirt, disfigurement and weather. Do not use damaged materials and replace with approved material at sole discretion of Consultant.
- .3 Cover and protect work of other Sections in area of work from damage. Make good damage to satisfaction of Consultant.
- .4 Protect work of this Section from damage of any kind. Protect other work from damage resulting from work of this Section. Replace damaged work which cannot be repaired, cleaned or restored.
- .5 Provide safe and adequate equipment on Site to execute the Work, safety protection equipment, tools, and other equipment required for completion of the Work.

1.6 WARRANTY

- .1 Warrant the Work of this Section against defects and deficiencies for a period of 3 years commencing at Substantial Performance. Promptly make good defects and deficiencies which become apparent within warranty period at no cost to Owner, at times convenient to Consultant.

1.7 **EXTRA STOCK**

- .1 Panels: 1% of each type of panels.
- .2 Pedestals and Stringers: of sufficient quantity to support quantity of extra panels specified herein.
- .3 Put foregoing in suitable cartons with appropriate content identification labels. Store at locations designated by the Owner.

PART - 2 PRODUCTS

2.1 **MATERIALS**

- .1 Access floor: 35 mm thick, lightweight high strength concrete core encased in galvanized sheet steel to form 610 mm x 610 mm size panel, Class A flame spread rating, ConCore 1500 by Tate Access Floors Inc., or approved equivalent by Maxcess Technologies or by ASM Modular Systems.
 - .1 Finish: as determined by Consultant, and to match the finish of existing access flooring.
- .2 Pedestals: Steel assembly, with minimum 103 sq.cm. ribbed base plate; threaded supporting rod and vibration-proof locking device to permit only 38 mm adjustment; galvanized or plated finish. Pedestal head to be formed to accept panel bolt down stringerless system.
- .3 Stringer: 610 mm grid module, removable sections, individual bolted connection to pedestals heads.
- .4 Stringer gaskets and adhesive: Extruded continuous conductive vinyl channel with aligning ridge and conductive adhesive.
- .5 Lateral bracing: Hot dipped galvanized steel channels, sized to suit design loading specified, complete with brackets and fasteners.
- .6 Ramps: Same basic materials, structural strength, and construction as floor panels. Cover open joints with flush stainless steel cover plates.
- .7 Fascia panels: Closure panels to manufacturer's standard. Include corner pieces, trim, reinforcing and fixing angles required. Finish with anodized finish.
- .8 Adhesives: Waterproof type as recommended by manufacturer of article to be bonded.
- .9 Polyethylene sheet: CAN/CGSB-51.33-M, Type 2, 6 mils thick.

PART - 3 EXECUTION

3.1 **EXAMINATION**

- .1 Prior to commencing Site work, examine substrates for suitability of receiving pedestals, and report in writing all unsatisfactory surfaces and conditions detrimental to proper installation of Work under this Section. Do not commence work until ridges and high spots have been removed, and low spots filled as required for satisfactory installation.
- .2 Clean structural slab thoroughly of dirt, dust, extraneous materials, foreign matter and contamination. Reapply surface sealer after any of above repairs have been made.
- .3 Site check squareness of area to receive access panels. If area is out of square, layout work in a way perimeter panels are cut to fit and follow configuration of abutting vertical surface.
- .4 Filling squareness differential with strips of access flooring material will not be accepted.

- .5 Level floor sufficiently so finished elevated floor is level within tolerance specified without exceeding adjusting capacity of pedestals.

3.2 **INSTALLATION**

- .1 Install components to system manufacturer's instructions.
- .2 Arrange pedestal assemblies to meet grid spacing required.
- .3 Bond pedestals base plate to structural floor with adhesive.
- .4 When adhesive is cured no bond impairment is acceptable when 360-in-lb horizontal force is applied to top of pedestals. Install additional pedestal assemblies where grid pattern is disturbed by columns, walls, ramps, openings, and steps, and at cut-outs that impair floor load capacity.
- .5 Mechanically fasten floor panels solidly on pedestals with countersunk flat head screws, level to maximum variation over entire floor of 1:2000.
- .6 Install ramp panels similar to floor panels, securely fixed.
- .7 Provide floor and ramp complete with necessary edge trims, end closures and lateral bracing at step edges and other locations where pedestal is not braced 4 ways.
- .8 Install fascia panels at exposed sides and where indicated.
- .9 Secure panels at edge of access flooring system to continuous clip angles mechanically secured to structural floor and to edge of floor panels.

3.3 **INSTALLATION**

- .1 Install floor system using laser method and in accordance with manufacturer's directions and reviewed shop drawings.
- .2 Co-ordinate with Sections providing services below the access flooring.
- .3 Immediately prior to installation of access floor, vacuum floor substrate and keep substrate clean during installation.
- .4 Arrange pedestal assemblies to meet grid spacing required. Provide additional pedestal assemblies where grid pattern is disturbed by columns, walls, openings that impair floor load capacity.
- .5 Set pedestals to substrate in full bed of adhesive. Install additional pedestal assemblies where grid pattern is disturbed by columns, walls, ramps, openings, and steps, and at cut-outs that impair floor load capacity.
- .6 Arrange stringer symmetrically with all stringer lengths the same except at columns, perimeters and elsewhere where approved.
- .7 Erect grid system to provide 4 way support to pedestals and adjust to correct height. Interconnect pedestals with stringers or lateral bracing, free standing pedestal will not be accepted.
- .8 Provide lateral bracing connecting pedestals to adjacent walls where understructure does not extend to walls.
- .9 Secure stringers to pedestals and install panels with hairline joints and matched corners. Fully support panels at all sides.
- .10 Provide additional pedestals to support stringers less than a module at perimeter and other obstructions. Connect pedestals with lateral bracing for a distance of three normally supported pedestals.
- .11 Provide additional supports at edges of irregularly shaped and cut panels.

- .12 Check panels for uniformity of bearing and test that each panel can be removed by means of suction cup grip.
- .13 Do fitting around corners, columns and other object penetrating the floor system.
- .14 Reinforce openings where necessary with additional pedestals or lateral bracing to maintain floor loading capacity.

3.4 **CLEANING AND PROTECTING**

- .1 Clean area under floor completely. Remove debris and vacuum clean entire underfloor walls, floor and supporting structure, removing dust.
- .2 Protect completed finished floor surface with 6 mil thick polyethylene sheets or heavy duty kraft paper, taped and sealed at edges, or by other means acceptable to Consultant.
- .3 Immediately before turning over to Owner, remove protection and dispose of same and leave floor in a clean condition, free from defects.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section Includes: Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 QUALITY ASSURANCE

- .1 Applicator qualification: Qualified journeypersons, painters, as defined by local jurisdiction shall be engaged in painting and decorating work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyperson in accordance with trade regulations.
- .2 Materials, preparation and quality of work: In conformance with requirements of the latest edition of the Architectural Painting Specification Manual by the Master Painters Institute, referred to as the MPI Painting Manual in this Section, issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
- .3 Manufacturers and products: Listed under the Approved Product List section of the MPI Painting Manual.
- .4 The best practices specified or recommended in CAN/CGSB-85.100 shall govern for painting materials, methods and procedures.

1.3 SUBMITTALS

- .1 List of painting materials: Submit duplicate copy of list of painting materials for review prior to ordering materials.
- .2 Project Data Manual: At project completion provide an itemized list complete with manufacturers' application instructions, paint type and colour coding for all colours used for Owner's later use in maintenance.

1.4 SAMPLES

- .1 Sample Colours: Provide duplicate minimum 300 mm square samples of surfaces or acceptable facsimiles requested painted with specified paint or coating in colours, gloss, sheen and textures required for Consultant's review. When approved, samples become acceptable standard of quality with one of each sample retained on-site.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Deliver all painting materials in sealed, original labelled containers bearing manufacturer's name, brand name, type of paint or coating and colour designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.
- .2 Store all paint materials in original labelled containers in a lockable, dry, heated and well ventilated single designated area meeting the minimum requirements of both paint manufacturer and authorities having jurisdiction and at a minimum ambient temperature of 7 degree C. Only material for use on this project is to be stored on site.
- .3 Take necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect the environment from hazard spills. Store materials that constitute a fire hazard in suitable closed and rated containers and removed from the site on a daily basis.

- .4 Comply with requirements of authorities having jurisdiction, in regard to the use, handling, storage and disposal of hazardous materials.

1.6 **SCHEDULING**

- .1 Schedule painting operations to prevent disruption of and by other Sections.

1.7 **PROJECT CONDITIONS**

- .1 Unless specifically pre-approved by the Consultant, and the product manufacturer, do not perform work when the ambient air and substrate temperatures are below 10 degree C.
- .2 Do not perform interior work unless adequate continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above minimum requirements for 24 hours before, during and 48 hours after work is complete, unless required otherwise by manufacturer's instructions. Provide supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
- .3 Do not perform work when the relative humidity is above 85% or when the substrate temperature is less than 3 degree C above the measured dew point.
- .4 Do not perform work when the maximum moisture content of the substrate exceeds:
 - .1 12 % for concrete and masonry.
 - .2 15% for wood.
 - .3 12 % for plaster and gypsum board.
- .5 Conduct all moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple cover patch test.
- .6 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .7 Apply work only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.
- .8 Do not perform work unless a minimum lighting level of 325 Lux is provided on surfaces to be painted or decorated.

1.8 **WASTE MANAGEMENT AND DISPOSAL**

- .1 Paint, stain and wood preservative finishes and related materials such as thinners, solvents are regarded as hazardous products and are subject to regulations for disposal. Obtain information on these controls from applicable authorities having jurisdiction.
- .2 Separate and recycle waste materials. Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility. Materials that cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
- .3 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
- .4 Strictly adhere to the following procedures to reduce the amount of contaminants entering waterways, sanitary and storm drain systems or into the ground:
 - .1 Retain cleaning water for water-based materials to allow sediments to be filtered out. In no case shall equipment be cleaned using free draining water.

- .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
 - .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
 - .4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.
 - .5 Empty paint cans are to be dry prior to disposal or recycling (where available).
 - .6 Close and seal tightly partly used cans of materials including sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.
- .5 Set aside and protect surplus and uncontaminated finish materials not required by the Owner and deliver or arrange collection for verifiable re-use or re-manufacturing.

PART - 2 PRODUCTS

2.1 MATERIALS

- .1 Only materials listed in the latest edition of the MPI Approved Product List (APL) are acceptable for use on this project. Provide material from a single manufacturer for each system used.
- .2 Acceptable manufacturers:
 - .1 Benjamin Moore
 - .2 Dulux Paints/PPG
 - .3 Sherwin Williams
- .3 Other materials not listed in the APL shall be the highest quality product of an MPI listed manufacturer and shall be compatible with paint materials being used as required.
- .4 All materials used shall be lead and mercury free and shall have low VOC.
- .5 Provide materials having good flowing and brushing properties and capable to dry or cure free of blemishes, sags, air entrapment.
- .6 Where required, paints and coatings shall meet flame spread and smoke developed ratings to code requirements and authorities having jurisdiction.

2.2 EQUIPMENT

- .1 Painting and Decorating Equipment: to best trade standards for type of product and application.
- .2 Spray Painting Equipment: of ample capacity, suited to the type and consistency of paint or coating being applied and kept clean and in good working order at all times.

2.3 MIXING AND TINTING

- .1 Unless otherwise specified or pre-approved, provide materials ready-mixed and pre-tinted. Re-mix materials in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .2 Mix paste, powder or catalyzed materials in strict accordance with manufacturer's written instructions.

- .3 Do not exceed amount of thinner beyond manufacturer's recommendations. Do not use kerosene or organic solvents to thin water-based materials.
- .4 If required, thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Consultant.

2.4 FINISH AND COLOURS

- .1 Paint (PT): Consultant will select colours from a manufacturer's full range of colours.
- .2 Access doors, prime coated butts and other prime painted hardware, registers, radiators and covers, exposed piping and electrical panels: To match adjacent surfaces, unless otherwise noted or where pre-finished.
- .3 Where other applied finishes and nosing are not specified at stairs, ramps and landings providing access and exit for persons with visual impairment, provide colour contrast slip resistant finish and warning strips at treads and landings.

2.5 GLOSS AND SHEEN RATINGS

- .1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI values:

Gloss Level	Description	Units@ 60 degrees	Units@ 85 degrees
G1	Matte or Flat finish	Max. 5	Max. 10
G2	Velvet finish	Max. 10	10 to 35
G3	Eggshell finish	10 to 25	10 to 35
G4	Satin finish	20 to 35	Main. 35
G5	Semi-Gloss finish	35 to 70	
G6	Gloss finish	70 to 85	
G7	High-Gloss finish	More than 85	

PART - 3 EXECUTION

3.1 CONDITION OF SURFACES

- .1 Prior to commencement of work thoroughly examine and test as required conditions and surfaces scheduled to be painted. Do not commence work until adverse conditions and defects have been corrected and surfaces and conditions are acceptable to Consultant.

3.2 SURFACE PREPARATION

- .1 Prepare all surfaces in accordance with MPI requirements.
- .2 Sand, clean, dry, etch, neutralize and test surfaces under adequate illumination, ventilation and temperature requirements.
- .3 Remove and securely store miscellaneous hardware, surface fittings and fastenings such as electrical plates, mechanical louvers, door and window hardware, hinges, knobs, locks, trim, frame stops, removable rating/hazard/instruction labels, washroom accessories, light fixture trim, from wall and ceiling surfaces, doors and frames, prior to commencement of work. Carefully clean and replace items upon completion of work in each area. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes. Remove doors to finish bottom and top edges and re-hang doors when work is complete.

- .4 Protect all adjacent interior surfaces and areas, including rating/hazard/instruction labels on doors, frames, equipment, piping, from painting operations and damage using drop cloths, shields, masking, templates, or other suitable protective means and make good damages caused by failure to provide such protection.
- .5 Make good substrate defects and sand ready for finishing particularly after the first coat is applied. Start of finishing on defective surfaces indicates acceptance of substrate and any costs of making good defects shall be borne by this Section including re-painting of entire defective surface.
- .6 Confirm preparation and primer used with fabricator of steel items.

3.3 **APPLICATION**

- .1 Do not perform work unless substrates are acceptable and until heating, ventilation, lighting and completion of work of other Sections are acceptable for applications of products.
- .2 Apply materials in accordance with MPI Painting Manual Premium Grade finish and manufacturers' requirements.
- .3 Work specified is intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer's recommendations.
- .4 Tint each coat of finish progressively lighter to enable confirmation of number of coats.
- .5 Sand between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1000 mm.
- .6 Do not apply finishes on surfaces that are not sufficiently dry. Unless manufacturer's directions state otherwise, each coat shall be sufficiently dry and hard before a following coat is applied.
- .7 Prime coat of stain or varnish finishes may be reduced in accordance with manufacturer's directions.
- .8 Paint finish shall continue through behind all wall-mounted items.

3.4 **INTERIOR FINISHING SYSTEMS**

- .1 Finish interior surfaces in accordance with MPI Painting Manual requirements, unless noted otherwise.
- .2 Gloss and sheen ratings: as selected by Consultant.
- .3 Structural Steel and Metal Fabrications:
 - .1 INT 5.1R: High performance architectural latex finish.
- .4 Galvanized Metal: Doors, frames, misc. steel, pipes, overhead decking, ducts.
 - .1 Non-heritage elements: INT 5.3M - High performance architectural latex.
 - .2 For painted heritage elements (cast iron storefront, handrails, etc.):
 - .1 First coat: direct to metal 2-component mastic epoxy, tinted to gray colour, VOC compliant; acceptable product: PPG Pittguard 97-145 series.
 - .2 Second and third coats: 2-component low VOC, Polyester Acrylic Polyurethane; acceptable product: Amershield VOC by PPG. Gloss and colours as selected by Consultant.

- .5 Dressed Lumber: Doors, door and window frames, casings, molding.
 - .1 For painted non-heritage elements: INT 6.3A - High performance architectural latex.
 - .2 For heritage elements: Refer to Section 08 14 00, Wood Door and Frame.
 - .6 Equipment backboards:
 - .1 INT 6.3R: Pigmented fire-retardant finish (ULC rated).
 - .7 Plaster and Gypsum Board:
 - .1 INT 9.2B: High performance architectural latex finish.
 - .8 Aluminum:
 - .1 Highest quality, three (3) coat system by Matthews Paint, PPG Industries:
 - .1 Primer: One (1) coat of chromate-free, low VOC undercoat, compatible with topcoat.
 - .2 Second and third coats: aliphatic, acrylic polyurethane coating, 2.0 mil DFT minimum each coat.
 - .9 Existing Galvanized Metal: Low contact low traffic areas such as Misc. steel, pipes, overhead decking, ducts.
 - .1 RINT 5.3A - Latex, gloss level 5 (over waterborne primer).
 - .10 Existing Galvanized Metal: High contact high traffic areas such as doors, frames, railings.
 - .1 RIN 5.3J - High performance architectural latex, gloss level 5.
- 3.5 **MECHANICAL, ELECTRICAL EQUIPMENT AND RELATED SURFACES**
- .1 Unless otherwise specified or noted, finish all unfinished conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and texture to match adjacent surfaces, in the following areas:
 - .1 Where exposed-to-view in areas.
 - .2 In interior high humidity interior areas.
 - .3 In boiler room, mechanical and electrical rooms.
 - .2 In unfinished areas leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
 - .3 Touch up scratches and marks on factory finished equipment with products compatible with factory finish.
 - .4 Do not paint over nameplates.
 - .5 Paint the inside of all ductwork where visible behind louvers, cast iron storefront items, grilles and diffusers for a minimum of 450 mm or beyond sight line, whichever is greater, with primer and one coat of flat black paint.
 - .6 Paint the inside of light valances gloss white.

- .7 Back prime and paint face and edges of plywood service panels for telephone and electrical equipment before installation to match adjacent wall surface. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.6 **FIELD QUALITY CONTROL AND STANDARD OF ACCEPTANCE**

- .1 Painted interior surfaces will be considered to lack uniformity and soundness if any of the following defects are apparent:
 - .1 Brush and roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
 - .2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
 - .3 Damage due to touching before paint is sufficiently dry or any other contributory cause.
 - .4 Damage due to application on moist surfaces or caused by inadequate protection from the weather.
 - .5 Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).
- .2 Painted surfaces will be considered unacceptable if any of the following are evident under final lighting source (including daylight) for interior surfaces:
 - .1 Visible defects are evident on vertical and horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm.
 - .2 Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
 - .3 When the final coat on any surface exhibits a lack of uniformity of colour, sheen, texture, and hiding across full surface area.
- .3 Make good painted surfaces rejected by Consultant and at the no extra cost to the Owner. Touch up small affected areas. Repaint large affected areas or areas without sufficient material dry film thickness. Remove runs, sags of damaged paint by scraper or by sanding prior to application of paint.

3.7 **PROTECTION**

- .1 Protect interior surfaces and areas, equipment and any labels and signage from painting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.
- .2 Erect barriers or screens and post signs to warn of or limit or direct traffic away or around work area as required.

3.8 **CLEAN-UP**

- .1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.
- .2 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.

- .3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of same in accordance with requirements of authorities having jurisdiction.
- .4 Clean equipment and dispose of wash water / solvents as well as all other cleaning and protective materials (e.g. rags, drop cloths, masking papers, etc.), paints, thinners, paint removers / strippers in accordance with the safety requirements of authorities having jurisdiction.

3.9 **EXISTING SURFACES**

- .1 Finish or refinish existing surfaces of items or rooms where noted, including new work which has been incorporated into the existing work and existing work which has been damaged, altered or otherwise disturbed during renovation operations.
- .2 Refinish surfaces or rooms adjacent to rooms where alterations or renovations have been carried out and which have been damaged or otherwise disturbed by the alterations or renovations. Where such damages occur, refinish completely.
- .3 Remove from existing surfaces rust, scale, oil grease, mildew, chemicals and other foreign matters.
- .4 If coatings on existing surfaces have failed so as to affect the proper performance or appearance of materials to be applied, or if such coatings can be easily removed, remove them and prepare the substrates properly. Dull hard or glossy surfaces by sanding, sandblasting or by other abrasive methods prior to finishing.
- .5 Refinish surfaces entirely between changes of planes which have been incorporated into the existing work and existing work which has been damaged, altered or otherwise disturbed during renovation operations.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment, engineered hydraulic calculations & shop drawings, permit applications and services necessary to complete the work of a complete and functioning fire protection system.
 - .2 Refer to Section 23 05 01 – Basic Mechanical Requirements.
 - .3 Refer to General Sections of the specifications.

1.2 RELATED WORK IN THIS CONTRACT

- .1 Work performed under other Sections
 - .1 Finish painting: Division 09.

1.3 CODES, REGULATIONS AND STANDARDS

- .1 Comply with Municipal or Provincial Codes – e.g.: OBC, Rules and Regulations and/or Authorities having jurisdiction.
- .2 Fire protection system to be compliant with and approved by FM Global.
- .3 Comply with the National Building Code in areas where Municipal or Provincial Regulations and/or Codes are not mandatory.
- .4 Revisions issue: latest version as amended to date.

1.4 REFERENCES

- .1 Comply with applicable requirements of the latest issue of the following Standards:
 - .1 OFC - Ontario Fire Code
 - .2 NFPA 10 - Portable Fire Extinguishers
 - .3 SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems
 - .4 NFPA - 13 Installation of Sprinkler Systems
 - .5 ASHRAE - HVAC Applications, Seismic and Wind Restraint Design
 - .6 CAN/ULC-S508 - Rating and Fire Testing of Fire Extinguishers

1.5 WORKING DRAWINGS AND DOCUMENTS

- .1 Design Drawing Intent
 - .1 The design Drawings are schematic in arrangement, and describe the general design intent but do not show pipe sizes or the exact details for the installation. They are not interference, fabrication or installation drawings.
 - .2 The Work is suitably outlined on the Drawings with regard to zone sizes, locations, general arrangements and installation details, and has been generally coordinated for routing of services. Refer to other trades and disciplines drawings for coordinated and integrated with other systems. The routing of ductwork, piping and equipment arrangement are shown more or less in diagram except where in

- certain cases the Drawings may include details giving the exact locations and arrangements required.
- .3 The location of equipment, and the associated arrangement of piping, ductwork, and other material describes the general requirements of the Work. Final location is dependant on the actual equipment supplied. The Consultant reserves the right to make reasonable adjustment of up to 1 m to the location of equipment, floor drains, routing of major piping and ductwork, at no cost to the Owner.
 - .4 In order to provide clarity to the arrangement of the work, not all details including valves, thermometers, pressure gauges, etc. are shown on the plan drawings. Refer to schematic drawings, standard details and the specification for these requirements.
 - .5 Where Standard Details are provided, these show the general installation requirements, and are applicable to each occurrence in the Work, unless otherwise specified or shown.
- .2 Contractor Coordination Responsibilities
- .1 Provide the services of a mechanical/electrical coordination supervisor, to coordinate this Division of the Work, as well as providing coordination with other Divisions and/or contracts. This supervisor may be full time or part time on site, as appropriate to the work stage and complexity of the work, at the discretion of the Owner.
 - .2 Where multiple trades are required, the mechanical coordinating supervisor shall be the lead coordinator.
 - .3 The Owner reserves the right to require the coordinating supervisor to increase their attendance at site, at no cost to the Owner, if in the Owner's opinion the current level of coordination is not sufficient for the progress of the Work.
 - .4 Make changes and modifications as necessary to ensure coordination and to avoid interference and conflicts with other trades.
 - .5 Prepare dimensioned construction/installation/fabrication drawings, coordinated with other trades and contracts, as required. Supply the lead Mechanical Contractor with 3-D Cad drawings for his incorporation in the Overall Interference drawings 3-D Cad model.
 - .1 Provide sufficient detail to disclose critical interferences of major equipment and services to ensure adequate accessibility.
 - .2 Indicate sleeves, openings and stress points (such as anchors, guides and inserts).
 - .3 Indicate deviation in sizes and weights and also in water, drainage, electric power or other service requirements for all equipment proposed which is different from those show on the Design Drawings.
 - .4 Provide these drawings to other trades for coordination with their Work.
 - .5 Update these drawings as part of the As-built drawings, showing actual locations of major equipment, services, access doors, shut-off valves, etc.
 - .6 The design drawings show the major requirements for the installation of equipment based on one manufacturer's requirements, but may not show all installation requirements. The Contractor shall include as part of the Work the specific manufacturers installation requirements for the equipment actually provided by the Contractor.

1.6 **COORDINATION AND EXAMINATION**

.1 Examination

- .1 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences.
- .2 Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.

.2 Coordination

- .1 Coordinate Work of Division 21, 22, 23 and 25, with Electrical Divisions such that items will properly interface with Work of other Divisions. Prepare installation drawings of critical locations and submit to Consultant for review.
- .2 Architectural Drawings, or in their absence, Mechanical Drawings govern all locations.

1.7 **EXISTING SERVICE**

.1 Tie-in to existing services

- .1 Do not shut down or make tie-in connections to any existing service without written permission of the Owner and/or Consultant.
- .2 Arrange work to minimize interruption to physical access to the building.
- .3 Include for all costs associated with making connections to existing services.

.2 Work in existing buildings

- .1 Route pipes, conduits and other services to avoid interference with existing installation.
- .2 Relocate existing services and equipment to suit installation of new work.
- .3 Cut back and cap existing services not being used, so that finished work presents a neat and clean appearance.
- .4 Unless noted to be reused, fixtures and materials being removed become the property of the Contractor and are to be removed from site, unless otherwise noted.

.3 Continuity of Services

- .1 Be responsible for any damage to existing systems, including insulation and coverings, when making connections.
- .2 Keep existing buildings in operation with minimum length of shut-down periods.
- .3 Include overtime work to tie-in piping or wiring at night or on weekends.

1.8 **SUBMITTALS**

.1 Shop Drawings: conform to the following.

- .1 Shop Drawings showing more than one size or model will not be considered unless properly marked up.
- .2 For electrically driven appliances, provide the following information:
 - .1 Electrical characteristics including voltage, phase, frequency and power rating.

- .3 For other equipment include the following information:
 - .1 Equipment performance ratings, including flow rates, pressures drops.
 - .2 Electrical control power requirements.
- .4 For all equipment, include the following:
 - .1 Equipment dimensions and weights.
 - .2 Itemized product description with optional items clearly marked as being included. Standards compliance and labels and certifications for the equipment.
- .5 Provide wiring Shop Drawings:
 - .1 Wiring diagrams and schematics for all equipment which has electrical controls or devices furnished with the equipment.
 - .2 Wiring diagrams alone are not sufficient; schematic and interconnecting drawings, and sequence of operation of equipment are required for review.
 - .3 Prepare wiring diagrams, Drawings and schematics.
 - .4 Clearly indicate the materials and/or equipment being supplied:
 - .1 Details of construction, finish, accurate dimensions, capacities and performance.
 - .2 Certify drawings correct for construction by the manufacturer, before submission.
 - .3 Identify Equipment Shop Drawings with designations as shown on the Drawings or in the Specifications.
 - .4 If not complied with, Shop Drawings will not be reviewed and will be returned to the Contractor.
- .2 Contractor shall prepare a fully coordinated dimensioned installation/interface drawing including ALL services and equipment which is intended to be supported from the structure above. The services to be coordinated include BUT are not limited to HVAC piping, domestic piping and drainage, and sprinkler piping including sprinkler head locations, all HVAC ductwork, all equipment, all lighting, all electrical, communication, security, fire alarm, audio visual systems wiring, conduits, cable, race ways and all other essential vertically-horizontally mounted services. The said services point of origin and destination must be clearly identified.
- .3 These interference drawing shall:
 - .1 be 3-D Cad composite drawing showing all of the required services complete with elevation markers as required.
 - .2 be issued in the form of a shop drawing for review by the Consultant.
 - .3 include all sections to satisfy the requirements of the submittal
- .4 The purchasing, fabrication and installation of all of the related services shall not commence until the above review process has been completed without any pending comments or requirements. Purchasing, fabricating and installing any of the related services prior to the above shop drawing review process shall be at the contractor's risk."

1.9 **"AS-BUILT" RECORD DRAWINGS**

.1 Reference

- .1 Maintain an accurate dimensional record of all underground piping and all deviations and changes in aboveground piping and equipment.
- .2 Prepare Cad as built drawings.

1.10 **INSTALLATION AND START-UP INSTRUCTIONS**

.1 Reference

- .1 Submit as shop drawings in form of a pdf file, installation instructions and start-up instructions for items and equipment to the Consultant.

1.11 **OPERATING AND MAINTENANCE INSTRUCTION MANUALS (O&M MANUALS)**

.1 Reference

- .1 O& M manuals shall be prepared in form of a pdf file for Consultant's review. In addition, provide the Owner with a hard copy and a pdf version of the O & M manuals, as a minimum include the following in the manuals:
 - .1 Non-dimensional layout showing location of all electrical devices on mechanical equipment.
 - .2 Operating instructions, including start-up and shut-down procedure.
 - .3 Lubricating instructions and recommended cycle of lubrication for each item of equipment, including various types of lubricants.
 - .4 List of spare parts.
- .2 All the above applies to component parts of equipment whether they are manufactured by the supplier of the equipment or are supplied as a component part of an item of equipment.

1.12 **WARRANTY**

- .1 Provide at least 24 months parts and labour warranty for all equipment and systems installed under this contract. Refer to the General Conditions of Contract for details of the warranty; the more stringent conditions shall govern.
- .2 The twenty four (24) months warranty shall start from the date of the substantial completion of contract works.
- .3 If within the warranty period, upon written notice from the Owner, it is found that the equipment or system is defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the Contractor at the cost of the Contractor and at no cost to the Owner.

1.13 **CLEANING, TESTING AND APPROVAL RECORDS**

.1 Records

- .1 Maintain records of all pressure tests and flushing and sterilization tests, inspections and approvals by the Plumbing Inspector.
- .2 Forward these tests to the Owner on completion of the work.
- .3 Forward to Consultant and Commissioning Agent, copy of records on site on completion of each test, cleaning operation, etc.

1.14 **DIMENSIONS AND QUANTITIES**

- .1 Dimensions
 - .1 Dimensions shown on Drawings are approximate.
 - .2 Verify dimensions by reference to shop drawings and field measurement.
- .2 Quantities
 - .1 Quantities or lengths indicated in any of the Contract Documents are approximate only and shall not be held to gauge or limit the Work.

1.15 **TRADE QUALIFICATIONS**

- .1 Applicable to the following trades
 - .1 Sprinkler/Fire Protection
- .2 Requirements
 - .1 Trade workers to have a Certificate of Qualification as Journeyman or Apprentice Registration for the province where the work is performed or an Interprovincial Certificate.
 - .2 Ratio of journeyman to apprentice: not to exceed the defined ratio in the Apprenticeship Act of Ontario.
 - .3 On award of Contract, submit a list of trade journeyman and apprentices, together with their Certificate and Registration numbers.
 - .4 Certificates and Registration must be provided to the Consultant on request.
 - .5 Maintain on-site an up-to-date record listing journeyman and apprentices working on site.

PART - 2 PRODUCTS

2.1 **MATERIALS**

- .1 Use new materials and equipment, free from defects impairing strength and durability, as specified or specified equivalent.
- .2 Of Canadian manufacture wherever possible.
- .3 Labelled or listed as required by Code and/or inspection authorities.
- .4 Design of mechanical systems has been based on the first listed supplier and model number/size stated on the Equipment Schedules on the Drawings. Bear all costs due to physical or performance differences between stated equipment and proposed equipment. These differences include but are not limited to size, layout, arrangement, connection size, location and/or quantity of connections, or performance differences such as noise, power requirements, flow, throw, etc.

2.2 **EQUIPMENT/STRUCTURE COORDINATION**

- .1 Locations and dimensions of curbs and floor opening framing, where indicated on the Drawings, are based on an arrangement to suit the above named supplier.

- .2 Be responsible to verify the actual size requirements of the openings, and notify the Consultant immediately in case the dimension of the unit supplied and the connecting ductwork/piping, etc. are at variance with the dimensions given on the Drawings.
- .3 Bear all costs for modification of curbs and floor openings resulting from failure to notify the Consultant prior to the fabrication or construction of opening framing and curb.

2.3 **STANDARD SPECIFICATIONS**

- .1 Product Quality
 - .1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all products provided comply with the latest issue of applicable Standard Specifications issued by authorities having jurisdiction.
 - .2 Do not apply such Standard Specifications to decrease the quality of workmanship, products and services required by the Contract Documents.

2.4 **MANUFACTURER'S NAMEPLATES**

- .1 Metal Nameplates
 - .1 Provided with raised or recessed lettering, on each piece of equipment.
 - .2 Mechanically fasten nameplate on a metal stand-off bracket arranged to clear insulation.
 - .3 Mount on same stand-off Underwriters Laboratories and/or CSA registration plates.
- .2 Nameplate Data
 - .1 Indicate:
 - .1 Size
 - .2 Capacity
 - .3 Equipment model
 - .4 Manufacturer's name
 - .5 Serial number
 - .6 Voltage
 - .7 Cycle
 - .8 Phase and power of motors

2.5 **MOTORS AND WIRING**

- .1 In accordance with Section 23 05 13 *Motors and Wiring for Mechanical*

2.6 **PIPES, FITTINGS AND VALVES**

- .1 In accordance with Section 23 05 23 - Pipes, Fittings and Valves

2.7 **HANGERS AND SUPPORTS**

- .1 In accordance with Section 23 05 29 - Hangers and Supports

2.8 **VIBRATION AND SEISMIC RESTRAINT**

- .1 In accordance with Section 23 05 48 - Noise and Vibration Control

2.9 **IDENTIFICATION FOR EQUIPMENT AND PIPING**

- .1 In accordance with Section 23 05 53 - Mechanical Identification

2.10 **PORTABLE FIRE EXTINGUISHING EQUIPMENT**

- .1 Portable Fire Extinguishers

- .1 Extinguishers to be complete with full operating charge and wall mounting bracket, and of the following class:

- .1 Dry Chemical: Class ABC - 2.3 kg

- .2 Acceptable Manufacturers

- .1 Levitt (Ansul)

- .2 National

- .3 Flag

- .4 Cronin

- .2 Fire Extinguisher Cabinets

- .1 1.6 mm (16 gauge) steel tub

- .2 2.8 mm (12 gauge) hollow channel door and rebated frame

- .3 Where flush mounted, return edges by 13 mm or bevel on outer edge of door trim

- .4 Semi-concealed piano hinges

- .5 Door latch and 5 mm plate glass in door

- .6 Cabinet finish: grey primer to door, trim and full cabinet

- .7 Door finish: grey primer

- .8 Acceptable Manufacturers

- .1 National Fire Equipment

- .2 Impact

- .3 Stelpro

- .3 Provide wall brackets and hangers where fire extinguishers are not located within a cabinet.

PART - 3 EXECUTION

3.1 **GENERAL**

- .1 Execute work in accordance with requirements specified in the various Sections of Division 21.

- .2 Lay out work of each trade so that it does not interfere with work under other Divisions of Specifications.

- .3 Make good any damage to Owner's property or other trade's work caused by improperly locating or carrying out of work.

- .4 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided alteration is made before installation.

3.2 EQUIPMENT INSTALLATION

- .1 Set equipment in place, align, connect and place in operation with:
 - .1 Controls set for efficient, stable operation.
 - .2 Connections and required safety devices installed.
- .2 Protect equipment from damage during and after installation, and on completion of work ensure that equipment is free from cracks, scratches, discolourations, tool marks, and other defects.
- .3 Thoroughly clean finished surfaces before acceptance of work.

3.3 PROTECTION

- .1 Protect work and materials before, during and after erection from weather and other hazards and keep in a clean and orderly manner.
- .2 Protect pipe ends, valves and parts of equipment left unconnected to prevent damage or intrusion of foreign matter. Provide pipe caps for threaded male connections and plugs for threaded female connections.
- .3 Protect plumbing fixtures or mechanical equipment having a baked enamel finish by covering with polyethylene sheet securely held in place.

3.4 PAINTING

- .1 With the exception of prime painting of miscellaneous steel or any other specific requirements as specified under the respective Sections of Division 21, or equipment otherwise factory painted, all painting will be provided under Division 09.
- .2 Factory applied finish painting:
 - .1 Factory prime and final coats applied to pumps, air moving units, uninsulated pressure vessels, unit ventilators, convectors and bare metal equipment items, in boiler, mechanical and fan rooms.
 - .2 Use heat resistant paint where conditions require.
 - .3 Protect factory finished equipment during construction, and clean at completion of work.
- .3 Factory applied prime painting:
 - .1 Factory prime paint other equipment fabricated from iron or steel including access doors, grilles, diffusers, dampers, metal radiation enclosures, and fire hose cabinets.
 - .2 In occupied areas of the building, touch up any damage to prime coat resulting from shipping or installation and leave ready for final painting under Division 9.
- .4 Field painting:
 - .1 Mechanical rooms, crawl spaces, pipe tunnels: paint exposed galvanized metal surfaces with one coat of zinc dust galvanized primer and one coat of 100% alkyd base enamel.
 - .2 Clean rust and oil from exposed iron and steel work provided under this Division, whether or not it has been factory prime painted. Paint this equipment with one coat of chrome oxide phenolic base primer and one coat of 100% alkyd base enamel in an approved colour.

3.5 **MAINTENANCE OF BEARINGS**

.1 During Construction

- .1 Turn-over rotating equipment at least once a month after delivery;
 - .1 Run-in sleeve type bearings in accordance with manufacturer's recommendations.
 - .2 Drain, flush out and refill with new charge of oil or grease.
 - .3 Protect bearings, shafts and sheaves against damage, corrosion and dust accumulation.
 - .4 Provide extended grease nipples for bearing lubrication.

3.6 **FIRE EXTINGUISHERS**

.1 Provide fire extinguishers as follows, (provide wall brackets for wall hung units):

- .1 One extinguisher for each 300 m² of floor area in an electrical and in mechanical service rooms
- .2 In each extinguisher cabinet
- .3 In each service room, storage room, mechanical room – in quantities dependent on room size & complying with NFPA 10.
- .4 Type: Class ABC unless shown otherwise, 2.3 kg size.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section including, but not limited to, the following:

.1 Design of automatic sprinkler systems; (hydraulic calculations and shop drawings)

.2 Preparation of working drawings

.3 Wet pipe sprinkler system(s)

1.2 RELATED WORK

.1 The following related work is detailed under other Sections of the Work.

.1 Electrical

.1 Power wiring except as noted: Division 26:

.2 General

.1 Painting: Section 09 91 00.

1.3 REFERENCE STANDARDS

.1 Comply with the latest edition of the following:

.1 National Fire Protection Association

.1 NFPA 13 Installation of Sprinkler Systems

1.4 DESIGN CRITERIA

.1 Design Submissions

.1 Prepare complete drawings of fire protection system to include:

.1 Drawings and calculations bearing stamp of a Professional Engineer employed by the Fire Protection Company and who is registered as a member of the Association of Professional Engineers of the Province of Ontario.

.2 Submit six (6) copies of plans, hydraulic design calculation sheets, shop drawings and equipment submittals through Owner's fire insurance broker for approval by designated organization.

.3 Submit all copies of drawings, etc. duly approved by Owner's insurance underwriter to Consultant for final review prior to commencement or work.

.4 Submit reviewed shop drawings to local municipal authority.

.5 Provide systems in accordance with approved drawings, subject to inspection and testing requirements of Owner's Insurance Underwriter and Consultant.

.2 Water Flow Test Data

.1 Water flow test data shall be obtained by this Contractor.

- .2 Perform hydraulic calculations for each sprinkler system based on the above mentioned flow test results.
- .3 Underwriters/Owners Approval
 - .1 Fire protection work requires approval of Owner's fire insurance underwriter and Consultant.
 - .2 Reviewing Organization:
 - .1 Factory Mutual – FM Global
- 1.5 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Submit shop drawings, 6 sets.
 - .2 Samples
 - .1 Submit samples for the following
 - .1 Each type of sprinkler.
 - .3 Operation and Maintenance Data
 - .1 Submit printed operating instructions and maintenance data.
 - .4 Maintenance Materials
 - .1 Provide the following materials at project handover:
 - .1 Storage cabinet
 - .2 Sprinkler wrench
 - .3 Spare stock of sprinklers. Include at least one head of each type and temperature rating installed in system and to NFPA 13 requirements.
- 1.6 **QUALITY ASSURANCE**
 - .1 Qualifications
 - .1 An accredited member in good standing of the Canadian Automatic Sprinkler Association
- 1.7 **CODES AND REGULATIONS, PERMITS, COSTS AND FEES**
 - .1 Comply with Municipal or Provincial Codes, Rules and Regulations and/or Authorities having jurisdiction.
 - .2 Apply for and obtain permits required for this work and pay costs levied for permits, inspections and fees.
 - .3 Comply with the National Building Code in areas where Municipal or Provincial Regulations and/or Codes are not mandatory.
 - .1 Revisions issue: latest version as amended to date.

PART - 2 PRODUCTS

2.1 LINE MATERIALS

- .1 General
 - .1 Unless otherwise noted, equipment and apparatus to be ULC listed and labelled.

2.2 SPRINKLER HEADS

- .1 Ratings
 - .1 ULC listed and labeled.
 - .2 Standard orifice size: 12mm diameter orifice or 20mm diameter orifice.
 - .3 Standard temperature rating: 57°C to 74°C.
 - .4 Intermediate and high temperature rating heads to suit local conditions.
- .2 Type
 - .1 Indicated by type in accordance with the following
 - .2 No ceilings
 - .1 Upright, bronze body, glass bulb type
 - .3 Suspended or Drop Ceilings
 - .1 Pendent recessed, chrome plated body ring and cup, glass bulb type.
 - .4 Side Wall
 - .1 Side wall, chrome plated body and escutcheon plate, fusible solder type.
 - .2 Side wall, chrome plated body and escutcheon plate, glass bulb, 11.2 K-factor extended coverage ordinary hazard standard response sprinkler, TYCO Model SW-24.
 - .5 Spare Heads and Cabinet
 - .1 Each sprinkler system: ULC approved metal cabinet containing required number of spare sprinkler heads of each type and temperature rating.
 - .2 Wrench for removal and replacement of sprinkler heads.
 - .6 Acceptable Manufacturers
 - .1 Viking Sprinkler Company
 - .2 Reliable Automatic Sprinkler Company
 - .3 Grinnell Company of Canada Limited
 - .4 Astra Sprinkler Company Limited
 - .5 Star Sprinkler Corporation
 - .6 GEM Sprinkler Corporation

2.3 SPARE PARTS CABINET

- .1 For storage of maintenance materials, 5 spare sprinkler heads and special tools.
- .2 Construct to sprinkler head manufacturers standard.

2.4 **PIPE PAINTING**

- .1 Paint
 - .1 Primer paint: fast drying alkyd conforming to CISC/CPMA 2.75 red in colour
 - .1 ICI/Devoe, Sherwin-Williams or PPG Industries.
 - .2 Final coat to be interior grade alkyd.

PART - 3 EXECUTION

3.1 **GENERAL**

- .1 Apportionment of the Work:
 - .1 Classify and apportion all materials and the performance of all labour to trades involved in accordance with all local customs, rules, regulations, jurisdictional awards, decisions, etc., insofar as they may apply and as required to efficiently execute the work involved in this Contract.
- .2 Measurements and Deviations
 - .1 Where any parts of the work are specifically located by dimensions on the Drawings, check and verify these dimensions on the site prior to installation.
 - .2 Examine work of other Trades or Contractors prior to commencement of fire protection installations. Immediately report in writing to Consultant any discrepancies on the part of any other Contractor which will affect fire protection installations. Failure to report discrepancies shall be considered acceptance of conditions.
 - .3 Where site conditions require minor deviations from indicated arrangements or locations, make changes on approval of Consultant without additional cost to Owner.
 - .4 Should discrepancies occur during installation of fire protection work which will necessitate major revisions, immediately notify Consultant and secure his authorization in writing before proceeding with the work.

3.2 **INSTALLATION**

- .1 Sprinkler Head Selection
 - .1 Select heads for all areas in accordance with ceilings and finishes and room temperature.
- .2 Test Connections and Drains
 - .1 Locate inspector's test connections, complete with valve, sight glass, and drain piping either at high points of sprinkler system or at the end of the longest run of sprinkler piping in accordance with NFPA 13.
- .3 Flushing of Piping
 - .1 Flush sprinkler system piping in accordance with NFPA requirements.

3.3 **MISCELLANEOUS STEEL**

- .1 General

- .1 Hang or support piping with miscellaneous structural supports and braces as may be required.
- .2 **Materials and Fabrication**
 - .1 Conform to CAN/CSA-S16.1M for materials, design of details and execution of the work.
 - .2 Conform to CAN/CSA-G40.21-M grade 300W for structural shapes, plates, etc.
 - .3 Conform to the latest issue of the following CSA Specifications.
 - .1 CSA W47.1 - for qualification of welders
 - .2 CSA W48.1-M - for electrodes (only coated rods allowed)
 - .3 CSA W59-M - for design of connections and workmanship
 - .4 CAN/CSA W117.2-M - for safety
- 3.4 **TESTING**
 - .1 **Requirements**
 - .1 Execute fire protection systems tests in accordance with NFPA requirements
 - .2 Minimum hydrostatic test of not less than 1380 kPa pressure for two hours, or at 345 kPa in excess of maximum static pressure developed in system, if maximum static pressure is in excess of 1034 kPa.
 - .3 Furnish pumps, gauges and other equipment required to complete test.
 - .4 Execute tests in presence of Consultant and Owner's authorized representative.
 - .5 Promptly repair defects which develop during tests, and then re-test system to complete satisfaction of authorized inspectors.
 - .6 Submit a certificate covering materials and tests to Underwriter's Inspection Authority, together with a request for inspection and approval of complete fire protection system. On receipt of approval, forward certificate to Owner.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

- .1 Labour, products, equipment and services necessary to complete the work of this Section including but not limited to that listed herein.
- .2 The terms “mechanical work”, “mechanical contractor” “Mechanical Division” or their derivatives includes the Work of Divisions 21, 22, and 23, unless otherwise specified.
- .3 Refer to Section 23 05 01, Basic Mechanical Requirements.
- .4 Refer to General Sections of the specifications.
- .5 Seismic Restraint, comply with:
 - .1 SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems
 - .2 ASHRAE - HVAC Applications, Seismic and Wind Restraint Design
- .6 Piping Systems:
 - .1 Sanitary drainage and venting system within building(s) including connection to sanitary sewer inside building.
 - .2 Domestic cold and hot water piping to plumbing fixtures within building
 - .3 Domestic cold water piping connection to existing lines inside building.
 - .4 Condensate drainage from HVAC equipment complete with indirect discharge to Funnel Floor Drains.
- .7 Equipment:
 - .1 Plumbing specialties
 - .2 Drainage specialties
 - .3 Plumbing fixtures and fittings
 - .4 Hot water storage tank and heater

1.2 RELATED WORK

- .1 Work performed under other Sections
 - .1 Finish painting: Division 09.
 - .2 Electrical wiring: Division 26.
- .2 Refer to Section 23 05 01 – Basic Mechanical Requirements.

1.3 CODES, REGULATIONS AND STANDARDS

- .1 Comply with Municipal or Provincial Codes, Rules and Regulations and/or Authorities having jurisdiction, OBC – Ontario Building Code, NFPA 13.
- .2 Revisions issue: latest version as amended to date.

1.4 **PERMITS AND INSPECTIONS**

- .1 Material approvals
 - .1 Obtain special inspection and approvals by CSA and/or local authorities, for materials where specified.
 - .2 Obtain such approval for the particular installation with the co-operation of the material supplier.
- .2 Permits
 - .1 Obtain permits required for the installation of mechanical trades work including:
 - .1 Plumbing inspection
 - .2 Electrical inspection
 - .2 Arrange for inspections and tests and pay all fees and costs for the permits, inspections and tests. Obtain permits immediately after notification of award of Contract.
 - .3 Obtain copies of Drawings from the Consultant for submission with application for permits.

1.5 **WORKING DRAWINGS AND DOCUMENTS**

- .1 Design Drawing Intent
 - .1 The design Drawings are schematic in arrangement, and describe the general design intent but do not show the exact details for the installation. They are not fabrication or installation drawings.
 - .2 The Work is suitably outlined on the Drawings with regard to sizes, locations, general arrangements and installation details, and has been generally coordinated for routing of services. The routing of ductwork, piping and equipment arrangement are shown more or less in diagram except where in certain cases the Drawings may include details giving the exact locations and arrangements required.
 - .3 The location of equipment, and the associated arrangement of piping, ductwork, and other material describes the general requirements of the Work. Final location is dependant on the actual equipment supplied. The Consultant reserves the right to make reasonable adjustment of up to 1 m to the location of equipment, floor drains, routing of major piping and ductwork, at no cost to the Owner.
 - .4 In order to provide clarity to the arrangement of the work, not all details including valves, thermometers, pressure gauges, etc. are shown on the plan drawings. Refer to schematic drawings, standard details and the specification for these requirements.
 - .5 Where specific installation dimensions for location of equipment and access space requirements are indicated on the drawings, install to these requirements.
 - .6 Where Standard Details are provided, these show the general installation requirements, and are applicable to each occurrence in the Work, unless otherwise specified or shown.
- .2 Contractor Coordination Responsibilities
 - .1 Provide the services of a mechanical/electrical coordination supervisor, to coordinate this Division of the Work, as well as providing coordination with other Divisions and/or contracts. This supervisor may be full time or part time on site, as

- appropriate to the work stage and complexity of the work, at the discretion of the Owner.
- .2 Where multiple trades are required, the mechanical coordinating supervisor shall be the lead coordinator.
 - .3 The Owner reserves the right to require the coordinating supervisor to increase their attendance at site, at no cost to the Owner, if in the Owner's opinion the current level of coordination is not sufficient for the progress of the Work.
 - .4 Make changes and modifications as necessary to ensure coordination and to avoid interference and conflicts with other trades.
 - .5 Prepare construction / installation / interference drawings, coordinated with other trades and contracts, as required by Section 01 11 00, Summary of Work.
 - .1 Provide sufficient detail to disclose critical interferences of major equipment and services to ensure adequate accessibility.
 - .2 Specific dimensions for equipment location or access which are shown on the Consultants drawings.
 - .3 Indicate sleeves, openings and stress points (such as anchors, guides and inserts).
 - .4 Indicate deviation in sizes and weights and also in water, drainage, electric power or other service requirements for all equipment proposed which is different from those show on the Design Drawings.
 - .5 Provide these drawings to other trades for coordination with their Work.
 - .6 Update these drawings as part of the As-built drawings, showing actual locations of major equipment, services, access doors, shut-off valves, etc.
 - .6 The design drawings show the major requirements for the installation of equipment based on one manufacturer's requirements, but may not show all installation requirements. The Contractor will include as part of the Work the specific manufacturers installation requirements for the equipment actually provided by the Contractor.
 - .7 The construction / installation / fabrication drawings are not to be submitted as shop drawings. Make them available for viewing at site when requested by the Consultant.

1.6 **COORDINATION AND EXAMINATION**

- .1 Examination
 - .1 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences.
 - .2 Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.
- .2 Coordination
 - .1 Coordinate Work of Division 21, 22, 23 and 25 such that items will properly interface with Work of other Divisions. Prepare installation drawings of critical locations and submit to Consultant for review.
 - .2 Architectural Drawings, or in their absence, Mechanical Drawings govern all locations.

1.7 **EXISTING SERVICE**

- .1 Tie-in to existing services
 - .1 Do not shut down or make tie-in connections to any existing service without written permission of the Owner and/or Consultant.
 - .2 Arrange work to minimize interruption to physical access to the building.
 - .3 Include for all costs associated with making connections to existing services, including but not limited to, cutting and patching of existing floors, partitions, ceilings and finishes.
- .2 Work in existing buildings
 - .1 Route pipes, ducts, conduits and other services to avoid interference with existing installation.
 - .2 Relocate existing services and equipment to suit installation of new work.
 - .3 Cut back and cap existing services not being used, so that finished work presents a neat and clean appearance.
 - .4 Unless noted to be reused or otherwise noted, fixtures and materials being removed become the property of the Contractor and are to be removed from site.
- .3 Continuity of Services
 - .1 Be responsible for any damage to existing systems, including insulation and coverings, when making connections.
 - .2 Keep existing buildings in operation with minimum length of shut-down periods.
 - .3 Include overtime work to tie-in piping or wiring at night or on weekends.

1.8 **SUBMITTALS**

- .1 Shop Drawings: conform to the following.
 - .1 Shop Drawings showing more than one size or model will not be considered unless properly marked up showing model and options to be provided.
 - .2 For electrically driven appliances, provide the following information:
 - .1 Electrical characteristics including voltage, phase, frequency and power rating.
 - .3 For other equipment include the following information:
 - .1 Electrical control power requirements.
 - .4 For all equipment, include the following:
 - .1 Equipment dimensions and weights.
 - .2 Itemized product description with optional items clearly marked as being included.
 - .5 Provide wiring Shop Drawings:
 - .1 Wiring diagrams and schematics for all equipment which has electrical controls or devices furnished with the equipment.
 - .2 Wiring diagrams alone are not sufficient; schematic and interconnecting drawings, and sequence of operation of equipment are required for review.

- .2 Contractor shall prepare a fully coordinated interference/interface drawing including ALL services and equipment which is intended to be supported from the structure above. The services to be coordinated include BUT are not limited to HVAC piping, domestic piping and drainage, FSP and sprinkler piping including sprinkler head locations, all HVAC ductwork, all equipment, all lighting, all electrical, communication, security, fire alarm, audio visual systems wiring, conduit, cable, race ways and all other essential vertically-horizontally mounted services. The said services point of origin and destination must be clearly identified,
 - .3 The interference drawing shall:
 - .1 be a composite drawing showing all of the required services complete with elevation markers as required.
 - .2 illustrate that a CLEAR dimension of 2800 mm can be achieved between the finished floor and the underside of the total sum services at the ceiling level in the Via Catering space and 3250mm clear outside of the Via Catering space. (Refer to the architectural drawings for the extent of the motorized tug cart path and the scissor lift area.)
 - .3 be issued in the form of a shop drawing for review by the Consultant.
 - .4 include all sections to satisfy the requirements of the submittal
 - .4 The purchasing, fabrication and installation of all of the related services shall not commence until the above review process has been completed without any pending comments or requirements. Purchasing, fabricating and installing any of the related services prior to the above shop drawing review process shall be at the contractor's risk."
- 1.9 **"AS-BUILT" RECORD DRAWINGS**
- .1 Reference
 - .1 Maintain an accurate dimensional record of all underground piping and all deviations and changes in aboveground piping and equipment.
- 1.10 **INSTALLATION AND START-UP INSTRUCTIONS**
- .1 Reference
 - .1 Submit copies of installation instructions and copies of start-up instructions for any item of equipment when requested by the Consultant.
- 1.11 **OPERATING AND MAINTENANCE INSTRUCTION MANUALS**
- .1 Reference
 - .1 In addition, include the following in the manuals:
 - .1 Non-dimensional layout showing location of all electrical devices on mechanical equipment.
 - .2 Operating instructions, including start-up and shut-down procedure.
 - .3 Lubricating instructions and recommended cycle of lubrication for each item of equipment, including various types of lubricants.
 - .4 List of spare parts.
 - .2 All the above applies to component parts of equipment whether they are manufactured by the supplier of the equipment or are supplied as a component part of an item of equipment.

1.12 **WARRANTY**

- .1 Provide at least 24 months parts and labour warranty for all equipment and systems installed under this contract. Refer to the General Conditions of Contract for details of the warranty; the more stringent conditions shall govern.
- .2 The twenty four (24) months warranty shall start from the date of the substantial completion of contract works.
- .3 If within the warranty period, upon written notice from the Owner, it is found that the equipment or system is defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the Contractor at the cost of the Contractor and at no cost to the Owner.

1.13 **CLEANING, TESTING AND APPROVAL RECORDS**

- .1 Records
 - .1 Maintain records of all pressure tests and flushing and sterilization tests, inspections and approvals by the Plumbing Inspector.
 - .2 Forward these tests to the Owner on completion of the work.
 - .3 Forward to Consultant, copy of records on site on completion of each test, cleaning operation, etc.

1.14 **DIMENSIONS AND QUANTITIES**

- .1 Dimensions
 - .1 Dimensions shown on Drawings are approximate.
 - .2 Verify dimensions by reference to shop drawings and field measurement.
- .2 Quantities
 - .1 Quantities or lengths indicated in any of the Contract Documents are approximate only and shall not be held to gauge or limit the Work.

PART - 2 PRODUCTS

2.1 **MOTORS AND WIRING**

- .1 In accordance with Section 23 05 13 Motors and Wiring for Mechanical

2.2 **PIPE, FITTINGS AND VALVES**

- .1 In accordance with Section 23 05 23 Pipes, Fittings and Valves

2.3 **HANGERS AND SUPPORTS**

- .1 In accordance with Section 23 05 29 Pipe Hangers and Supports

2.4 **VIBRATION RESTRAINT**

- .1 In accordance with Section 23 05 48 Noise and Vibration Control

2.5 **IDENTIFICATION FOR EQUIPMENT AND PIPING**

- .1 In accordance with Section 23 05 53 Mechanical Identification

2.6 **EQUIPMENT INSULATION**

- .1 In accordance with Section 23 07 16 Equipment Insulation

2.7 **PIPING INSULATION**

- .1 In accordance with Section 23 07 19 Piping Insulation

2.8 **MATERIALS**

- .1 Use new materials and equipment, free from defects impairing strength and durability, as specified or specified equivalent.
- .2 Of Canadian manufacture wherever possible.
- .3 Labelled or listed as required Code and/or inspection authorities.
- .4 Design of mechanical systems has been based on the first listed supplier and model number/size stated on the Equipment Schedules on the Drawings. Bear all costs due to physical or performance differences between stated equipment and proposed equipment. These differences include but are not limited to size, layout, arrangement, connection size, location and/or quantity of connections, or performance differences such as noise, power requirements, flow, throw, etc.

2.9 **EQUIPMENT/STRUCTURE COORDINATION**

- .1 Locations and dimensions of curbs and roof and floor opening framing, where indicated on the Drawings, are based on an arrangement to suit the above named supplier.
- .2 Be responsible to verify the actual size requirements of the openings, and notify the Consultant immediately in case the dimension of the unit supplied and the connecting ductwork/piping, etc. are at variance with the dimensions given on the Drawings.
- .3 Bear all costs for modification of curbs and floor/roof openings resulting from failure to notify the Consultant prior to the fabrication or construction of opening framing and curb.

2.10 **STANDARD SPECIFICATIONS**

- .1 Product Quality
 - .1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all products provided comply with the latest issue of applicable Standard Specifications issued by Authorities having jurisdiction.
 - .2 Do not apply such Standard Specifications to decrease the quality of workmanship, products and services required by the Contract Documents.

2.11 **MANUFACTURER'S NAMEPLATES**

- .1 Metal Nameplates
 - .1 Provided with raised or recessed lettering, on each piece of equipment.
 - .2 Mechanically fasten nameplate on a metal stand-off bracket arranged to clear insulation.
 - .3 Mount on same stand-off Underwriters Laboratories and/or CSA registration plates.

- .2 Nameplate Data
 - .1 Indicate:
 - .1 Size
 - .2 Capacity
 - .3 Equipment model
 - .4 Manufacturer's name
 - .5 Serial number
 - .6 Voltage
 - .7 Cycle

PART - 3 EXECUTION

3.1 GENERAL

- .1 Execute work in accordance with requirements specified in the various Sections of Division 22.
- .2 Lay out work of each trade so that it does not interfere with work under other Divisions of Specifications.
- .3 Make good any damage to Owner's property or other trade's work caused by improperly locating or carrying out of work.
- .4 Supply anchor bolts and templates for installation by other Divisions.
- .5 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided alteration is made before installation.

3.2 INSTALLATION

- .1 General
 - .1 Install complete plumbing, drainage and vent piping within washrooms, etc. in accordance with the Ontario Building Code, standard trade practice and as specified herein.
 - .2 Arrange piping within pipe spaces behind washroom fixtures to allow unimpeded access to piping for servicing.
- .2 Air Handling Equipment Drains
 - .1 Provide drains for air handling equipment in locations and in arrangements as indicated on the Drawings, or as required by design. All HVAC equipment shall be provided with condensate drainage piping and discharge system.
 - .2 Drain piping is as specified for Sanitary Drainage, with deep seal copper trap.
 - .3 Install trap seal equivalent to not less than 1½ times the maximum static pressure in duct system, discharge condensate drains indirectly into FFD and funnel drains.
 - .4 Provide condensate drainage of piping not less than 1 inch dia., unless noted otherwise, for all HVAC equipment with cooling coils, and provide necessary FFD – funnel floor drains for indirect discharge of this condensate.

3.3 EQUIPMENT INSTALLATION

- .1 Set equipment in place, align, connect and place in operation with:
 - .1 Controls set for efficient, stable operation.
 - .2 Connections and required safety devices installed.
- .2 Protect equipment from damage during and after installation, and on completion of work ensure that equipment is free from cracks, scratches, discolourations, tool marks, and other defects.
- .3 Thoroughly clean finished surfaces before acceptance of work.

3.4 FLUSHING AND STERILIZATION

- .1 Sterilize water piping in accordance with local municipal requirements.
- .2 Flush each system after completion by allowing full flow of water through the system for a period of 15 minutes or longer when directed by the Consultant.
- .3 After flushing of the system is completed, perform a 24 hour contact sterilization treatment by treating the water with 50 ppm of chlorine as recommended in AWWA Specification C-651.
- .4 After sterilization period has elapsed, flush system to reduce chlorine content to an acceptable level, but not less than 30 minutes.
- .5 Remove and clean strainer screens after flushing operation is completed. Repeat two weeks after initial operation of systems and within two weeks after Substantial Completion.

3.5 PROTECTION

- .1 Protect work and materials before, during and after erection from weather and other hazards and keep in a clean and orderly manner.
- .2 Protect pipe ends, valves and parts of equipment left unconnected to prevent damage or intrusion of foreign matter. Provide pipe caps for threaded male connections and plugs for threaded female connections.
- .3 Protect plumbing fixtures or mechanical equipment having a baked enamel finish by covering with polyethylene sheet securely held in place.

3.6 PAINTING

- .1 With the exception of prime painting of miscellaneous steel or any other specific requirements as specified under the respective Sections of Division 22, or equipment otherwise factory painted, all painting will be provided under Division 09.
- .2 Factory applied finish painting:
 - .1 Use heat resistant paint where conditions require.
 - .2 Protect factory finished equipment during construction, and clean at completion of work.
- .3 Factory applied prime painting:
 - .1 Factory prime paint other equipment fabricated from iron or steel including access doors, grilles, diffusers, dampers, and metal radiation enclosures.

- .2 In occupied areas of the building, touch up any damage to prime coat resulting from shipping or installation and leave ready for final painting under Division 9.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.
 - .2 Refer to Sections – Division 23 for piping, valves and specialties and insulation specifications, (e.g.: section 23 05 23, Pipe, Fittings and Valves).

1.2 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings.
- .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data.

PART - 2 PRODUCTS

2.1 DRAINAGE SPECIALTIES

- .1 Acceptable Manufacturers:
 - .1 Jay R. Smith
 - .2 Watts
 - .3 Zurn
 - .4 Enpoco
 - .5 Northstar/MEA
- .2 The Manufacturer's catalogue numbers are specified to indicate quality and features required. Sizes as shown on drawings.

2.2 FUNNEL DRAIN

- .1 Funnel Drain
 - .1 Jay R. Smith oval Funnel (8-1/4" x 3-1/4") duco Cast Iron.

2.3 DRAINAGE CLEANOUTS

- .1 Cleanouts - Line Cleanout
 - .1 Jay R. Smith #4420 Line Cleanout, duco coated cast iron ferrule with cast bronze tapered thread plug, with full size pipe opening.
- .2 Cleanouts - Concealed Stack Cleanout - Cleanout Tees with S.S Cover and Screw
 - .1 Jay R. Smith #4530 Stack Cleanout, in base of cast iron stacks duco coated cast iron with tee and counter sunk neoprene gasketed plug, round stainless steel plate and slotted flat head stainless steel screw.

- .3 Cleanouts - Floor Cleanout - Finished Areas
 - .1 Jay R. Smith #4020 'Twis-To-Floor' Floor Cleanout, duco coated cast iron body and removable positive gasket seal closure plug, secured with stainless steel screws, C.O. cast in cover. (For water-proofed areas provide 'F-C' flange with flashing clamp), scoriated Secured Nickel Bronze Top.
- .4 Cleanouts - Floor Cleanout - Terrazzo Areas
 - .1 Jay R. Smith #4180 'Twis-To-Floor' Floor Cleanout, duco coated cast iron body and removable positive gasket seal closure plug, with 1/2" (12mm) terrazzo recess, secured with stainless steel screws, C.O. cast in cover. (For water-proofed areas provide 'FC' flange with flashing clamp), round adjustable nickel bronze top.
- .5 Cleanouts - Floor Cleanout - Tiled Areas
 - .1 Jay R. Smith #4040 'Twis-To-Floor' Floor Cleanout (Square Cover), duco coated cast iron body and removable positive gasket seal closure plug, with 1/8" (3mm) tile recess, secured with stainless steel screws, C.O. cast in cover. (For water-proofed areas provide 'F-C' flange with flashing clamp). (For medium load traffic) Cover can be adjusted to suit floor lines when installing finished floor. (Mosaic tile provide Series 4160 with square cover.), square Adjustable Nickel Bronze Top.

PART - 3 EXECUTION

3.1 INSTALLATION

- .1 Cleanouts
 - .1 Locate drainage cleanout fittings in drainage piping:
 - .1 At locations indicated on the Drawings
 - .2 At base of each vertical stack
 - .3 As required to comply with applicable plumbing code
- .2 Expansion Joints
 - .1 Provide horizontal expansion joints on suspended drainage pipe which:
 - .1 Is welded
 - .2 Crosses a building expansion joint, whether the pipe is welded or not

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 CODES AND REGULATIONS

- .1 Conform to the latest edition of the Codes and Standards referenced herein.
- .2 Pressure Ratings
 - .1 Suitable for working pressure of 860 kPa.
- .3 Efficiency and Stand-by Loss Ratings
 - .1 To ASHRAE/IES 90.1b-1992
- .4 Electric hot water heaters to:
 - .1 CSA C22.2 No. 110
 - .2 CSA C191 Series M
- .5 Relief Valves
 - .1 Temperature, Pressure and Combination: to CAN1-4.4, or ANSI Z21.22

1.3 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 33 00.
 - .2 Provide certification for compliance to ASHRAE 90.1 for efficiency and stand-by loss ratings.
- .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data in accordance with Section 01 77 00.

PART - 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- .1 Connections up to NPS 3 to be screwed and over NPS 3 to be flanged.
- .2 Water heaters to be factory pre-piped and pre-wired, except where devices are specified to be shipped loose to be installed by others.

2.2 LIGHT COMMERCIAL ELECTRIC TANK-TYPE

- .1 Construction
 - .1 Glass lined steel tank with removable anodes.
 - .2 CFC free foam insulation.

- .3 Baked enamelled steel jacket housing.
- .4 Thermostatically controlled long life elements.
- .5 Manual reset high temperature limit switch
- .6 Built-in and factory pre-wired controls including contactors
- .7 Hose threaded drain valve
- .8 ASME rated temperature and pressure relief valve
- .2 Electrical
 - .1 Capacities and voltage as per equipment schedule.
- .3 Manufacturer
 - .1 J.H Wood
 - .2 A.O.Smith

PART - 3 EXECUTION

3.1 INSTALLATION

- .1 General
 - .1 Provide valved drain from each tank to nearest funnel or hub drain.
 - .2 Pipe-up T&P relief valve down to drain pan.
 - .3 Connect up to cold water supply lines and domestic hot water distribution piping.
 - .4 Provide thermometer on outlet piping from hot water tank (and as shown).
- .2 Electric Hot Water Heaters
 - .1 Power wiring and unfused disconnected by Electrical Division 26.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 RELATED WORK

- .1 The following work will be performed by other Divisions of the Work:
 - .1 Caulking of fixtures: Division 07.

1.3 SUBMITTALS

- .1 Shop Drawings: Submit shop drawings.
- .2 Operation and Maintenance Data: Submit printed operation instructions and maintenance data.
- .3 Contractor shall prepare a fully coordinated interference/interface drawing including ALL services and equipment which is intended to be supported from the structure above. The services to be coordinated include BUT are not limited to HVAC piping, domestic piping and drainage, FSP and sprinkler piping including sprinkler head locations, all HVAC ductwork, all equipment, all lighting, all electrical, communication, security, fire alarm, audio visual systems wiring, conduit, cable, race ways and all other essential vertically-horizontally mounted services. The said services point of origin and destination must be clearly identified.
- .4 The interference drawing shall:
 - .1 be a composite drawing showing all of the required services complete with elevation markers as required.
 - .2 illustrate that a CLEAR dimension of 2800 mm can be achieved between the finished floor and the underside of the total sum services at the ceiling level in the Via Catering space and 3250mm clear outside of the Via Catering space. (Refer to the architectural drawings for the extent of the motorized tug cart path and the scissor lift area.)
 - .3 be issued in the form of a shop drawing for review by the Consultant.
 - .4 include all sections to satisfy the requirements of the submittal
- .5 The purchasing, fabrication and installation of all of the related services shall not commence until the above review process has been completed without any pending comments or requirements. Purchasing, fabricating and installing any of the related services prior to the above shop drawing review process shall be at the contractor's risk."

PART - 2 PRODUCTS

2.1 PLUMBING FIXTURES

- .1 General Requirements
 - .1 CSA approved plumbing fixtures and fittings, of make, type and size specified herein.

- .2 Plumbing supplies and fixture trim material to be of CSA approved plumbing brass with chrome plated finish, and of make and type specified.
 - .1 Each item to bear name of manufacturer or identifying trademark.
- .3 Manufacturer's standard design and material specification as indicated by trade name and/or catalogue number, and as described.
- .4 Type number allocated to each style of fixture identifies that particular fixture on Drawings.

2.2 **PLUMBING FIXTURES AND DRAIN GOODS**

- .1 WC-1 - Wall Hung Toilet - Vitreous China - For Flushometer - Exposed - No Touch - Hardwired
 - .1 American Standard AFWall Millennium FloWise Elongated #3351.101.020 HET Toilet, Vitreous china with EverClean antimicrobial surface which inhibits the growth of stain and odor causing bacteria mold and mildew, elongated bowl, White Finish, Wall hung, Siphon jet flush action, Operates in the range of 4.2 L to 6 L (1.1 US Gal to 1.6 US Gal) per flush, Condensate channel, 305 mm x 254 mm (12" x 10") water surface, Siphon jet flush action, Condensate channel, elongated bowl, 54 mm (2-1/8") fully glazed internal trapway, Toilet seat not included, 38 mm (1-1/2") dia. Top spud. Mount fixture 16"(406mm) above finished floor to rim of toilet (or as required to meet local codes). Centoco #820STS.001 Toilet Seat, extra heavy duty, For elongated bowl, open front, Solid plastic, With cover, Stainless steel check hinges, metal flat washers stainless steel posts and nuts. Sloan Royal Optima #Royal Optima 111-1.28 ES-S-CP, Exposed Flushometer For Top Spud Toilet, polished chrome finish, 4.8 L (1.28 US Gal) factory set flow, quiet action 'PERMEX' diaphragm type with dual filter by-pass, Infrared sensor located on a 125 mm x 125 mm (4-15/16" x 4-15/16") stainless steel plate, solenoid operated flush controller circuitry, Courtesy Flush electronic over-ride button, V.P. Smooth design stop cap on bak-chek angle stop (screwdriver operated), Flush tube for 292 mm (11-1/2") rough-in, high pressure vacuum breaker, sensor located above the toilet, 5 VA Power Required per unit. Sensor to clear toilet seat cover. Provide 4" (102 mm) square electrical box for mounting sensor plate. Sloan #EL-154, Box Mount Hardwired Transformer, 120 VAC/ 24 VAC, 50 VA. Will operate up to 10 'Optima' flush valve units. Sloan YG Extended seat bumper on Watts #ISCA-101-M11 single horizontal Adjustable Toilet Carrier, mounted on concrete floor, all epoxy coated cast iron fitting, adjustable ABS slide nipple with integral test cap and neoprene bowl gasket, wasted plated hardware, chrome cap nuts, tiling frame, 102 mm (4") no hub waste, 51 mm (2") no hub vent, 158.8 kg (350 lbs) static load. 305 mm (12") finished metal stud wall to back of pipe space. Champion MI-X Series #MI-XHUB Drain Coupling, Coupling, no-hub, type 304 AISI stainless steel band, type 304 AISI stainless steel eyelet, elastomeric compound gasket meeting the requirements of ASTM C-564, type 304 AISI stainless steel shield; painted red for easy identification, Tested to maintain 15 psi maximum line pressure at 80 inch lb min to 100 inch lb maximum torque bolt tightness, Tested by IAPMO to comply to FM 1680-1989 Standard (except for markings) and CSA B602-2010 Standard (up to 10"). They are tested and certified to ASTM C1540-2011 Standard. Per OSHPD Code Application Notice 5-311.9 revised 6/29/2011, signed by Paul Coleman; Section I (a) states that: "the use of couplings that have been tested to conform to the performance requirements of FM approvals, Approval Standard 1680, Class I, by FM Approvals or by a nationally recognized independent testing agency" are acceptable

- .2 L-1 - Wall Hung Basin Electronic 'No Touch' Faucet - Thermostatic Mixing Valve
 - .1 American Standard Murro with EverClean #0955.001EC/0062.000EC Basin, Center hole only, 540 mm x 520 mm x 165 mm (21-1/4" x 20-1/2" x 6-1/2") high, Vitreous china, White Finish, for carrier with concealed arms, Rear overflow, recessed self-draining faucet ledge. American Standard 0062.000EC.020 Semi-pedestal P-trap cover Sloan BASYS #EFX-200-000-0040-CP Electronic 'No Touch' Faucet, polished chrome finish, Center hole only, die cast body, integral above deck water supply shut off, optimal "Mid" height spout for effective hand washing, 167 mm (6-9/16") projection reach, active IR sensing, 0.5 GPM (1.9 LPM) multi-laminar, back up alkaline battery provided, Eaf-37 transformer included. Sloan #BDT, thermostatic mixing valve, solid bimetal (bronze, brass, stainless steel), Hot limit stop set to a maximum of 43 °C (109.4 °F). Screwdriver adjustment temperature dial with scale: COLD-HOT. Provide tee, adaptors and flex. copper tubing to suit installation. Provide tempered water to hot side of faucet. McGuire #155A Open Grid Drain, cast brass one-piece top, 17 GA. (1.5 mm) tubular 32 mm (1-1/4") tailpiece. McGuire #LFH170BV Faucet Supplies, Chrome plated finish polished brass, commercial duty 1/4 turn ball valve angle stops, 13 mm (1/2") I.D. Inlet x 127 mm (5") horizontal extension tubes, convertible 1/4 turn/loose key handles, Escutcheon and flexible copper risers. McGuire #8872C P-Trap, heavy cast brass adjustable body, with slip nut, 32 mm (1-1/4") size, Shallow wall flange and Seamless tubular wall bend. Watts #WCA-411 Basin Carrier, concealed arms, wall flanges to attach to backing plate secured in wall with locking device and levelling screws, heavy gauge steel uprights with integral welded feet. For one unit: 102 mm (4") for two to six units in a row: 152 mm (6") finished metal stud wall to back of pipe space.
- .3 DF – Drinking Station and Bottle Filling Station
 - .1 Halsey Taylor HydroBoost Bottle Filling Station, & Single ADA Cooler, Model # HTHB-HACG8PV-WF, High Efficiency Filtered 30 LPH Platinum Vinyl. Chilling Capacity of 3.0 LPH of 10 degree C drinking water, based on 26.6 degree C inlet water and 32.2 degree C ambient, per ASHRAE testing. Unit shall include Sanitary Sensor Activated, Visual Filter Monitor, Filtered, High Efficiency, Green Counter, Laminar Flow, Antimicrobial, Drain, Double Bubbler, Electronic Bottle Filler Sensor with Mechanical Front and Side Bubbler Pushbar activation. Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120. Unit shall be lead-free design certified to NSF/ANSI 61 & 372 and meets Federal and Provincial low-lead requirements. Full load Amps 5.5, 120 V / 1ø/60 Hz. Include one (1) WSF 6000R-2 PK – Water Sentry Fresh 6000 CTO Filter – Replacement (2 pack)
- .4 Water Hammer Arrestors - PPP SC Series
 - .1 SMS INC. #SC Series Water Hammer Arrestors with brass piston in a type 'K' copper casing size according to manufacturer's recommendations to eliminate water hammer and shock from piping system. Provide Water Hammer Arrestors on hot and cold water supplies to all quick valves, solenoids, and plumbing fixtures, and locate in an upright position between the last two fixtures on a line, or horizontally at the end of line closest to supply source.

PART - 3 EXECUTION

3.1 INSTALLATION

- .1 Water Flow Rate
 - .1 Flush valve urinals and water closets.

- .1 Adjust flush valves to provide specified water flow rate based on manufacturers calibration data for valve open time vs. inlet water pressure
- .2 Barrier Free Use
 - .1 Rough-in and install plumbing fixtures and drinking fountains at the recommended height for normal or handicapped use as applicable to location.
 - .2 Water closets:
 - .1 Seat located 406 mm above the floor
 - .3 Lavatory:
 - .1 Top not more than 864 mm above floor
 - .2 Insulate exposed supplies
- .3 Wall Hung Lavatories
 - .1 Install hanger brackets supplied with fixtures to wall with 10 mm bolt studs welded to steel anchor plates embedded within wall.
 - .2 In locations where a pipe space is provided behind wall, extend bolt studs through wall and anchor with steel back-plates. Ensure proper placement and positioning of anchor plates and bolt studs during wall construction.
- .4 Wall Hung Water Closets
 - .1 Install chair carriers of type as recommended by manufacturer for each particular installation with due regard to construction and piping details.
 - .2 For thicker than standard wall assemblies provide extended rods and extended nipple sections/kits, to accommodate fixture installation on its carrier.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.
 - .2 The terms “Mechanical Work”, “Mechanical Subcontractor”, “Mechanical Division” or their derivatives includes the work of Division 21, 22, and 23 unless otherwise specified, therefore this section applies to the afore mentioned divisions.
 - .3 Comply with other Divisions of these specifications, e.g. Division 01, “General Requirements”.
 - .4 Demolition work shall comply with these specifications and in particular with Division 02 “Existing Conditions” and Section 02 41 11 – “Demolition and Preparatory Work”.
 - .5 Seismic Restraint, comply with:
 - .1 SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems
 - .2 ASHRAE - HVAC Applications, Seismic and Wind Restraint Design

1.2 CODES, REGULATIONS AND STANDARDS

- .1 Comply with Municipal or Provincial Codes, Rules and Regulations and/or Authorities having jurisdiction.
- .2 Comply with the National Building Code in areas where Municipal or Provincial Regulations and/or Codes are not mandatory.
- .3 Comply with the Occupational Health and Safety Act and Regulations for Construction Projects, Ontario Regulation 691.
- .4 Owners Health and Safety Requirements
- .5 Revisions issue: latest version as amended to date.

1.3 PERMITS AND INSPECTIONS

- .1 Material approvals
 - .1 Obtain special inspection and approvals by CSA and/or local authorities, for materials where specified.
 - .2 Obtain such approval for the particular installation with the co-operation of the material supplier.
- .2 Permits
 - .1 Obtain permits required for the installation of mechanical trades work including:
 - .1 Plumbing inspection
 - .2 Piping inspection
 - .3 Electrical inspection

- .2 Arrange for inspections and tests and pay all fees and costs for the permits, inspections and tests. Obtain permits immediately after notification of award of Contract.
- .3 Obtain copies of Drawings from the Consultant for submission with application for permits.

1.4 **WORKING DRAWINGS AND DOCUMENTS**

- .1 Design Drawing Intent
 - .1 The design Drawings are schematic in arrangement, and describe the general design intent but do not show the exact details for the installation. They are not fabrication or installation drawings.
 - .2 The Work is suitably outlined on the Drawings with regard to sizes, locations, general arrangements and installation details, and has been generally coordinated for routing of services. The routing of ductwork, piping and equipment arrangement are shown more or less in diagram except where in certain cases the Drawings may include details giving the exact locations and arrangements required.
 - .3 The location of equipment, and the associated arrangement of piping, ductwork, and other material describes the general requirements of the Work. Final location is dependant on the actual equipment supplied. The Consultant reserves the right to make reasonable adjustment of up to 1 m to the location of equipment, floor drains, routing of major piping and ductwork, at no cost to the Owner.
 - .4 In order to provide clarity to the arrangement of the work, not all details including valves, thermometers, pressure gauges, etc. are shown on the plan drawings. Refer to schematic drawings, standard details and the specification for these requirements.
 - .5 Where specific installation dimensions for location of equipment and access space requirements are indicated on the drawings, install to these requirements.
 - .6 Where Standard Details are provided, these show the general installation requirements, and are applicable to each occurrence in the Work, unless otherwise specified or shown.
- .2 Contractor Coordination Responsibilities
 - .1 Provide the services of a mechanical/electrical coordination supervisor, to coordinate this Division of the Work, as well as providing coordination with other Divisions and/or contracts. This supervisor may be full time or part time on site, as appropriate to the work stage and complexity of the work, at the discretion of the Owner.
 - .2 Where multiple trades are required, the mechanical coordinating supervisor shall be the lead coordinator.
 - .3 The Owner reserves the right to require the coordinating supervisor to increase their attendance at site, at no cost to the Owner, if in the Owner's opinion the current level of coordination is not sufficient for the progress of the Work.
 - .4 Make changes and modifications as necessary to ensure coordination and to avoid interference and conflicts with other trades.

1.5 **INTERFERENCE DRAWINGS**

- .1 Also, refer to General Sections and to Summary of Work of these specifications, for requirements of Interference Drawings

- .2 Prepare 3-D Cad model - dimensioned construction / installation / overall interference drawings, coordinated with other Trades and contracts. Solicit and collect information from Other Trades and Divisions. All Trades and Divisions shall Prepare their own 3-D Cad dimensioned construction/installation/fabrication drawings, coordinated with other trades and contracts and supply them to the Lead Mechanical Subcontractor for his incorporation in the Overall Interference drawings 3-D Cad model.
 - .1 Incorporate in the overall interference drawings 3-D Cad model all systems of HVAC, P&D Plumbing and Drainage, Fire Protection, Controls, Electrical Divisions and Architectural and Structural building components. These drawings shall be prepared for all areas of the entire project under this contract.
 - .2 Provide sufficient detail to disclose critical interferences of equipment and services to ensure adequate accessibility.
 - .3 Specific dimensions for equipment location and required by manufacturer proper access to this equipment.
 - .4 Indicate sleeves, openings and stress points (such as anchors, guides and inserts)
 - .5 Indicate deviation in sizes and weights and also in water, drainage, electric power or other service requirements for all equipment proposed which is different from those show on the Design Drawings.
 - .6 Provide these drawings to other trades for coordination with their Work.
 - .7 Update these drawings as part of the As-built drawings, showing actual locations of major equipment, services, access doors, shut-off valves, etc.
 - .8 The design drawings show the major requirements for the installation of equipment based on one manufacturer's requirements, but may not show all installation requirements. The Contractor will include as part of the Work the specific manufacturers installation requirements for the equipment actually provided by the Contractor.
 - .9 Do not commence construction without prior review and approval of these interference drawings. The review team shall include the Owner, Contractor, all Trades and Divisions and the Consultant.

1.6 **COORDINATION AND EXAMINATION**

- .1 Examination
 - .1 Examine the site for access path for mechanical equipment, measure widths of access doors and corridors.
 - .2 Coordinate with Construction Project Manager the acceptable equipment delivery paths and schedule time of delivery. Provide equipment suppliers and manufacturers with critical maximum dimensions of equipment components, prior to requesting manufacturers' shop drawings.
 - .3 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences.
 - .4 Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.
- .2 Coordination
 - .1 Coordinate Mechanical Work such that items will properly interface with Work of other Divisions. Prepare installation drawings of critical locations and submit to

Consultant for review. Refer to Submittals article for additional interference drawing requirements.

- .2 Architectural Drawings, or in their absence, Mechanical Drawings govern all locations.

1.7 **MEASUREMENTS AND DEVIATIONS**

- .1 Where any parts of the mechanical work are specifically located by dimensions on the Drawings, check and verify these dimensions on site prior to installation.
- .2 Before installing piping, review architectural, structural and electrical drawings with mechanical drawings
- .3 Where interference may occur and departures from arrangements as shown are required, consult with other trades involved, come to agreement as to changed locations or elevations and obtain approval of the Consultant for proposed changes before proceeding with the work.
- .4 Where site conditions require minor deviations from indicated arrangements or locations, make such changes on approval of the Consultant without additional cost to the Owner.
- .5 Should any discrepancies occur during installation of mechanical work which will necessitate major revisions to the mechanical trades work or the work of other trades or contractors, notify the Consultant immediately and obtain written authorization before proceeding with the work.

1.8 **CUTTING AND PATCHING**

- .1 Do not cut, remove or burn structural parts or sections of the building, whether they are steel, concrete or masonry without the written authorization of the Consultant.
- .2 Should cutting, repairing, and patching of previously finished work of other trades be required to allow installation of mechanical work, pay all costs for the trade concerned to perform the work.

1.9 **EXISTING SERVICE**

- .1 Tie-in to existing services
 - .1 Do not shut down or make tie-in connections to any existing service without written permission of the Owner and/or Consultant.
 - .2 Arrange work to minimize interruption to physical access to the building.
 - .3 Include for all costs associated with making connections to existing services, including but not limited to, cutting and patching of existing floors, partitions, ceilings and finishes, new shut off valves, draining and re-filling of existing system.
- .2 Work in existing buildings
 - .1 Route pipes, ducts, conduits and other services to avoid interference with existing installation. Do not use open flame tools & equipment without obtaining Owner's written approval and without hot work permit.
 - .2 Relocate existing services and equipment to suit installation of new work.
 - .3 Cut back and cap existing services not being used, so that finished work presents a neat and clean appearance.

- .4 Unless noted to be reused or otherwise noted, fixtures and materials being removed become the property of the Contractor and are to be removed from site.
- .3 Continuity of Services
 - .1 Be responsible for any damage to existing systems, including insulation and coverings, when making connections.
 - .2 Keep existing buildings in operation with minimum length of shut-down periods.
 - .3 Include overtime work to tie-in piping or wiring at night or on weekends.
- 1.10 **SUBMITTALS**
 - .1 Shop Drawings: submit as pdf files thru Contractor for Consultant's review. Conform to the following:
 - .1 Shop Drawings showing more than one size or model will not be considered unless properly marked up showing model and options to be provided.
 - .2 For electrically driven provide the following information:
 - .1 Electrical characteristics including voltage, phase, frequency and power rating. Provide maximum overcurrent protection requirement.
 - .2 For motors, NEMA, Class and efficiency ratings. Indicate whether motor is rated for use with variable frequency drives.
 - .3 For other equipment include the following information:
 - .1 Electrical control power requirements
 - .4 For all equipment, include the following:
 - .1 Equipment dimensions and weights.
 - .2 Itemized product description with optional items clearly marked as being included.
 - .5 Provide wiring Shop Drawings:
 - .1 Wiring diagrams and schematics for all equipment which has electrical controls or devices furnished with the equipment.
 - .2 Wiring diagrams alone are not sufficient; schematic and interconnecting drawings, and sequence of operation of equipment are required for review.
- 1.11 **"AS-BUILT" RECORD DRAWINGS**
 - .1 Reference
 - .1 Maintain an accurate dimensional record of all underground piping and all deviations and changes in aboveground piping ductwork, and equipment.
 - .2 Prepare Cad as built drawings.
- 1.12 **INSTALLATION AND START-UP INSTRUCTIONS**
 - .1 Reference
 - .1 Submit copies of installation instructions and copies of start-up instructions for any item of equipment when requested by the Consultant.

1.13 **OPERATING AND MAINTENANCE INSTRUCTION MANUALS (O&M MANUALS)**

- .1 Reference
 - .1 Prepare these O&M manuals as pdf files for Consultant's review - submission as shop drawings. Supply the Owner with a pdf file and one hard copy of the O&M manuals. In addition, include the following in the manuals:
 - .2 In addition, include the following in the manuals:
 - .1 Non-dimensional layout showing location of all electrical devices on mechanical equipment.
 - .2 Operating instructions, including start-up and shut-down procedure.
 - .3 Lubricating instructions and recommended cycle of lubrication for each item of equipment, including various types of lubricants.
 - .4 List of spare parts.
 - .3 All the above applies to component parts of equipment whether they are manufactured by the supplier of the equipment or are supplied as a component part of an item of equipment.

1.14 **WARRANTY**

- .1 Provide at least 24 months parts and labour warranty for all equipment and systems installed under this contract. Refer to the General Conditions of Contract for details of the warranty; the more stringent conditions shall govern.
- .2 The twenty four (24) months warranty shall start from the date of the substantial completion of contract works.
- .3 If within the warranty period, upon written notice from the Owner, it is found that the equipment or system is defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the Contractor at the cost of the Contractor and at no cost to the Owner.

1.15 **CLEANING, TESTING AND APPROVAL RECORDS**

- .1 Records
 - .1 Maintain records of all pressure tests and flushing and sterilization tests, inspections and approvals by the Plumbing Inspector.
 - .2 Forward these tests to the Owner on completion of the work.
 - .3 Forward to Consultant, copy of records on site on completion of each test, cleaning operation, etc.

1.16 **DIMENSIONS AND QUANTITIES**

- .1 Dimensions
 - .1 Dimensions shown on Drawings are approximate.
 - .2 Verify dimensions by reference to shop drawings and field measurement.
- .2 Quantities
 - .1 Quantities or lengths indicated in any of the Contract Documents are approximate only and shall not be held to gauge or limit the Work.

1.17 **TRADE QUALIFICATIONS**

- .1 Applicable to the following trades
 - .1 Sheet metal workers
 - .2 Plumbers
 - .3 Steamfitters
- .2 Requirements
 - .1 Trade workers to have a Certificate of Qualification as Journeyman or Apprentice Registration for the province where the work is performed or an Interprovincial Certificate.
 - .2 Ratio of journeyman to apprentice: not to exceed the defined ratio in the Apprenticeship Act of Ontario.
 - .3 On award of Contract, submit a list of trade journeyman and apprentices, together with their Certificate and Registration numbers.
 - .4 Certificates and Registration must be provided to the Consultant on request.
 - .5 Maintain on-site an up-to-date record listing journeyman and apprentices working on site.

PART - 2 PRODUCTS

2.1 **MATERIALS AND EQUIPMENT**

- .1 Materials
 - .1 Use new materials and equipment, free from defects impairing strength and durability, as specified or specified equivalent.
 - .2 Of Canadian manufacture wherever possible.
 - .3 Labelled or listed as required Code and/or inspection authorities.
 - .4 Design of mechanical systems has been based on the first listed supplier and/or model number/size stated on the Equipment Schedules on the Drawings. Bear all costs due to physical or performance differences between stated equipment and proposed equipment. These differences include but are not limited to size, layout, arrangement, connection size, location and/or quantity of connections, or performance differences such as noise, power requirements, flow, throw, etc. Review of shop drawings by Engineer does not relieve Contractor of this responsibility.

2.2 **EQUIPMENT/STRUCTURE COORDINATION**

- .1 Locations and dimensions of curbs and floor opening framing, where indicated on the Drawings, are based on an arrangement to suit the above named supplier.
- .2 Be responsible to verify the actual size requirements of the openings, and notify the Consultant immediately in case the dimension of the unit supplied and the connecting ductwork/piping, etc. are at variance with the dimensions given on the Drawings.
- .3 Bear all costs for modification of curbs and floor openings resulting from failure to notify the Consultant prior to the fabrication or construction of opening framing and curb.

2.3 **STANDARD SPECIFICATIONS**

.1 Product Quality

- .1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all products provided comply with the latest issue of applicable Standard Specifications issued by Authorities having jurisdiction.
- .2 Do not apply Standard Specifications to decrease the quality of workmanship, products and services required by the Contract Documents.

2.4 **MANUFACTURER'S NAMEPLATES**

.1 Metal Nameplates

- .1 Provided with raised or recessed lettering, on each piece of equipment.
- .2 Mechanically fasten nameplate on a metal stand-off bracket arranged to clear insulation.
- .3 Mount on same stand-off Underwriters Laboratories and/or CSA registration plates.

.2 Nameplate Data

- .1 Indicate:
 - .1 Size
 - .2 Capacity
 - .3 Equipment model
 - .4 Manufacturer's name
 - .5 Serial number
 - .6 Voltage
 - .7 Cycle
 - .8 Phase and power of motors

2.5 **BUILDING ATTACHMENTS**

.1 Welding Studs:

- .1 Maximum size: 10 mm for attaching miscellaneous materials and equipment to building steel.
- .2 If the weight of materials or equipment require bolts or studs larger than 10 mm diameter, use steel clips or brackets, secured to building steel by (welding or) bolting as approved by the Consultant.
- .3 Acceptable Manufacturers:
 - .1 Graham
 - .2 Omark
 - .3 Nelson

.2 Self drilling expansion type concrete inserts:

- .1 To secure miscellaneous equipment and materials to masonry or concrete construction already in place.

- .2 Of sufficient number and size to prevent concrete from breaking away.
- .3 The use of powder or power actuated fasteners will not be allowed unless prior written approval is obtained from the Consultant.
- .4 Acceptable Manufacturers:
 - .1 ITW "Redhead"
 - .2 Star "SSS"
 - .3 USM "Parabolt"
- .3 Beam clamps:
 - .1 2-bolt design and of such type that the rod load is transmitted only concentrically to the beam web centreline.
 - .2 The use of "C" and "I" beam side clamps, etc., will not be allowed without written consent of the Consultant.
 - .3 Acceptable Manufacturers:
 - .1 Grinnell
 - .2 Myatt
 - .3 Carpenter & Paterson

2.6 **DRIVES AND ACCESSORIES**

- .1 Drives
 - .1 V-belt drive selection: 150 percent of the motor size rating.
 - .2 Sheaves: cast iron construction with machined grooves.
 - .1 Sheaves 75 mm size and larger diameter: taper lock bushings.
 - .2 Multi-belt drives: matched sets.
 - .3 Statically and dynamically balance all sheaves as an operating unit.
 - .3 Adjustable sheaves:
 - .1 Motors less than 11 kW rating: adjustable pitch motor sheave with diameter range selected to obtain specified RPM of the driven equipment at approximately the mid-point setting of the sheave.
- .2 Drive Couplings
 - .1 Acceptable Manufacturers:
 - .1 Falk
 - .2 Fast
 - .3 Thomas
- .3 Lubricating Devices
 - .1 Equipment to have oil reservoirs with level indicators, or pressure grease fittings.
 - .2 Inaccessible fittings: provide extended tubes to an accessible location.
 - .3 Grease fittings: Zerk or Alemite.
 - .1 All fittings of one type.

- .4 Drive Guards
 - .1 To OSHA requirements.
 - .2 Build guards of all welded construction on exposed rotating parts or elements and on all drives including the following:
 - .1 V-belt drives
 - .2 Flexible couplings
 - .3 Gear drives

2.7 **SEALANTS, CONCRETE AND GROUTS**

- .1 Pipe Sleeve Seals
 - .1 Acceptable Manufacturers:
 - .1 Thunderline "Link-Seal" Series LS
- .2 Concrete
 - .1 Strength: 25 MPa concrete: to CSA-A23.1/A23.2
- .3 Concrete Grouts
 - .1 Acceptable Manufacturers:
 - .1 Sternson "M-Bed Standard"
 - .2 Sika "SikagROUT 212"
 - .3 Master Builders "Construction Grout"
 - .4 Meadows "CG-86"
 - .5 Euclid "Euco NS Grout"
 - .6 CPD "Non-Shrink Grout"
- .4 Bonding Agents
 - .1 Acceptable Manufacturers:
 - .1 Sika "Sikadur 32" Hi-Mod
- .5 Caulking Compounds
 - .1 Acceptable Manufacturers:
 - .1 Denso-Plast
- .6 Firestopping
 - .1 ULC listed firestopping assembly
 - .2 Rating to suit wall and floor penetrations
 - .3 Acceptable Manufacturers:
 - .1 Fire Stop Systems
 - .2 Dow Corning
 - .3 3M
 - .4 Tremco

- .5 A/D Fire Protection System
- .6 Johns Manville
- .7 Hilti

2.8 MISCELLANEOUS

.1 Access Doors

- .1 Minimum size: 200 mm x 200 mm size, unless otherwise specified on the Drawings or in other divisions of the Specifications, or as required to replace or repair said equipment.
- .2 Material:
 - .1 Fabricated of 2.5 mm bonderized steel.
 - .2 Fabricated of 2.5 mm stainless steel in areas finished with tile or marble surfaces.
 - .3 Flush mounted, concealed hinges and screwdriver lock.
 - .4 Plast lock and anchor straps.
 - .5 Doors to be of a type and fire rating to suit the particular type of wall or ceiling construction in which they are to be installed.
 - .6 Doors in painted partitions to be painted to match adjacent partition. Doors shall be installed prior to final painting. Bear all costs for repainting of partition/ceiling and doors resulting from failure to do so.
- .3 Acceptable Manufacturers:
 - .1 E.H. Price
 - .2 Titus
 - .3 Controlled Air
 - .4 Williams (S.M.S.)
 - .5 Acudor

.2 Isolating Unions

- .1 Acceptable Manufacturers:
 - .1 Epco
 - .2 Marpac "Petro"
 - .3 Corrosion Service

PART - 3 EXECUTION

3.1 GENERAL

- .1 Execute work in accordance with requirements specified in the various Sections of Division 23.
- .2 Lay out work of each trade so that it does not interfere with work under other Divisions of Specifications.

- .3 Make good any damage to Owner's property or other trade's work caused by improperly locating or carrying out of work.
- .4 Supply anchor bolts and templates for installation by other Divisions.
- .5 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided alteration is made before installation.

3.2 **DEMOLITION**

- .1 All demolition work shall comply with section 02 41 11 – "Demolition and Preparatory Work".
- .2 During demolition protect systems that are to remain in place, to ensure uninterrupted operation of these.
- .3 Survey the site for amount of demolition work, prior to pricing.
- .4 Provide temporary connections and by-passes necessary to maintain operation of existing systems.

3.3 **EQUIPMENT INSTALLATION**

- .1 General
 - .1 Install equipment in a compact, neat and workmanlike manner.
 - .2 Align, level and adjust for satisfactory operation.
 - .3 Install in such a manner that connecting and disconnecting of piping and accessories can be made readily and that all parts are easily accessible for inspection, operation, maintenance and repair.
 - .4 Install and start up items of equipment in accordance with the manufacturer's printed installation and operating instructions.
- .2 Noise and Vibration
 - .1 Noise and vibration levels of equipment and systems shall be within design intent.
 - .2 If noise or vibration levels created by any mechanical equipment and systems and transmitted to occupied portions of building or other mechanical work are over the limits, make all necessary changes and additions as approved by the Consultant without additional cost.
- .3 Lubrication
 - .1 Lubricate all equipment prior to start up in accordance with the manufacturer's printed instructions.
 - .2 Supply all lubrication including sufficient quantity for drainage and refilling of oil sumps, etc., when required by manufacturer's instructions.

3.4 **EQUIPMENT SUPPORTS**

- .1 Ceiling or Wall Mounting
 - .1 Provide seismic restraint as per OBC and SMACNA and in compliance with the requirements of Structural sections of the specifications.
 - .2 Where ceiling or wall mounting is indicated or required, provide a suspended platform, bracket or shelf.

- .3 Materials: standard steel members and steel plates of welded construction throughout.
- .4 Attach to building steel with rod hangers and beam clamps, or attach to precast structure as the case may be.
- .5 Do not use inserts unless specifically shown on the Drawings or approved by the Consultant for any particular item of equipment.
- .6 Attach brackets or shelves to vertical member or sections of the building structure as hereinbefore specified.
- .2 Suspended Equipment Support:
 - .1 Provide double locknuts on suspended equipment supports as follows:
 - .2 Upper attachment
 - .1 Beam clamp: provide a double nut on end of beam clamp tie rod.
 - .2 Supplemental steel: double nut all mechanical fasteners fixing supplemental steel to building structural steel.
 - .3 Middle attachment
 - .1 Upper load bearing point, to beam clamp: not applicable.
 - .2 Upper load bearing point, to supplemental steel: double nut on top of load bearing point, single locknut on underside of bearing point
 - .3 Lower load bearing point, all: double nut on underside of bearing point, single locknut on top of bearing point.
 - .4 Lower attachment
 - .1 Trapeze hanger or equipment fastening: refer to middle attachment requirements above.
 - .5 Apply Loctite 242 to the second nut (and matchmark both nuts).

3.5 MISCELLANEOUS STEEL

- .1 Hang or support equipment, piping, ductwork etc., with miscellaneous structural supports, platforms, braces as may be required unless Drawings or other Sections of the Specifications state otherwise. Provide miscellaneous structural steel necessary for support of mechanical equipment, this steel shall be properly sized and certified by Contractor's retained Structural Engineer P.Eng. seal.
- .2 Materials and Fabrication
 - .1 Conform to:
 - .1 CAN/CSA-S16.1-M for materials, design of details and execution of the work.
 - .2 CSA-G40.20/G40.21 grade 300W for structural shapes, plates, etc.
 - .3 CSA W47.1 - for qualification of welders.
 - .4 CSA W48.1-M - for electrodes (only coated rods allowed).
 - .5 CSA W59-M - for design of connections and workmanship.
 - .6 CSA W117.2 - for safety.
- .3 Construction:

- .1 Welded construction wherever practicable.
- .2 Chip welds to remove slag, and grind smooth.
- .3 Bolted joints allowed for field assembly using high strength steel bolts.
- .4 **Painting and Cleaning**
 - .1 Clean steel to Steel Structures Painting Council SSPC-SP6, Commercial Blast Cleaning.
 - .2 Apply one coat of oil alkyd primer conforming to CISC/CPMA 2.75 to all miscellaneous steel.
 - .3 In the field, touch up all bolt heads and nuts, previously unpainted connections and surfaces damaged during erection with primer as hereinbefore specified.
 - .4 Apply two coats of primer to all surfaces which will be inaccessible after erection.
 - .5 Thoroughly remove all foreign matter from steelwork on completion of installation.
- 3.6 **CONCRETE INSERTS**
 - .1 Install inserts required for attachment of hangers, either for suspension of piping or equipment.
 - .2 For masonry or poured concrete construction use expansion type units. Insert into the concrete after concrete has cured. Do not use anchors or inserts installed by explosive means.
- 3.7 **FIRE STOPPING**
 - .1 Submit shop drawings, including the following information:
 - .1 ULC/CUL listing number
 - .2 Installation drawings for each type of penetration
 - .3 Installation materials
 - .2 **General**
 - .1 Seal piping, ductwork, conduits and miscellaneous support steel penetrating fire separations.
 - .2 Install fire stopping in accordance with manufacturer's instructions and ULC listing requirements.
 - .3 Provide a written report on completion of fire stopping, by area or floor if necessary, indicating the work is completed and ready for inspection. Do not cover over fire stopping, including installation of walls and ceilings, until work is inspected.
- 3.8 **ACCESS DOORS**
 - .1 Coordinate access doors installation with the Architectural Division. Access doors in ductwork are specified in Section 23 33 00.
 - .2 Supply access doors for installation by other trades in walls or ceilings where accessibility is required for the operation and/or maintenance of:
 - .1 Concealed valves
 - .2 Traps
 - .3 Cleanouts

.4 Dampers

3.9 **SPARE PARTS**

.1 Furnish spare parts

.1 One glass for each gauge glass

.2 One set of V-belts for each drive

.3 One filter cartridge or set of filter media for each filter or filter bank installed.

3.10 **PROTECTION**

.1 Protect work and materials before, during and after erection from weather and other hazards and keep in a clean and orderly manner.

.2 Protect pipe ends, valves and parts of equipment left unconnected to prevent damage or intrusion of foreign matter. Provide pipe caps for threaded male connections and plugs for threaded female connections.

.3 Protect plumbing fixtures or mechanical equipment having a baked enamel finish by covering with polyethylene sheet securely held in place.

3.11 **PAINTING**

.1 Field painting:

.1 Clean rust and oil from exposed iron and steel work provided by Mechanical Subcontractor, whether or not it has been factory prime painted. Paint this equipment with one coat of chrome oxide phenolic base primer and one coat of 100% alkyd base enamel in an approved colour.

3.12 **MAINTENANCE OF BEARINGS**

.1 During Construction

.1 Turn-over rotating equipment at least once a month after delivery;

.1 Run-in sleeve type bearings in accordance with manufacturer's recommendations.

.2 Drain, flush out and refill with new charge of oil or grease.

.3 Protect bearings, shafts and sheaves against damage, corrosion and dust accumulation.

.4 Provide extended grease nipples for bearing lubrication.

3.13 **CONSTRUCTION REVIEW**

.1 The construction review will include milestone and periodic reviews.

.2 Milestone Reviews:

.1 Specific milestone reviews will be performed by the Consultant for compliance with the Ontario Building Code, including any or all of the following:

.1 Before closure of pipe chases

.2 Before closure of walls

.3 Before closure of ceilings

- .4 Equipment Demonstration and Training
- .5 Substantial Performance and Deficiency Review
- .6 Total Performance
- .2 Some or all of these reviews are of portions of the work which may be concealed. If work is enclosed before the Consultant can review the installation, the Consultant may direct the Contractor to expose the Work for it to be examined, at no additional cost to the project including rework affecting other Trades.
- .3 If deficiencies are noted during any review where work will be enclosed, correct noted deficiencies and have them reviewed by the Consultant prior to the Work being enclosed.
- .4 Provide a minimum of seven (7) calendar days written notice to the Consultant when requesting each review date.
- .5 The Consultant will provide a check-list to the Contractor of required milestone reviews which must be completed. Maintain this list on site along with identified test reports, and make available for Consultants review when requested. When completed, include this checklist form with the Test Reports forms specified in Section 23 08 13.
- .3 Periodic Reviews
 - .1 The Consultant will conduct periodic reviews, as required for the project. These reviews are for the benefit of the Owner to describe the progress and workmanship of the Work, and are not intended as any form of quality assurance for the Contractor.
 - .2 Deficiencies will generally not be reported as part of this review, as the work has not been reported by the Contractor as being complete. However, deficiencies may be reported where it may not be possible to correct the work at a later date, or at great expense.
 - .3 The Contractor shall not rely on these Periodic Reviews to identify deficiencies during the progress of the Work.
- .4 Deficiency Review
 - .1 The Consultant will conduct a deficiency review only after the Contractor submits an application for Substantial Performance. As part of this application, the Contractor shall submit their own comprehensive deficiency list of incomplete or incorrect work. Failure by the contractor to list any deficiency does not relieve the Contractor from correcting or completing the Work.
 - .2 The Consultant shall review the work and any deficiencies noted will be classified as Major or Minor.
 - .1 Major deficiencies are required to be corrected as part of obtaining Substantial Performance.
 - .2 Minor deficiencies may be corrected before or after Substantial Performance.
- .5 Final Review
 - .1 The Consultant will conduct a final review only after the Contractor submits a declaration that all of the following has been completed:
 - .1 Noted deficiencies have been corrected

- .2 Final As-built drawings have been submitted to the Owner
 - .3 Final Operating and Maintenance manuals have been submitted to the Owner
 - .4 Final Test reports, including Alternate season tests have been submitted to the Owner.
- .2 The Consultant will only review the deficiency list to confirm these deficiencies have been corrected.

3.14 **PERFORMANCE TESTING AND BALANCING**

- .1 Refer to Section 23 08 xx - series

3.15 **ADJUSTMENT AND OPERATION OF SYSTEMS**

- .1 When the work is complete:
- .1 Adjust equipment items of the various systems for proper operation within the framework of design intent, and the operating characteristics as published by the equipment manufacturer.
 - .2 Complete additional instructions are specified under the respective Mechanical Sections.
- .2 The Consultant reserves the right to require the services of an authorized representative of the manufacturer in the event that any item of equipment is not adjusted properly.
- .1 Arrange for such services and pay all costs thereof.
 - .2 After completion of adjustments, place systems in full operating condition and advise Consultant that the work is ready for acceptance.

3.16 **ACCEPTANCE**

- .1 After all equipment has been installed and adjusted and all systems balanced:
- .1 Conduct performance tests in the presence of the Consultant, Commissioning Agent and the Owner.
 - .2 Arrange the time for these tests at the convenience of the Consultant, Commissioning Agent and Owner.
 - .3 Conduct tests under climatic circumstances to ensure complete and comprehensive tests and of such a manner and duration as the Consultant may deem necessary.
- .2 During these tests:
- .1 Demonstrate the correct performance of all equipment items and of the systems they comprise.
 - .2 Should any system or any equipment item fail to function as required, make such changes, adjustments or replacements necessary to meet performance requirements.
 - .3 Repeat tests until requirements have been fully satisfied and all systems accepted by the Consultant.

3.17 **COORDINATION WITH SEPARATE TESTING AND BALANCING WORK**

- .1 Review with the Mechanical Subcontractor before fabrication:

- .1 Location of balancing devices
- .2 Test connections
- .3 Access openings
- .2 Report conditions which could affect optimum system performance.
- .3 Inspection:
 - .1 Assure that all testing, balancing and metering devices are installed properly and in preselected locations.
 - .2 Report any errors to the Consultant.
 - .3 The Mechanical Subcontractor will obtain the approval of the Testing and Balancing Firm before relocating these devices due to field conditions.
- .4 TAB Contractor Coordination:
 - .1 Cooperate with the Mechanical Subcontractor giving adequate prior notification of request for services of tradesmen.
 - .2 Coordinate efforts so that items requiring replacement and/or delivery time (sheaves, motors, etc.) are tested as early as possible.
- .5 Mechanical Subcontractor Coordination:
 - .1 Cooperate with the Testing and Balancing Firm.
 - .2 Provide the following assistance and/or services:
 - .3 Schedule sufficient time so that the initial testing and balancing can be completed before occupancy begins and coordinate with the trades involved.
 - .4 Keep the Testing and Balancing Company informed of any major changes made during construction and provide same with a set of project drawings and reviewed Shop Drawings.
 - .5 Provide balancing devices, test connections access openings, balancing probe inlets and plugs.
 - .6 Clean and pre-run all equipment, filters, etc. and place all heating, ventilating and air conditioning systems into full operation and continue same during each working day of testing and balancing.
 - .7 Provide immediate labour from pertinent mechanical trades and tools, equipment and materials to make equipment and system alterations and adjustments, as required including control adjustments.
 - .8 Make available all equipment data (shop drawing performance data and operating instructions) to the Testing and Balancing Firm.
 - .9 As part of the coordination effort, the Mechanical Subcontractor will be fully responsible for systems constructed, installed and adjusted to provide optimum performance as required by design intent. Any re-adjusting required as the result of spot checks by the Consultant shall be done at no increase in Contract Price.
 - .10 Nothing contained in this Section voids the responsibility of the Mechanical Subcontractor for systems constructed, installed and adjusted to achieve the design intent.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 REFERENCE STANDARDS

- .1 Standards
 - .1 CSA 390 M (Motor efficiency ratings)
 - .2 IEEE 112 (Motor efficiency ratings) for three phase motors
 - .3 IEEE 114 (Motor efficiency ratings) for single phase motors.
- .2 Table 10.8, Minimum Nominal Efficiency for Motors, in OBC 2006, SB-10.

1.3 CODES AND REGULATIONS; PERMITS, COSTS AND FEES

- .1 Codes
 - .1 Electrical Safety Authority (ESA) and Ontario Electrical Safety Code
 - .2 Canadian Electrical Code
- .2 Permits
 - .1 Obtain electrical permits and inspections and pay all costs for the portion of the work performed by this Division.

1.4 QUALITY ASSURANCE

- .1 Contractor Qualifications
 - .1 Electrical wiring for Mechanical Trades work performed by a specialist firm with an established reputation in this field.

1.5 SUBMITTALS

- .1 Shop Drawings
 - .1 Include nameplate data, motor efficiencies, NEMA rating and insulation rating.

1.6 RELATED WORK

- .1 The following work will be performed by Division 26.
 - .1 Power wiring between the electrical distribution system and motor or equipment.
 - .2 Motor starters, except where specified as an integral component of the mechanical equipment.
 - .3 Fused or unfused disconnects, except where specified as an integral component of the mechanical equipment.

PART - 2 PRODUCTS

2.1 MOTORS

.1 General

.1 Motor nameplate rating:

- .1 Not less than input brake horsepower of driven equipment plus 5%, at specified operating conditions, and;
- .2 Not less than the scheduled minimum horsepower.
- .3 Premium efficiency.
- .4 Selected for chemical duty or explosion proof where scheduled.
- .5 Service factor: 1.15 minimum for three phase motors.

.2 Single Phase Motors

.1 Continuous duty, resilient mount.

- .1 Motor rating: less than 375 W
- .2 Voltage, frequency and RPM as scheduled.

.3 Grounding Lug

.1 Motors less than 15 kW:

- .1 Ground lug on motor terminal box.

2.2 WIRING AND CONDUIT

.1 Wire

- .1 RW-90 X-link
- .2 Minimum No. 12 AWG for power
- .3 Colour coded No. 14 AWG for control power, 120VAC and lower
- .4 Individually identify conductors on each end with slip-on, plastic wire markers. Identification to match wiring diagrams.

.2 Conduit

.1 Thin wall conduit:

- .1 Up to 32 mm size in ceilings, furred spaces, in hollow walls and partitions and where not exposed to mechanical injury.

.2 Rigid galvanized steel:

- .1 38 mm size and larger.
- .2 any size where located in poured concrete, and where exposed.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Motor and Equipment Control

- .1 Starters and/or disconnect switch for each motor or electrically connected item:
provided by Electrical Division 26.
 - .1 Exception: disconnects which are specified as part of the equipment.
- .2 Power Conduit and Wire
 - .1 Provided by Mechanical Division:
 - .1 Line voltage thermostats, and wiring from thermostat to fan coil units.
 - .2 Hardwire interlock wiring between control devices (pressure switches, temperature switches, limit switches, etc.) and motor starters.
 - .2 Provided by Electrical Division 26:
 - .1 Power wiring at all voltages 120 VAC and higher to motors or equipment.
- .3 Control Conduit and Wire
 - .1 Provided by Mechanical Division:
 - .1 Control wiring, conduit and relays to interlock starters and connect safety and operating controls.
- .4 Grounding
 - .1 Ground electrical equipment and wiring in accordance with Electrical Safety Authority and Local Authority's Rules and Regulations.
- .5 Corrosion Protection Anodes
 - .1 Provide external corrosion protection anodes for:
 - .1 Metallic services as shown.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of the Mechanical Division: Fire Protection, P&D, HVAC.

1.2 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit valve shop drawings and piping data sheets for each service.

PART - 2 PRODUCTS

2.1 ESCUTCHEON PLATES

- .1 Materials:
 - .1 Heavy chrome plated cast brass or stamped metal.
 - .2 Two piece construction fitted with substantial hinges and positive latches.
 - .3 Fit all plates with tempered springs to ensure positive attachment to the pipe.

2.2 PIPE AND FITTINGS – PLUMBING, DRAINAGE AND FIRE PROTECTION

- .1 Pipe and fittings shall be in conformance with the following unless specified otherwise by local authorities.
- .2 Domestic hot and cold water, above grade, for smaller sizes.
 - .1 Copper tube, type L above grade and type K for buried to ASTM B88.
 - .2 Hard copper for above ground pipe.
 - .3 Solder-joint water fittings shall conform to ANSI B16.22 "Wrought Copper and Copper Alloy Solder Joint Pressure Fittings."
 - .4 Joints shall be made with 95-5 solder for size NPS 2 and under. For NPS 2½ and larger, joints shall be silver soldered. Solders and fluxes containing greater than 0.2% lead shall not be used.
- .3 Sanitary drainage and vent piping installed above grade shall be:
 - .1 NPS 2½ and smaller - copper drainage type (DWV) to ASTM B306 with solder joint fittings to CSA B158.1 or ANSI B16.29.
 - .2 NPS 3 and larger - cast iron hubless soil pipe and fittings to CSA B70. Fittings shall be jointed with elastomer sleeve complete with corrugated stainless steel sheath. Alternately, use copper pipe as permitted by code.
 - .3 Alternative: PVC piping by IPEX, 1½" to 12" (40mm to 300mm) DIA, System 15 PVC – Waste, Drain & Vent piping c/w FR fire coating on pipes and fittings to ULC-S102.2 standard, PVC material to ASTM D1784 all tested to \$CAN/ULC S102.2 M88. Provide Fire Stops "Doughnuts" to CAN4-S115.

- .4 Sprinkler system piping
 - .1 Pipe and fittings shall meet the requirements of NFPA-13 and the Underwriters. It shall meet any additional requirements indicated in the specifications and contract drawings.
 - .2 Pipes shall be black, welded and seamless steel pipe to ASTM A120 or ASTM A53. Electric resistance welded steel pipe shall be to ASTM A135.
 - .3 The minimum nominal wall thickness for welded and seamless pipe joined by welding or by roll grooved pipe and ULC listed couplings, shall be in accordance with Schedule 10 for sized up to NPS 5, 3.4 mm for NPS 6, and 4.78 mm for NPS 8 and 10 pipe, for pressures up to 2070 kPa(g).
 - .4 When the steel pipe specified above is joined by threaded fittings or by ULC listed couplings used with pipe having cut or rolled grooves, the minimum wall thickness shall be in accordance with Schedule 30 in NPS 8 and larger, and Schedule 40 in sizes less than NPS 8 for pressures up to 2070 kPa(g).
 - .5 Threaded fittings shall be listed cast iron threaded fittings, Class 125 or Class 250 as required, to ANSI B16.4.
 - .6 Pipe jointed with mechanical grooved fittings shall be joined by a listed combination of fittings, gaskets and grooves. Mechanical grooved couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.

2.3 **PIPES AND FITTINGS – HVAC**

- .1 Use pipes, fittings and accessories as shown below unless specifically shown or specified otherwise.
- .2 Pipes for hot water and chilled water
 - .1 Alternative for entire system
 - .2 Hard temper copper ASTM B88, type L, plain ends.
- .3 Pipe runouts to all fan coil units
 - .1 Soft temper copper ASTM B88, type L, plain ends.
- .4 Pipes for condensate drainage from fan-coils, drain pans, etc.:
 - .1 Copper tube, type DWV.
- .5 Fittings for hot water, chilled water
 - .1 Alternative for entire system: Victaulic coupling c/w manufacturer approved gasket.
 - .2 Wrought copper or cast bronze, solder joint, ANSI B16.22
- .6 Fittings for Condensate
 - .1 NPS 2 and smaller
 - .1 Copper drain pipe as per Section 15201.
 - .2 Cast iron ASTM A126, 1723 kPa(g) (WSP), threaded, ANSI B164.
- .7 For pipe NPS 2½ and larger, use flanges and for smaller pipe, use unions at all valves and equipment.
- .8 Where a branch at least two pipe sizes smaller connects into a main, welding fittings of Bonney Forge, full flow fittings or other approved manufacturer may be used.

- .9 Flare connections may be used on soft copper tubing where one end of the flare connection is an integral part of the equipment or valve.
- .10 Unions for pipe NPS 2 and smaller
 - .1 Hot water, chilled water
 - .1 Malleable iron ASTM A197, Class 150, with bronze to iron ground joint, ANSI B16.3.
- .11 Flange Accessories
 - .1 Hot water
 - .1 Gasket, 1.58 mm Synthetic fibre base and butadiene acrylonitrile rubber binder for -40°C to 205°C and 2068 kPa(g) pressure. Crane #2160. Coat with graphite paste.
 - .2 Bolts, square head machine with hexagonal nut, steel ASTM A307, ANSI B18.2
 - .2 Chilled water
 - .1 Gasket, cloth inserted rubber ring
 - .2 Bolts, square head machine with hexagonal nut, steel ASTM A307, ANSI B18.2
- .12 Use "Y" pattern strainers with screens of type 304 stainless steel or Monel with approximately 0.79 mm perforations. Provide a valved blow-off connection in all caps NPS 2½ and larger. Maximum pressure drop with clean screen shall not exceed 6.89 kPa. With water velocity through inlet pipe of 1.5 m/s.
- .13 Strainers for steel water lines and condensate:
 - .1 NPS 2 and smaller
 - .1 Cast iron 860 kPa (WSP), threaded.
- .14 Strainers for copper water lines
 - .1 NPS 2 and smaller
 - .1 Bronze, 860 kPa (WSP), threaded.
- .15 Mechanical Grooved Piping
 - .1 Mechanical grooved coupling, fittings, valves and other accessories may be utilized as an alternate to some of the products specified above provided all pressure ratings and other specified criteria are satisfied (i.e. gear operator on butterfly valves, etc.). This system may be used for the following aboveground services except inside walls and partitions:
 - .1 Hot water heating
 - .2 Chilled water
 - .2 Mechanical grooved piping couplings, fittings and accessories shall be Victaulic, products specified below.
 - .3 Victaulic Style 75, 72 and 750 mechanical grooved pipe couplings, fittings Mechanical-T stub-ins may be used.
 - .4 Gaskets shall be EPDM Grade E for all water services with operating temperatures of -34°C through 110°C.

- .5 All grooved products, including couplings, fittings, valves and building service specialty items to be of one manufacturer.

2.4 VALVES – PLUMBING

- .1 Except where special features are required or unless otherwise approved or noted, all valves shall be of one manufacturer with the manufacturer's name and the pressure rating clearly marked on the outside of the valve body. Valves shall be manufactured by Crane, Toyo, Newman Hattersley, Jenkins, Victaulic or other approved manufacturer. Butterfly valves shall be by Centreline, Jenkins, Dezurick, Victaulic or other approved manufacturer. Non-slam check valves shall be Smolensky, APCO, Victaulic or other approved manufacturer.
- .2 All valves must have current CRN numbers.
- .3 Aboveground domestic cold water, domestic hot water, soft water, discharge of sanitary, storm and submersible pumps - copper piping.

Item	Size (NPS)	Description	Mfr's Number
Gate valves	Up to 2	1380 kPa C.W.P., bronze, solder joint, solid wedge disc non-rising stem.	Crane 1320 Toyo 281A Jenkins 313J Kitz 41
Globe valves	Up to 2	1380 kPa C.W.P., bronze, solder joint, renewable composition or teflon disc, or screwed and with adaptors.	Crane 1310 Toyo 221 Jenkins 106BPJ Kitz 09
Ball valves	Up to 2	2.75 Mpa C.W.P., bronze/brass body and ball, teflon packing, solder ends.	Crane 9322 Toyo 5049 Jenkins 904J Kitz 69
Check valves	Up to 2	1380 kPa C.W.P., bronze solder joint, Y pattern swing check valve.	Crane 1342 Toyo 237 Jenkins 4093J Kitz 23

- .4 City water, except where city water is also a source of fire protection water.

Item	Size (NPS)	Description	Mfr's Number
Aboveground Gate Valve	½ to 2	1300 kPa C.W.P., bronze solder joint, solid wedge disc, non-rising stem.	Crane 1320 Toyo 281A Jenkins 313J Kitz 41

2.5 VALVES – HVAC

- .1 Use valves as shown below unless specifically shown or specified otherwise.

- .2 Except where special features are required or unless otherwise approved or noted, all valves shall be of one manufacturer with the manufacturer's name and the pressure rating clearly marked on the outside of the valve body. Specific model numbers are listed below to establish a standard for comparison.
- .3 Acceptable Manufacturers:
 - .1 Gate, globe, ball and swing check valves:
 - .1 Crane, Jenkins, Kitz, Newman Hattersley, Red-White/Toyo, Victaulic, DAHL.
 - .2 Butterfly valves:
 - .1 Bray, Centreline, Crane, Dezurik, Jenkins, Victaulic
 - .3 Other valves shall be as specified.
 - .4 All valves must have current CRN numbers.
 - .5 Hot water, chilled water:
 - .1 Gate valves:
 - .1 NPS 2 and smaller: threaded bronze body, 1034 kPa(g) (WSP), rising stem; solid wedge disc; bronze trim; union bonnet.
 - .1 Acceptable Products:
 - .1 Jenkins 2810J
 - .2 Red-White/Toyo 298
 - .3 Kitz 42
 - .2 Globe valves:
 - .1 NPS 2 and smaller: threaded bronze body, 1720 kPa(g) (WSP); rising stem; stainless steel disc and seat ring; union bonnet.
 - .1 Acceptable Products:
 - .1 Red-White/Toyo 214
 - .2 Kitz 09
 - .3 Ball valves:
 - .1 NPS 1/2 to 2: bronze body 4.1 MPa(g) CWP, chrome-plated brass ball, PTFE seats and packing.
 - .1 Acceptable Products:
 - .1 Jenkins 901J
 - .2 Red-White/Toyo 5044A
 - .3 Kitz 58

.4 DAHL

.2 For grooved-end piping, NPS ¼ “ and 2”: Valves shall be rated for 4 MPa (g), and 230°C maximum service temperature.

.1 Acceptable Products:

.1 Victaulic 722

.6 Circuit Balancing Valve (CBV) shall be Armstrong CBV or Tour and Andersson STA-D and STA-F or Series 780.

.7 CBV Valve Selection, based on TA – Tour & Anderson/Victaulic valves:

.1 Circuit balancing valves should be sized in relation to GPM flows (and not in relation to pipeline size).

.1 The minimum flow is calculated from the minimum recommended pressure drop of 1 ft. WG (=3.0kPa)

.2 The Nom. Flow is calculated from the maximum setting of the valve and the minimum recommended pressure drop, 2 ft. WG (=6.0 kPa).

.3 The max. flow is calculated from the maximum setting of the valve and the maximum pressure drop, 20 ft. WG (=60.0 kPa).

.2 Series 785-TA

Valve Size			Nom. Range Minimum	Maximum Flow GPM/LPM
Nom. Dia. in/mm	Actual Outside Dia. In/mm			
½	0.840	0.27	Flow	9.5
15	21.3	1.02	GPM/LPM	36.0
¾	1.050	0.38	3.0-4.0	15.0
20	26.7	1.44	11.4 – 15.1	56.8

.3 Series 786-/787-TA

Valve Size		Minimum Flow GPM/LPM	Nom. Range of Flow GPM/LPM	Maximum Flow GPM/LPM
Nom. Dia. in/mm	Actual Outside Dia. In/mm			
½	0.840	0.13	0.5 – 2.8	8.6
15	21.3	0.49	1.9 – 10.6	36.0
¾	1.050	0.39	2.8 – 6.0	20.0
20	26.7	1.48	10.6 – 22.7	75.7
1	1.315	0.45	6.0 – 10.0	30.0
25	33.7	1.70	22.7 – 37.9	113.6
1-1/4	1.660	0.87	10.0 – 15.0	48.0
32	42.4	3.29	37.9 – 56.8	181.7
1-1/2	1.900	1.30	15.0-20.0	66.0
40	48.3	4.92	56.8 – 75.7	249.8
2	2.375	2.00	20.0 – 36.0	110.0
50	60.3	7.57	75.7 – 136.3	416.4

PART - 3 EXECUTION

3.1 GENERAL PIPING CONSTRUCTION METHODS

.1 General

.1 Standards:

.1 To ANSI Sections B31.1 to B31.9 as applicable to service, unless specified otherwise herein.

.2 Inserts, sleeves and anchors:

.1 Avoid unnecessary cutting of masonry.

.2 Supply inserts, sleeves and anchors to other trades for building in as the work proceeds.

.3 Arrange with other trades to leave openings, slots and chases to accommodate later installation of mechanical work.

.3 Inspect pipe and fittings for soundness and clean off all dirt and other foreign matter immediately prior to installation.

.1 Reject all damaged items.

.4 Pipe layout:

.1 Install piping in the most direct, straight and functional manner possible.

.2 Except where otherwise shown, install all vertical lines plumb, and run horizontal lines parallel to building walls.

.3 Install piping close to walls, partitions and ceilings.

.4 On multiple runs of piping, space piping to allow for installation of insulation and for proper servicing of valves.

.5 Conceal piping in finished areas and rooms within walls or ceilings, and in furred spaces elsewhere.

.1 Provide access doors or panels as hereinafter specified for access to concealed piping specialties, etc.

.2 Expansion and Contraction

.1 Installation:

.1 Install all piping free from strain and distortion due to expansion and contraction: to Section 6, Chapter 3 of ANSI B31.1, except as hereinafter modified.

.2 Allow for expansion and contraction by offsets, expansion U-bends or loops.

.3 Expansion joints of any type will not be allowed unless specifically indicated on the Drawings or specified under another Section of this Division for a particular installation.

.2 Expansion/contraction allowance criteria:

.1 Steel pipe: 25 mm movement per 30 m of pipe.

.2 Brass and copper pipe: 38 mm movement per 30 m of pipe

.3 Temperature difference: for each 55°C (100°F) temperature difference

- from 21°C (70°F) ambient.
- .4 Fabricate expansion bends in steel pipe from pipe sections and long radius welding elbows.
- .3 Swing and swivel joints:
 - .1 On hot water heating piping for connections from mains to risers and from risers to radiation and other heating units.
 - .2 Use at least five fittings from main to riser including tee in main.
 - .3 Use at least four fittings from riser to heating unit including tee in riser.
- .3 Lines, Grades and Slopes
 - .1 Install piping in conformity with elevations and grades indicated on the Drawings using axis lines and bench marks provided under General Construction.
 - .1 Verify such axis lines and bench marks.
 - .2 Lay out work and be responsible for lines, elevations, measurements, etc., required for installation of the Work.
 - .2 Slopes:
 - .1 Slope piping drains and sewers as indicated on the drawings.
 - .2 Install so that slope between elevations shown on the Drawings is even and constant.
 - .3 Install liquid and air lines free of pockets and pitch to drain at low points in the line with valves or traps installed as required for drainage of the lines.
 - .3 Minimum slopes:
 - .1 As shown on drawings; if not shown, then as follows.
 - .2 Drainage piping, NPS 3 and less: 1:50.
 - .3 Drainage piping, NPS 4 and larger: 1:100.
 - .1 In special circumstances as provided for under the Codes and Regulations and the express approval of the Consultant, drains of NPS 4 size and larger may be laid at a lesser slope.
 - .4 Domestic water lines: pitch to low points so that all lines may be completely drained.
 - .5 Hot water heating, and chilled lines: slope up 1:500 in direction of flow.
 - .4 Where pipe slope causes pipe to rise to top of ceiling space, or fall to bottom of structural members, ceiling space or defined service space, provide risers as follows:
 - .1 Domestic water lines: provide drain valve at bottom of low point, and provide riser to increase elevation of piping.
 - .2 Hot water heating, and chilled water lines: provide automatic air vent, complete with drainage piping, at high point, provide drain valve at bottom of low point and provide riser to lower elevation of pipes.
- .4 Piping Connections to Mains
 - .1 Water piping:
 - .1 Make down feed piping connections to horizontal supply and return mains

to the bottom quadrant of the mains.

3.2 **SYSTEM REQUIREMENTS**

.1 Plumbing

- .1 Install complete plumbing, drainage and vent piping for washrooms, etc, in accordance with the Ontario Building Code.
- .2 Size vent lines based on developed pipe length and hydraulic load.
- .3 Arrange piping within pipe spaces behind washroom fixtures to allow unimpeded access to piping for servicing.

.2 Copper Pipe - Type L

- .1 Provide dielectric unions or couplings at all connections between copper tubing and ferrous piping

.3 PVC Drainage, Waste and Vent Piping

- .1 Above grade: install in accordance with CSA B181.11 and B181.12 and manufacturer's recommendations.
- .2 Provide fire stop seals on all fire separation penetrations, except at connections through concrete floor slabs to non-combustible water closets.
- .3 Do not use combustible piping in return air ceiling plenums or vertical riser shafts.
- .4 PVC drainage, waste and vent piping shall be "System XFR PVC-DWV" and shall only be used when combustible piping is required to be installed within ceiling plenums or as specifically designated as "SAN-1".

.4 HVAC

- .1 Provide automatic air eliminators at all high points on piping mains for hot and chilled water systems. Where venting a horizontal pipe, grade pipe up in direction of flow with vent at high point. Use float type eliminators, designed for a minimum of 1 Mpa water pressure with steel or cast iron body having removable flanged top, stainless steel or copper float and stainless steel valve and lever mechanism. Provide gate valve at the float inlet. Pipe outlets to drain using flexible polyethylene pipe. Drain pipe shall be run such that its route is visible.
- .2 Provide manual air vents on all hot water heating units where air may be trapped. Use screw-driver operated vents of chrome plated brass. Vents shall be accessible without removing cover of heating unit.
- .3 Arrange all runs of piping to prevent interference and to achieve a satisfactory and workman like installation of neat appearance. Run all piping parallel to walls. All valves controls, equipment, expansion compensators, flexible connections and, as far possible, all piping shall be easily accessible for inspection, maintenance and operation.
- .4 Provide adequate allowance for expansion and contraction of piping by providing expansion joints or loops or cold springing pipe, where required.
- .5 Pitch all lines 0.2% unless shown otherwise.
- .6 Carefully ream threaded joints and use joint compound on the male thread only. Retighten flanged connections after the installation has been brought up to its service temperature, after which operation, the insulation may be applied. Take care not to over stress the material during construction.

- .7 Pipe welding operations shall be performed by welders holding a certificate from the Department of Labour for the class of piping to be welded. No superfluous material shall restrict the internal opening of pipes and fittings.
- .8 When welding or cutting with a torch-take precautions to prevent fire. Welding or torch cutting operations shall have a fully charged 5 kg carbon dioxide extinguisher with them. Protect combustible materials with fire proof blankets.
- .9 Arrange piping to permit ease of equipment removal. Provide flanges or unions on all pipe connections to each piece of equipment.
- .10 Connect all multi-row water coils in counter flow.
- .11 Drains from packaged air handling unit drain pans shall be of same size as connection on unit and shall be DWV copper.
- .12 Grooved Piping Practice
 - .1 Ensure pipe ends are clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. The dimensions should be according to the standard cut groove or roll groove specifications published by the manufacturer.
 - .2 Install pipe, fittings and valves in accordance with the manufacturers' installation instructions.
 - .3 Provide shop drawings of all grooved end piping components.

3.3

SLEEVES

- .1 Installation Requirements
 - .1 Provide where piping passes through foundations, above grade floors and walls.
 - .2 Materials
 - .1 Schedule 40 black steel pipe or type "K" copper tubing for installation in foundations or floors
 - .2 1 mm (20 ga.) galvanized sheet steel where installed in above grade walls.
 - .3 Terminate sleeves flush with finished ceilings, walls and floors on grade.
 - .1 For piping passing through floors above grade extend sleeve a minimum of 75 mm above the floor.
 - .4 Sleeve sizes
 - .1 Large enough to pass full thickness of pipe covering where same is used.
 - .2 With sufficient clearance between pipe/insulation and sleeve to allow for any lateral movement of piping due to expansion and contraction.
 - .5 Assume responsibility for the setting of all sleeves necessary for this work in masonry walls during construction or in concrete forms before concrete is poured.
 - .6 Coat exterior surface of all sleeves of ferrous material with a heavy asphalt emulsion.
- .2 Escutcheon Plates
 - .1 Place escutcheon plates on bare piping passing through finished walls or floors.

3.4 **JOINTS, UNIONS, FLANGES AND FITTINGS**

.1 Pipe Joints

.1 Preparation

- .1 Ream pipe ends and thoroughly clean all dirt, cuttings and foreign matter from pipe after cutting and threading.
- .2 Thoroughly clean all fittings, valves and equipment before connections are made.
- .3 Cut copper tubing with a tube cutter and clean the joining surfaces of the tubing and fitting with fine emery cloth. Wipe clean with a dry cloth.

.2 Cast iron pipe sleeve joints

- .1 For cast iron plain end soil pipe, install sleeve type couplings such as Titan Foundry Type MJ, or Bibby MJ Series 2000 in strict accordance with manufacturer's printed instructions.

.3 Cast iron bell and spigot joints

- .1 Make joints either neoprene compression type preformed gaskets such as Bibby "Bi-seal", and caulk in such a manner to produce a permanently tight joint.
- .2 Cold caulking compound in cord form such as W.R. Meadows PC4 may also be used.
- .3 Assemble preformed neoprene gaskets to manufacturer's printed instructions.

.4 Mechanical joints:

- .1 Assemble mechanical joint on ductile iron pressure pipe with cast iron gland, rubber sealing gasket and high strength malleable iron bolts in accordance with the manufacturer's recommendations.

.5 Soldered joints:

- .1 Make soldered joints on copper tubing in accordance with the following usage:

	Service	Solder Type
1.	Domestic Hot and Cold Water	95/5 with matching flux
2.	Drainage, Waste, Vent	50/50 with matching flux

- .2 Do not use core type solder.

.6 Threaded joints:

- .1 Use Teflon tape or Masters metallic compound with the compound applied to the male threads only and particular care taken to prevent the compound from reaching the interior of the pipe or fittings.

.7 Grooved end piping systems: Install couplings, fittings, etc. in accordance with manufacturer's printed instructions.

- .2 Unions and Flanges
 - .1 Provide unions or flanges in the following locations:
 - .1 For by-passes around equipment or control valves or devices in piping systems.
 - .2 At connections to equipment. Locate between shut-off valve and equipment.
 - .3 In screwed or solder joint drainage tubing at inlet side of trap.
 - .2 If unions are concealed in walls, partitions or ceilings, build access thereto.
 - .3 Provide dielectric unions or isolating type companion flanges at all connections between copper tubing and ferrous piping.
 - .1 Brass body valves between ferrous piping and copper tubing is acceptable as a dielectric union.
- .3 Fittings
 - .1 Couplings
 - .1 Minimize couplings on runs of pipes.
 - .2 Do not use running couplings in any pipeline.
 - .3 NPS 2 and smaller: threaded coupling.
 - .2 Fittings and ancillary items installed in systems operating at pressures in excess of 103 kPa.
 - .1 Register in accordance with CSA B51-M.
 - .3 Eccentric reducer fittings
 - .1 To provide proper drainage or venting of the lines.
 - .2 At change of pipe sizes.
 - .3 At connections to equipment and control valves.
 - .4 Do not use bushings.
 - .4 Tee connections in welded piping
 - .1 Factory fabricated standard buttweld fittings.
 - .2 Bonney Forge "Weldolets", "Thredolets" or "Sockolets".
 - .3 Mitering, notching or direct welding of branches to mains is not permitted.
 - .5 Change of direction
 - .1 Use standard pipe fittings.
 - .2 Use long radius welded steel elbows unless short radius elbows are specifically authorized by the Consultant.
 - .3 Mitered joints or field fabricated pipe bends are not permitted.
 - .6 Tees, copper tubing
 - .1 Direct connection of branch into main using "T-Drill" method may be used where allowed by the Code, in lieu of manufactured tee fittings.

3.5 **VALVES**

- .1 Installation
 - .1 General
 - .1 Wherever possible, source valves from one manufacturer.
 - .2 Where required
 - .1 At locations shown on the Drawings.
 - .2 At all piping connections to equipment.
 - .3 At all connections to control valves or control devices.
 - .3 Type
 - .1 Shut-off service: gate, butterfly type, and ball (quarter-turn).
 - .4 Drain valves
 - .1 Hose thread outlet connection or valve with long nipple on outlet at all low points of each water system and above all riser or branch stop valves for proper drainage of lines.

3.6 **INSPECTION AND TESTING**

- .1 Pressure Leak Testing
 - .1 Make specified pressure tests on all piping included in this Contract.
 - .2 Test sections as authorized by Consultant to accommodate construction schedule. However, test complete systems on completion of work.
 - .3 Conduct tests in the presence of:
 - .1 Consultant
 - .2 Personnel of governing authorities having jurisdiction
 - .4 Notify above personnel in ample time to permit them to be present.
 - .5 Conduct tests before piping is painted, covered or concealed.
 - .6 Disconnect and/or remove equipment or specialties not designed to withstand the test pressure during the test and reconnect same after completion of test.
 - .7 Promptly correct any defects that develop through tests and re-test to the complete satisfaction of the Consultant and other parties involved.
 - .8 Forward copies of all final tests on all pressure and drainage piping and a copy of governing authority approvals to the Consultant immediately on acceptance of tests and/or approvals.
 - .9 Final payment for the work will not be made until the above has been received.
- .2 Hydrostatic Tests
 - .1 Conduct tests for a minimum period of 2 hours, or longer when requested by the Consultant or governing authority at the test pressure specified under the respective Section of the Specifications.
 - .2 Test requirements:
 - .1 Pressure to remain constant over test period to a pressure of 1½ times the operating pressure but not to exceed the material pressure class rating.

- .2 Exterior surfaces of pipe or fittings free of cracks or other form of leak.
 - .3 Tests to be performed at a constant ambient temperature.
 - .3 Pneumatic Tests
 - .1 Initially pressurize the system with air to approximately one-half the specified operating pressure but not to exceed 345 kPa.
 - .1 Examine joints for leaks with a soapsuds solution.
 - .2 Repair leaks as detected.
 - .3 Repeat test and repairs until soap test passes.
 - .2 Provide a final pressure test on the system with air to the test pressure specified under the respective Section of the Specifications.
 - .4 Drainage and Potable Water Testing
 - .1 Test drainage piping and potable water piping in accordance with requirements of The Ontario Building Code, latest edition, and any additional requirements of applicable local by-laws.
- 3.7 **PRE-OPERATIONAL CLEANING**
- .1 Temporary Connections
 - .1 Make temporary cross-overs, blank-off equipment connections, install drain and fill lines for circulating cleaning fluid through piping.
 - .2 Flushing of Piping Systems
 - .1 Flush water piping with water flowing at a velocity of not less than 1.8 m/sec, for a period of 15 minutes or longer as required to remove all dirt, scale, and cuttings from the entire length of the piping.
 - .2 Thoroughly clean, prior to fabrication, sections of new piping which cannot be isolated for flushing purposes.
 - .3 Thoroughly clean, insofar as possible, welded joints by swabbing interior of pipe with swabs soaked with a caustic solution.
 - .3 Chilled Water and Heating Water Systems
 - .1 Clean systems with neutral pH, non-chromate chemical cleaner to remove sludge oil and debris. Use cleansing compound at rate of 10 kg per 5000 litres of water in system.
 - .2 Circulate cleaner for 72 hours at room temperature then drain and refill with water with and inhibitor.
 - .3 Circulate inhibitor treated water for an additional six hours and drain.
 - .4 Refill each system with working fluid and add chemicals to provide protection against corrosion.
 - .5 Recirculate fluid for four hours and test samples from system for iron content. Drain, refill, and add chemicals so that total iron content in system is less than 1 ppm. When iron content of glycol system is satisfactory, add glycol to achieve design concentration.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings.
 - .2 Operation and Maintenance Data: Submit printed operation instructions and maintenance data.

PART - 2 PRODUCTS

2.1 STRAINERS AND FILTERS

- .1 "Y" Pattern Strainers
 - .1 NPS 2 and under:
 - .1 "Y" pattern
 - .2 Class 125 (860 kPa) bronze body
 - .3 Screwed ends and screwed cleanout.
 - .2 Screen material: 20 mesh stainless steel unless otherwise noted
 - .3 Manufacturers:
 - .1 Erwel
 - .2 Spirax Sarco
 - .3 Streamflo
 - .4 Brooks - Hart

2.2 FLEX CONNECTIONS AND EXPANSION COMPENSATION

- .1 Flexible Metal Hose Connections
 - .1 Size Application
 - .1 Steel piping: NPS ½ to NPS 14
 - .2 Construction
 - .1 Corrugated inner hose of bronze or stainless steel.
 - .2 Outer jacket of bronze or stainless steel braided wire mesh.
 - .3 Screwed or female soldered end connections up to NPS 2.
 - .4 Forged steel raised face flanged NPS 2½ and above.
 - .5 Selected for 1034 kPa working pressure and 93°C (200°F) working temperature.

- .6 Designed to absorb transverse movement. Selection based on "Constant Bend Radius".
- .7 Flexible length to meet required transverse movement as per item above, as recommended by flexible hose manufacturer in their printed performance/selection data.
- .3 Manufacturer
 - .1 Senior Flexonics (Canada) Limited
 - .2 Piping Accessories Canada Ltd.
 - .3 SSI Equipment Inc.
 - .4 Anaconda Flexpipe
 - .5 United Flexible Metallic Tubing (Canada) Limited
 - .6 HYSPAN, supplied by Flex-Pression

2.3 MISCELLANEOUS

- .1 Pressure Relief Valves
 - .1 ASME rated, selected of relieving flow at 25% above the working pressure.
 - .2 Body construction and trim: to suit specific service.
 - .3 Manufacturers
 - .1 STM Specialty Sales
 - .2 Watts
 - .3 Fisher
 - .4 Consolidated
 - .2 Drain Valves
 - .1 NPS ½ brass sediment faucets with hose outlets
 - .2 Manufacturers
 - .1 Emco 10740
 - .2 Cambridge Brass 32W201

PART - 3 EXECUTION

3.1 INSTALLATION - STRAINERS AND FILTERS

- .1 "Y" Strainers
 - .1 Horizontal installation: install with minimum 300 mm clearance between bottom of strainer and any obstruction
 - .2 Vertical installation: install with basket drain pointing down, and with minimum 300 mm clearance between bottom of strainer and any obstruction.
 - .3 Provide drain valve complete with chain and cap on NPS 3 and larger strainers
 - .4 Remove baskets, clean and replace at time of building handover.

3.2 **INSTALLATION - FLEX CONNECTIONS AND EXPANSION COMPENSATION**

- .1 Selection Criteria
 - .1 Provide manufactured expansion compensation units where shown on drawings.
 - .2 Provide expansion loops where shown on drawings.
 - .3 Select expansion joints to compensate for thermal expansion in pipe between anchors with not less than 25% safety factor calculating expansion from -18°C (0°F) ambient up to maximum possible operating fluid temperature, but not less than 93°C (200°F).
- .2 Provision of expansion joints and flex connections:
 - .1 Flexible Metal Hoses
 - .1 In hot water and chilled water piping connections to coils in air supply units when units, or sections of units to which piping is connected, are supported or suspended by means of springs or isolation pads.
 - .2 On piping connections to domestic hot water tanks
 - .2 Expansion Compensators
 - .1 Domestic hot water supply and recirculation piping up to and including NPS 3
 - .2 Heating system piping up to and including NPS 2 size
 - .3 Expansion joint installation:
 - .1 Provide pipe guides for each expansion joint using two guides on each side of and adjacent to joint
 - .2 Refer to Section 23 05 29 for pipe guides
 - .3 Guide may be omitted between joint and anchor where an anchor is located within 900 mm of expansion joint
 - .4 Provide anchors consisting of structural steel angles, channels, or plates secured to building structure.
 - .4 Flexible metal hose connection installation:
 - .1 Support or guide piping firmly adjacent to flexible connections and prevent pipes from swaying
 - .2 At chilled and/or hot water coils locate hoses on supply side between strainer and coil and on return side between coil and control valve.

3.3 **INSTALLATION - MISCELLANEOUS**

- .1 Pressure Relief Valves
 - .1 Install relief valves on pressure vessels where shown.
 - .2 Provide discharge elbow drain, and pipe drain with NPS ¾ pipe to nearest floor drain.
- .2 Drain Valves
 - .1 Provide at:
 - .1 Low points of water piping systems in order to completely drain each system

- .2 Cooling and heating coils
- .3 Other locations as shown.

END OF SECTION

PART - 1 GENERAL

1.1 WORK INCLUDED

- .1 Provide work of this Section in accordance with the Contract Documents.

1.2 SUBMITTALS

- .1 Shop Drawings (6 sets)
 - .1 Submit shop drawings as required by the Consultant.

PART - 2 PRODUCTS

2.1 MATERIALS

- .1 Acceptable Manufacturers
 - .1 Hangers:
 - .1 Anvil
 - .2 Myatt
 - .3 Carpenter & Paterson
 - .4 Hilti
 - .5 L.E. Taylor
 - .6 B-Line
 - .2 Insulation shields:
 - .1 Anvil
 - .2 Myatt
 - .3 Pipe Shields Inc.
- .2 Pipe Guides
 - .1 Outer hinged housing with sliding spider clamp.
 - .1 Carbon steel, black steel finish.
 - .2 Anvil figure 256.
- .3 Lower Attachment
 - .1 Clevis hanger – steel pipe
 - .1 Standard weight black steel clevis hangers with level adjustment and locknut (double bottom locknut).
 - .2 Anvil figures 260 and 300.
 - .3 For figure 260, provide clevis bolt spacer on insulated piping.
 - .2 Clevis hanger – copper pipe
 - .1 Light weight black steel clevis hangers with copper coloured finish and plastic insert to suit local authority requirements, with level adjustment and locknut (double bottom locknut).
 - .2 Anvil figure CT-65.

- .3 Roller hanger
 - .1 Adjustable roller type hangers with locknuts.
 - .2 Rollers of sufficient width to clear the outside diameter of the insulation on the piping.
 - .3 Support rollers at both ends, either by a yoke, swivel type hanger or by two adjustable rods with locknuts (double locknuts).
 - .4 Anvil figure 177 or 171 as applicable.
- .4 Insulation Protection
 - .1 Insulation saddles, for welding to pipe:
 - .1 Anvil figure 160-165 as applicable.
 - .2 Insulation shields:
 - .1 Either shop fabricated, or manufactured plates of the size required to properly fit the outside diameter of the pipe insulation.
 - .2 Anvil figure 167, modified with holes at each end to suit 12 mm wide stainless steel band clamps.
 - .3 Shop fabricate bearing plates conforming to the following table for various pipe sizes:

Pipe Size (NPS)	Length of Plate mm	Thickness of Plate mm (ga)
½ to 2	300	1.2 (18)
3 to 4	300	1.52 (16)
6	450	1.52 (16)
8 and over	600	1.9 (14)
 - .4 Form the bearing plates to the O.D. of the adjoining pipe insulation and extend the plate up to the horizontal centre line of the pipe.
- .5 Middle Attachment
 - .1 Machine threaded rods
 - .1 Black steel finish in concealed areas.
 - .2 Galvanized finish in mechanical rooms and exposed areas.
- .6 Upper Attachments
 - .1 Beam clamps:
 - .1 Malleable iron C-Clamp with retaining clip, FM approved: Anvil figure 87, NPS ½ to NPS 2; maximum load: 180 kg.
 - .2 Do not use top beam clamps.
 - .2 Concrete inserts (new construction):
 - .1 Single hanger: Malleable iron body and nut, universal nut style: Anvil figure 282, to NPS 8.
 - .2 Continuous hanger: cold formed hot dipped galvanized strip steel with end caps: Power-Strut PS 449.

- .3 Concrete clevis plates (existing concrete):
 - .1 Carbon steel plate, with clevis attachment.
 - .2 Anvil figure 49.
 - .3 Do not use explosive driven anchors.

PART - 3 EXECUTION

3.1 INSTALLATION

- .1 General
 - .1 Support or suspend piping with necessary hangers, structural supports and/or brackets, to prevent sagging, warping and vibration and to allow for movement due to expansion and contraction.
 - .2 Place hangers and supports close to fittings, elbows, valves and/or other heavy parts.
 - .3 Do not allow loads of any nature to be transmitted through the piping connections to equipment not specifically designed for such loads.
 - .1 Where flexible connections are not called for at connections to equipment, support the pipe by stands attached to both pipe and supporting structure so that force in any direction is not transmitted to the equipment.
 - .4 Place suitably dampened spring hangers at the first three supports from the equipment connection on piping subject to excessive movement or shock from any source, thermal expansion and contraction.
 - .1 Where it is evident that no undue loads will be transmitted to the equipment by the system concerned, i.e. small bore connections to comparatively large equipment, cold service piping not subject to shock, etc., then spring hangers may be omitted and standard hangers used.
 - .5 Use trapeze type hangers where pipes are grouped together, unless specifically indicated otherwise on the Drawings.
 - .1 Suspend horizontal member by adjustable rods with locking feature for maintaining level and slope.
 - .2 Space trapeze type hangers based on the closest interval required by any pipe supported thereon.
 - .3 Provide any auxiliary steel required to support trapeze between building steel.
 - .6 Do not hang pipe from another pipe unless specifically shown on the Drawings.
 - .7 Use oversized hangers for all insulated pipe. Hangers installed through pipe insulation is not permitted.
- .2 Hanger Selection
 - .1 Select lower attachment and insulation protection based on the following, unless otherwise shown on drawings:

Pipe Size NPS	Operating Temperature		
	Less than 43°C	Between 21°C and 43°C	Greater than 43°C
	Insulated	Non-insulated	Insulated
2 and less, steel	Clevis and Shield	Clevis only	Clevis
2½ to 6, steel	Clevis and Shield	Clevis only	Roller and Saddle
8 and over, steel	Roller and Saddle	Roller only	Roller and Saddle
½ to 4, copper	Clevis and Shield	Clevis	Clevis and Shield

.2 Install temporary spacers between the insulation Shield and the pipe equal to the thickness of insulation specified. Refer to Section 23 07 19

.3 Saddles and Roller Supports

- .1 Place saddles at roller supports for piping carrying liquids at 43°C (110°F) or higher.
- .2 Weld saddles to black or galvanized steel piping.
- .3 Refinish galvanized surfaces destroyed by the welding with a zinc rich paint such as W.R. Meadows "Galvafroid", Kerry Industries "ZRC" or Niagara Paint Inc. "PL052898".

.4 Insulation Shields

- .1 Place insulation shields at pipe supports for pipes carrying liquids at 21°C (70°F) or less.
- .2 Field or factory punch a hole at each end of the shield to allow a 12 mm stainless steel band clamp to pass through opening.
- .3 Secure shields with 2@ 12 mm stainless steel band clamps per shield.

.5 Hanger Spacing - General

- .1 Horizontal runs of plumbing and drainage piping: to hanger spacing requirements of the Ontario Building Code.
- .2 Place additional hangers in locations where there are concentrated loads such as valves, specialties, etc.

.6 Hanger Spacing - Black Steel and Galvanized Pipe

- .1 For horizontal runs of black or galvanized steel pipe, other than for plumbing service:
- .2 Maximum distances between supports and with minimum diameter rods as follows:

Pipe Size NPS	Rod Size mm	Spacing	
		Water Service m	Gas, Steam or Air m
Thru 1	10	2.0	2.7
1¼	10	2.0	2.7
1½	10	2.7	3.6
2	10	3.0	3.9
2½	12	3.3	4.2

Pipe Size NPS	Rod Size mm	Spacing	
		Water Service m	Gas, Steam or Air m
3	12	3.6	4.5
4	16	4.2	5.0
6	19	5.0	6.4
8	22	5.7	7.3

.7 Hanger Spacing - Copper Tubing

- .1 For horizontal runs of copper tubing for services other than plumbing:
- .2 Maximum distances between supports and with minimum diameter rods as follows:

Pipe Size NPS	Rod Size mm	Spacing	
		Water Service m	Gas, Steam or Air m
Thru ¾	10	1.5	1.8
1	10	1.8	2.4
1¼	10	2.0	2.7
1½	10	2.4	3.0
2	10	2.4	3.3
2½	12	2.7	3.9
3	12	3.0	4.2
4	16	3.6	4.8

.8 Hanger Spacing - PVC or CPVC

- .1 For horizontal runs of PVC or CPVC for services other than plumbing.
- .2 Maximum distances between supports and with minimum rods sizes for un-insulated pipe as follows.

Pipe Size NPS	Rod Size mm	Pipe Schedule			
		PVC 40	CPVC 40	PVC 80	CPVC 80
½	6	1.2	1.2	1.2	1.2
¾	6	1.2	1.2	1.2	1.5
1	6	1.2	1.5	1.5	1.8
1¼	6	1.2	1.5	1.5	1.8
1½	6	1.5	1.8	1.8	1.8
2	6	1.5	1.8	1.8	2.0
2½	6	1.8	2.0	1.8	2.4
3	6	1.8	2.0	2.0	2.4
4	6	2.0	2.4	2.4	2.7
6	6	2.4	2.4	2.7	3.0

Pipe Size NPS	Rod Size mm	Pipe Schedule			
		PVC 40	CPVC 40	PVC 80	CPVC 80
8	10	2.7	2.7	3.0	3.0
10	10	2.7	-	3.3	-
12	12	3.0	-	3.6	-

- .3 For insulated pipe, reduce spacing by 30%.
- .4 Do not restrain axial movement
- .5 Spacing based on fluids with specific gravity of 1.0 and 26°C (80°F). For other conditions, use other published data approved by Consultant.

- .9 Anchors and Guides
 - .1 Use anchors where shown on the Drawings and/or as required to maintain permanent location of pipe lines.
 - .1 Construct anchors for steel or galvanized pipe of approved steel straps and/or rods.
 - .2 For anchoring copper lines, use copper plated anchors, or use insulation bands between tubing and clamps if steel straps or rods are used.
 - .2 Provide minimum two (2) pipe guides on each side of an expansion joint and expansion compensator.
 - .1 1200 mm between each guide.
 - .2 Not more than 900 mm between last guide and start of expansion joint or expansion compensator.
 - .3 For special expansion joint/compensator or for special applications, where more than two guides on each side are required, follow manufacturer recommendations for location of guides.

- .10 Inserts
 - .1 In new construction, set inserts onto formwork prior to pouring of concrete.
 - .1 Provide a 200 mm length of rebar and wire through insert.
 - .2 Mechanical rooms, and other areas of multiple pipe runs.
 - .1 Provide continuous type insert channels at 1800 mm intervals along route of piping.
 - .2 Provide a 200 mm length of rebar and wire through insert.

- .11 Double Nut Requirements
 - .1 Lower attachment
 - .1 Clevis hanger: double nut on horizontal clevis bolt.
 - .2 Saddle hanger: refer to middle attachment requirements above.
 - .3 Trapeze hanger: refer to middle attachment requirements above.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 WORK INCLUDED

- .1 Provide work of this Section in accordance with the Contract Documents.

1.3 RELATED WORK

- .1 Section 23 05 24: Flexible Piping Connections
- .2 Section 23 33 00: Flexible Duct Connections
- .3 Section 23 33 00: Ductwork Silencers and Acoustic Plenums

1.4 DESIGN CRITERIA – NOISE AND VIBRATION

- .1 General
 - .1 Limit noise and vibration levels of equipment and systems within design intent.
 - .2 If noise or vibration levels created by any mechanical equipment and systems and transmitted to occupied portions of building or other mechanical work, are over the limits, make all necessary changes without additional cost.
 - .3 Install equipment, piping and ductwork in accordance with good noise and vibration control engineering practice in order to meet the requirements specified below.
 - .4 Maximum sound levels, combined internal background and mechanical equipment generated noise:

Room	N.C. Levels
Open Plan Offices	40
Closed Room Offices	38

- .1 Exclude environmental transient noise (traffic, etc).
 - .5 Meet the seismic requirements for the region as listed in the latest edition of the Ontario Building Code.

1.5 SUBMITTALS

- .1 Shop Drawings, (submit 6 sets):
 - .1 Submit as required by the Consultant.

PART - 2 PRODUCTS

2.1 MANUFACTURERS

- .1 Acceptable manufacturers of noise and vibration control hardware are:
 - .1 Vibron
 - .2 Vibro-Acoustics
 - .3 Korfund-Sampson
 - .4 Mason Industries Inc.
- .2 Noise and vibration control hardware: supplied by a single supplier.
 - .1 Exception: where vibration isolation is supplied as an internal component as part of a manufactured product.

2.2 MATERIALS

- .1 Pad Isolators
 - .1 Rubber in shear, minimum 13 mm thick, bonded to 6 mm steel plates.
 - .2 Mason or equal, Mason W pads molded in: neoprene with antioxidants for use in office ceiling spaces, retail and concourse ceiling spaces, W pads molded in bridge-bearing neoprene w/ antioxidants, oil resistance for use in mechanical rooms.
- .2 Neoprene Isolators
 - .1 Captured mount design with threaded insert and hold down bolts.
 - .2 Double deflection isolator refers to mounts with design static deflection of 13 mm .
 - .3 Selection: not loaded beyond its design limit, but not less than 60% of its design value.
 - .4 Mason or equal, Mason WMSW and MBSW PAD ASSEMBLIES
- .3 Spring Isolators
 - .1 Colour coded stable springs, levelling devices and neoprene insert or pad for acoustical isolation.
 - .2 Lateral spring stiffness: minimum 0.8 times vertical stiffness.
 - .3 Mounting hardware: zinc chromate plated.
 - .4 Bolt holes for hold down bolts and suitably stepped rubber washers.
 - .5 Stable spring types for open spring mounts.
 - .6 Steel spring operating load rating: load to between 50% and 70% of the SOLID spring deflection.
 - .7 Rubber spring operating load rating: between 60% to 100% of rated maximum.
 - .8 Neoprene pads: size pads at the base of the steel spring mounts to deflect between 1.5 to 2.5 mm at the operating load (for acoustical isolation above the first spring resonance).
 - .9 Mason or equal, spring isolators model Mason # SLF and SLFH, SINGLE OR MULTIPLE SPRINGS TYPE – as required to minimize spring mounting space requirement.

- .4 Resilient Hangers
 - .1 Captured mount design with threaded insert and hold down bolts.
 - .2 Capable of tolerating vertical misalignment for a total of plus or minus 10 degrees with the specified hanger rod and at the rated deflection.
 - .3 Double deflection isolator refers to mounts with design static deflection of 13 mm
 - .4 Selection: not loaded beyond its design limit, but not less than 60% of its design value.

PART - 3 EXECUTION

3.1 INSTALLATION

- .1 General
 - .1 Carry out the work in this section in accordance with manufacturer's instructions (and supervision where required) and only by workmen experienced in the installation of such systems.
- .2 Noise control
 - .1 Select and install isolation equipment to ensure that the mechanical equipment does not produce undue amounts of noise and vibration induced noise.
 - .2 Oversized pipe sleeves:
 - .1 Location: at wall or floor within the first 100 times diameter length from a noise/vibration source.
 - .2 Sleeve size: at least 50 mm larger than the pipe diameter.
 - .3 Sleeve sealing: pack the periphery with firestopping, or high density mineral wool (greater than 5 lb/cu.ft.) at not more than 50% compression.
 - .4 Caulk the ends of the packing and seal with non-hardening caulk such as Tremco Dymeric (with colourpak if weatherproof quality is required).
 - .3 Duct sealing:
 - .1 Pack and seal all spaces and cracks around ducts passing through walls or floor, as described above for pipes.
- .3 Vibration Control
 - .1 Types of vibration isolation hardware:
 - .1 Isolation mount types (xx = inches of static deflection, xx – indicate in shop drawings submittal)

CSxx	Closed spring mount
OSxx	Open spring mount
OSRxx	Open spring restricted mount
OSRIxx	Open spring restricted mount with internal levelling devices
ERxx	Elastomer rubber mount

.2 Rubber isolation pads types

R	Single layer rubber waffle pad
N	Single layer neoprene waffle pad
RSR	Multiple layers of rubber and steel as indicated
NSN	
RSRSR, etc	

.3 Isolation hangers types

SH	Spring hanger
SHR	Spring hanger with rubber isolator
SHP	Either of above spring hangers with pre-compressed spring rubber isolator hanger
SHRP	
RH	Rubber isolator hanger

.4 Base types

IS	Integral steel base
CI	Concrete inertia base
IR	Isolated rooftop equipment curb

.2 Minimum vibration isolation requirements for all motor driven equipment: type R

- .1 Refer to Equipment schedules for isolation requirements.
- .2 Use neoprene in potentially oily areas or outdoors.

.4 Isolator Requirements

- .1 Vibration isolation supplier to examine and conform to the overall requirements for the project in accordance with the requirements specified herein.
- .2 Include:
 - .1 Consider RPM of equipment in determining the disturbing frequency on all fans, pumps, compressors, etc.
 - .2 Establish vibration isolation requirements from equipment manufacturers certified shop drawings and performance data.
 - .3 Select spring isolators from the manufacturer's catalogue inventory wherever possible.
 - .4 Should deflection requirements warrant the use of special springs, provide complete design data to the Consultant with the review drawings.
 - .5 Equip base type spring isolators with 9 mm thick neoprene or neoprene composition anti-vibration pads bonded to the base and with combination

levelling bolts.

- .6 Equip hanger type spring isolators with neoprene or composition pads at both ends of the spring.

.5 Equipment isolation

- .1 Mount equipment as follows, unless otherwise shown on Equipment Schedules.

Equipment	Remarks	Base Type	Isolation Type	Minimum Deflection mm
Centrifugal Fans suspended	Provide Seismic restraint rods	None	SHR	45
Air Handling Units	Fans internally isolated	CI	OSRI	45

3.2 **INSPECTION AND REPORTING**

.1 Supervision of Installation

- .1 Manufacturer/supplier of hardware to provide on-site technical supervision of installation during construction.
- .2 Hardware supplier to inspect and report in writing that the installation has been carried out to their satisfaction.

.2 On-site testing

- .1 If, after the start-up of mechanical equipment, the Consultant is not satisfied that noise and vibration goals have been met, the Consultant retains the option of asking for a sound and vibration test report of all areas under question.
- .2 Carry out measurements by a competent person using equipment meeting general requirements of international standards following measurement methods that follow similar standards.

.3 Remedial work

- .1 If Consultant finds any installation of equipment and piping, and fabrication and installation of ductwork to be unsound or poor with regard to sound and vibration requirements, refabricate and reinstall such works as required at no increase in Contract Price.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings as required by the Consultant
 - .2 Submit schedule of Equipment Identification Nameplates for review.
- .2 Samples
 - .1 Submit samples of piping, valve and ductwork identification markers.

PART - 2 PRODUCTS

2.1 MATERIALS

- .1 Equipment Nameplates
 - .1 Laminated phenolic plastic with white finish and minimum 10 mm high black letters.
 - .2 Three rows of text, based as shown in equipment Schedules.
 - .1 Line 1: Equipment ID (e.g. P-1)
 - .2 Line 2: Equipment Name (e.g. Northwest Zone Heating Pump)
 - .3 Line 3: Optional, up to 15 characters (e.g. Standby Pump)
 - .3 This identification is in addition to manufacturers nameplate data.
- .2 Ductwork Identification
 - .1 Painted stencil lettering: 50 mm high.
 - .2 Paint colour:
 - .1 Black paint on canvas covered insulated ductwork
 - .2 White paint on metal covered insulated ductwork
 - .3 White paint on uninsulated ductwork
 - .3 Two levels of text in accordance with designations shown on Schedules:
 - .1 Level 1: Abbreviated name of air handling system for supply systems (e.g. AHU-1), or fan number for exhaust or ventilation only systems (e.g. F-1)
 - .2 Level 2: System name (e.g. General Supply)
 - .4 Direction arrows: 65 mm high
- .3 Pipe Identification – Type 1: Adhesive Labels
 - .1 Pre-printed 6 mil thick vinyl cloth, plastic coated with pressure sensitive self-adhesive backing surface. On insulated pipe, use adhesive suitable for this application.

- .1 Pipe diameter (including insulation) 75 mm or less: 29 mm width, 25 mm high lettering. Length of labels as dictated by legend.
- .2 Pipe diameter (including insulation) greater than 75 mm: minimum width of 64 mm and with 50 mm high letters.
- .3 Primary label colour: to CAN/CGSB-24.3.
- .4 Pipe label to include service pressure for steam, compressed air, natural gas (if more than one gas service pressure inside of building), and vacuum.
- .5 Legend: black with the legend printed in full wherever feasible.
- .2 Direction arrow banding tape: colour coded vinyl tape with pressure sensitive adhesive backing, 50 mm wide, with directional arrows.
- .3 Acceptable Manufacturers:
 - .1 Brady
 - .2 Safety Supply Co.
 - .3 S.M.S
 - .4 Revere-Seton
- .4 Pipe Identification – Type 2: Coil Wrap Labels
 - .1 Reversible direction, semi-rigid plastic vinyl, with subsurface printing, and integral direction arrows.
 - .1 Up to 6" diameter: coil wrap six rows of printing
 - .2 Over 6" diameter: saddle type with two rows of printing, fastened with stainless steel springs
 - .3 Lettering Size:

Outside Dia.	Letter Height
Less than 5/8"	1/4"
3/4" – 1 1/4"	1/2"
1 1/8" – 2 3/8"	3/4"
2 1/2" – 4 1/2"	1 1/4"
 - .4 Primary label colour: to CAN/CGSB-24.3.
 - .5 Legend: black with the legend printed in full wherever feasible.
 - .2 Acceptable Manufacturers:
 - .1 Brady
 - .2 Safety Supply Co.
 - .3 S.M.S
 - .4 Revere-Seton
- .5 Valve Identification
 - .1 Laminated phenolic plastic with minimum 10 mm high lettering, with brass keychain.

- .2 Minimum two lines of text:
 - .1 Line 1: valve designation
 - .2 Line 2: valve position instruction
- .6 Manufacturers
 - .1 Acceptable manufacturers
 - .1 S.M.S.
 - .2 Brady
 - .3 Safety Supply Co.
 - .4 Revere-Seton

PART - 3 EXECUTION

3.1 INSTALLATION

- .1 Equipment Nameplates
 - .1 Identify mechanical and electrical equipment installed under this Division with nameplates describing the function or use of the particular equipment involved.
 - .2 Do not commence fabrication of nameplates until after receipt of Consultant's review.
 - .3 Equipment includes, but not limited to:
 - .1 Equipment as shown on schedules and specified
 - .2 Motor starters
 - .3 Disconnect switches
 - .4 Contactors or relays in separate enclosures
 - .4 Securely fasten nameplates to the equipment with round-head cadmium plated steel self-tapping screws.
- .2 Ductwork Identification
 - .1 Label ductwork installed under Mechanical Division to indicate the content and direction of flow.
 - .2 Locate labels as follows:
 - .1 Within 1.5 m of air handling units and free standing fans.
 - .2 Within 3 m of divisions in exposed ductwork.
 - .3 On each exposed duct passing through a wall, partition or floor (one on each side of such wall, partition or floor).
 - .4 At intervals not to exceed 15 m along every exposed duct run exceeding 15 m in length.
 - .5 On every concealed duct where it enters a floor area that it serves.
 - .3 Labels to be visible from 1.5 m above the adjacent floor or platform.
 - .4 Clean surfaces with a trisodium phosphate solution before application of paint.

.3 Piping Identification

- .1 Label all piping installed under Mechanical Division to indicate the content and direction of flow with Type 1 or Type 2 labeling system.
- .2 Locate labels as follows:
 - .1 At every end of pipe run, adjacent to the valve or item of equipment serviced.
 - .2 At valves, tees and changes of direction.
 - .3 On each exposed pipe passing through a wall, partition or floor (one on each side of such wall, partition or floor).
 - .4 At intervals not to exceed 15 m along every exposed pipe run exceeding 15 m in length.
 - .5 At every access point on concealed piping.
- .3 Labels to be visible from 1.5 m above the adjacent floor or platform.
- .4 Type 1 Labels;
 - .1 Clean surfaces before application of labels.
 - .2 Secure label with direction arrow banding tape for full circumference of pipe, at each end of label.

.4 Valve Tags

- .1 Provide valve tags on all valves, except as follows:
 - .1 At plumbing fixtures.
 - .2 On chilled water and heating water shut-off and balancing valves at equipment being served.
 - .3 On isolation valves around control valves
- .2 Provide a valve identification directory for each system.
 - .1 Quantity: two (2) copies of valve identification directories for each system
 - .2 Documented as follows (example given):

Valve No.	Service	Valve Location	Nearest Column
HV-1	Northwest Zone Heating	Penthouse, North Side	A-8

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.
 - .2 Thermal insulation to ductwork.

1.2 WORK NOT INCLUDED

- .1 The following items are not to be insulated, or are factory insulated.
 - .1 Ductwork:
 - .1 Internal acoustically insulated ductwork, except overlap thermal insulation 300 mm over acoustic insulation section
 - .2 Supply ductwork which is exposed to the occupied space – only when the duct is serving the space in which it is located, unless otherwise noted

1.3 RELATED WORK

- .1 The following work is provided under other Sections or Divisions of the Work:
 - .1 Section 23 33 00: Internal acoustic insulation of ductwork.
 - .2 Section 23 33 00: Factory insulated ductwork.

1.4 REFERENCE STANDARDS

- .1 General
 - .1 Provide insulation materials and adhesives of fire retardant type with flame spread and smoke developed ratings not exceeding ULC, Government, or Municipal standards.
 - .2 Fire retardant materials with flame spread/smoke developed ratings not exceeding 25/50 when tested in accordance with CAN/ULC-S102, and complying with the requirements stated in the building code having jurisdiction.
 - .3 Identify insulation, coverings and adhesives where required by Federal and/or Provincial health and safety WHMIS legislation.
 - .4 Asbestos-free materials.
 - .5 All sealants and adhesives shall meet LEED requirements for low VOC emitting materials 80 g/l for fibreglass adhesive 250 g/l for sealants.
- .2 Reference Standards
 - .1 Comply with the latest edition of:
 - .1 NFPA 90-A
 - .2 NFPA 255, determination of flame spread rating and smoke development
 - .3 CAN/ULC-S102, determination of flame spread rating and smoke development
 - .4 ASTM C-411, materials testing

1.5 **SUBMITTALS**

- .1 Samples
 - .1 Before ordering insulation materials prepare sample board on which mount cross-section sample of types of insulation, including exterior jacket, properly identified for various services and equipment on project. State types of adhesives.
 - .2 Submit sample board to Consultant for review. After review and acceptance keep sample board in Consultant's site office for duration of project for reference. No deviation from accepted samples will be allowed.

1.6 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 General
 - .1 Retain insulation materials in original cartons or containers until immediately prior to application and store in dry location.
 - .2 Keep adhesives in their original containers with manufacturer's name and catalogue number clearly stated. Protect contents against freezing.

1.7 **DEFINITIONS**

- .1 For the purposes of this Section, the following definitions apply:
 - .1 "Conditioned supply ducts" - ductwork conveying air which has either been heated or cooled.
 - .2 "Concealed" - mechanical services and equipment located in: ceiling spaces above solid drywall and T-bar ceilings; space beneath raised floors; vertical service shafts; trenches; and non-accessible chases and furred spaces.
 - .3 "Exposed" - mechanical services and equipment in all other spaces not considered to be "concealed" as defined above. Services in tunnels are to be treated as "Exposed".

PART - 2 PRODUCTS

2.1 **DUCTWORK INSULATION**

- .1 Type D1
 - .1 Fiberglas: to ASTM C553
 - .2 Flexible blanket
 - .3 Laminated kraft-aluminum foil facing jacket
 - .4 Operating temperatures: 4 to 121°C (40 to 250°F)
 - .5 Density: 12 kg/m³
 - .6 k value: 0.051 W/m°C @ 24°C
 - .7 Acceptable Manufacturers
 - .1 Johns Manville - Microlite
 - .2 Knauf Fibreglass

- .2 Type D2
 - .1 Fiberglas: to ASTM C553
 - .2 Semi-rigid board
 - .3 Laminated kraft-aluminum foil facing jacket
 - .4 Operating temperatures: 4 to 121°C (40 to 250°F)
 - .5 Density: 48 kg/m³
 - .6 k value: 0.044 W/m°C @ 24°C
 - .7 Acceptable Manufacturers
 - .1 Owens Corning - 703/AF530
 - .2 Johns Manville - Spin-Glas Series 814
 - .3 Knauf Fibreglass

2.2 **INSULATION FINISH**

- .1 Canvas jacket
 - .1 ULC listed plain weave cotton fabric
 - .2 Weight: 220 gm/m²
 - .3 Acceptable manufacturers
 - .1 Fattal's Thermocanvas
- .2 PVC (Polyvinyl Chloride) jacket
 - .1 Minimum thickness: 20 mil
 - .2 Maximum permeability: 0.09 perms
 - .3 Premoulded one-piece fitting covers
 - .4 Tape: vinyl, pressure sensitive, colour matched
 - .5 Acceptable manufacturers:
 - .1 Johns Manville - Manville Zeston 2000
 - .2 ACWIL Insulations
 - .3 Sure Fit Systems
- .3 Metal jacket
 - .1 Aluminum: stucco embossed, minimum 0.45 mm thick
 - .2 Stainless steel: corrugated, minimum 0.25 mm thick
 - .3 Fittings: custom made, swaged ring or lobster back style on bends, die shaped over fittings, valves, strainers and flanges
 - .4 Bands: 13 mm wide stainless steel with mechanical fasteners
 - .5 Acceptable manufacturers:
 - .1 Alcan Canada Products - Thermo clad Type 1
 - .2 Childers Products Inc - Fab straps

2.3 **ADHESIVES**

- .1 Contact bond cement
 - .1 Quick setting for metal surfaces
 - .2 Acceptable manufacturers:
 - .1 Bakor - 200-37
 - .2 Foster - 85-75
- .2 Lap seal adhesive
 - .1 For joints and lap sealing of vapour barriers
 - .2 Acceptable manufacturers:
 - .1 Bakor - 230-39
 - .2 Foster - 85-75
- .3 Contact adhesive
 - .1 Acceptable manufacturers:
 - .1 Foster - 85-20
- .4 Lagging adhesive
 - .1 Acceptable manufacturers:
 - .1 Bakor - 120-18
 - .2 Foster - 30-36

2.4 **MASTIC**

- .1 Interior:
 - .1 Acceptable manufacturers:
 - .1 Bakor - 120-19
 - .2 Foster - 30-35
- .2 Exterior, with vapour barrier:
 - .1 Acceptable manufacturers:
 - .1 Bakor - 130-11
 - .2 Foster - 65-05
- .3 Exterior, breather type:
 - .1 Acceptable manufacturers:
 - .1 Childers - CP-10
- .4 Exterior - aluminum colour finish:
 - .1 Acceptable manufacturers:
 - .1 USE Hickson - Hydroshield Mastic 451 with "Stormking" aluminum coating

2.5 MISCELLANEOUS PRODUCTS

- .1 Sealants:
 - .1 Acceptable manufacturers:
 - .1 Bakor - 230-39
 - .2 Foster - 30-80
 - .2 Vapour barrier tape
 - .1 Colour matched, foil faced vapour barrier tape
 - .2 75 mm wide
 - .3 Vinyl backed or foil backed to suit insulation
 - .4 Acceptable manufacturers:
 - .1 Johns Manville - Zeston Z-tape
 - .2 MacTac Canada Ltd - Vinyl Scrim or Foil Scrim Kraft
 - .3 Compac Corp
 - .4 Fattal Canvas Inc
 - .3 Bands
 - .1 Stainless steel or galvanized metal, 12 mm wide with mechanical cinch locks.
 - .4 Insulation cement
 - .1 Acceptable manufacturers:
 - .1 Partek - Hilcote
 - .5 Vapour barrier insulation coating
 - .1 Acceptable manufacturers:
 - .1 Bakor - 130-11
 - .2 Foster - 60-38
 - .6 Weld pins, studs and clips
 - .1 Acceptable manufacturers:
 - .1 Midwest Fasteners Inc
 - .2 Continental Studwelding
 - .3 AGM
 - .7 Caulking
 - .1 Fast-drying colour matched flexible butyl elastomer based vapour barrier sealant.

PART - 3 EXECUTION

3.1 APPLICATION

- .1 General

- .1 Perform insulation work using qualified insulating applicators, in accordance with latest trade application methods and to the Consultant's approval.
 - .2 Clean all surfaces to be insulated to remove grime, grease, oil, moisture or other matter to ensure that insulation is applied to clean and dry surfaces.
 - .3 Apply insulation under ambient temperature conditions in accordance with insulation or adhesive manufacturer's recommendations.
 - .4 Do not apply insulation until such time as installation and testing of piping, ductwork and equipment has been inspected, verified, and accepted by General Contractor.
 - .5 Apply insulation neatly and tightly in unbroken lengths and with ends of sections firmly and squarely butted together. Lap canvas (or other specified wrapping) well over joints and cement down well with adhesive.
 - .6 At wall sleeves: use appropriate size sleeve and extend insulation through to make insulation continuous.
 - .7 At fire walls: terminate insulation at wall, and pack space between wall sleeve and duct or pipe as specified in Section 23 05 01.
 - .8 Provide 38 mm thermal insulation on all ductwork penetrating or connected to all exterior walls and roof for a minimum of 4500 mm from perimeter.
- .2 Treatment of existing insulation
- .1 Where new piping or ductwork systems connect to existing and where existing insulation is damaged through installation of new work, remove damaged sections of insulation for a minimum of 1 m and replace and finish to match existing.
- .3 Ductwork
- .1 General
 - .1 Insulate access doors or removable panels in ductwork as separate units to permit opening or removal without damage to adjoining insulation.
 - .2 Type D1
 - .1 Fasten insulation with adhesive, applied in 150 mm wide strips at 300mm centres.
 - .2 Tightly butt all edges and joints and seal with interior mastic and scrim foil tape.
 - .3 Tying cord may be used to temporarily hold insulation until adhesive has set.
 - .3 Type D2
 - .1 Secure insulation with welded pins and speed washer type fasteners at 300 mm centres. Provide a minimum of two rows of fasteners on each side of duct.
 - .2 In addition to mechanical fasteners, adhere insulation with adhesive applied in 150 mm strips on 450 mm centres.
 - .3 Tightly butt all edges and joints and seal with interior mastic and scrim foil tape.
 - .4 Cut off protruding ends of welded pins and cover speed washers with same tape.

3.2 INSULATION SELECTION

- .1 HVAC ductwork:
 - .1 Insulate the following systems:

System	Duct Type	Max. Op.Temp °C (°F)	Insulation Type	Insulation Thickness mm
Conditioned air supply ducts	Exposed	65 (150)	D2	25
	Concealed		D1	38
Fresh air intake plenums and ducts	Exposed	38 (100)	D2	25
	Concealed		D1	38
Return air ducts (as noted)	Exposed	38 (100)	D2	25
	Concealed		D1	38

Note 1: two layers of 25 mm thickness, overlapped butt joints.

Note 2: thickness and installation in strict accordance with ULC listing requirements.

Note 3: insulate all ductwork specifically identified on drawings.

3.3 FINISH

- .1 Ductwork
 - .1 Finish exposed ductwork in accordance with the following:

System	Equipment
D1 (round)	Canvas
D2	(Canvas)
	(Metal)
D3	None

- .2 General
 - .1 Canvas installation
 - .1 Do not apply canvas to elastomeric closed cell foam insulation.
 - .2 Securely paste canvas on with a two coat application of fire resistive lagging adhesive over the entire surface. Apply canvas between coats of adhesive, while first coat is still wet. Stretch canvas tightly and smoothly with overlapping seams located where least visible. Apply second coat of adhesive immediately following application of canvas. Do not use metal bands.
 - .3 Seal canvas with off-white sizing to leave a smooth non-porous surface ready to receive paint application.
 - .2 Do not allow mastic materials to come in contact with single ply membrane roofs.
 - .1 Clean up accidentally spills immediately.

- .2 Provide temporary drop sheets to protect the roof.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section including, but not limited to, the following:
 - .2 Thermal insulation to piping, ductwork and equipment.

1.2 WORK NOT INCLUDED

- .1 The following items are not to be insulated, or are factory insulated.
 - .1 Equipment:
 - .1 Domestic hot water heaters
 - .2 Supply ventilation systems which do not have a heating or cooling coil
 - .3 Air handling units with internal insulation

1.3 RELATED WORK

- .1 The following work is provided under other Sections or Divisions of the Work:
 - .1 Internal acoustic insulation of ductwork: Section 23 33 00
 - .2 Factory insulated ductwork: Section 23 33 00.

1.4 REFERENCE STANDARDS

- .1 General
 - .1 Provide insulation materials and adhesives of fire retardant type with flame spread and smoke developed ratings not exceeding ULC, Government, or Municipal standards.
 - .2 Fire retardant materials with flame spread/smoke developed ratings not exceeding 25/50 when tested in accordance with CAN/ULC-S102, and complying with the requirements stated in the building code having jurisdiction.
 - .3 Identify insulation, coverings and adhesives where required by Federal and/or Provincial health and safety WHMIS legislation.
 - .4 Asbestos-free materials.
 - .5 All sealants, adhesives and mastics shall meet or exceed LEED requirements for low VOC emitting materials: 80 g/l for fibreglass adhesive, 250 g/l for sealants.
- .2 Reference Standards
 - .1 Comply with the latest edition of:
 - .1 NFPA 90-A
 - .2 NFPA 255, determination of flame spread rating and smoke development
 - .3 CAN/ULC-S102, determination of flame spread rating and smoke development
 - .4 ASTM C-411, materials testing

1.5 **SUBMITTALS**

- .1 Samples
 - .1 Before ordering insulation materials prepare sample board on which mount cross-section sample of types of insulation, including exterior jacket, properly identified for various services and equipment on project. State types of adhesives.
 - .2 Submit sample board to Consultant for review. After review and acceptance keep sample board in Consultant's site office for duration of project for reference. No deviation from accepted samples will be allowed.

1.6 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 General
 - .1 Retain insulation materials in original cartons or containers until immediately prior to application and store in dry location.
 - .2 Keep adhesives in their original containers with manufacturer's name and catalogue number clearly stated. Protect contents against freezing.

1.7 **DEFINITIONS**

- .1 For the purposes of this Section, the following definitions apply:
 - .1 "Conditioned supply ducts" - ductwork conveying air which has either been heated or cooled.
 - .2 "Concealed" - mechanical services and equipment located in: ceiling spaces above solid drywall and T-bar ceilings; space beneath raised floors; vertical service shafts; trenches; and non-accessible chases and furred spaces.
 - .3 "Exposed" - mechanical services and equipment in all other spaces not considered to be "concealed" as defined above. Services in tunnels are to be treated as "Exposed".
 - .4 "Cold Piping" - piping carrying fluids at temperatures below 16°C (60°F)

PART - 2 PRODUCTS

2.1 **EQUIPMENT INSULATION**

- .1 Type E1
 - .1 Fiberglas: to ASTM C553
 - .2 Blanket insulation, with end grains perpendicular to the jacket
 - .3 Laminated kraft-aluminum foil facing or A.S.J. jacket
 - .4 Operating temperatures: -18 to 343°C (0 to 650°F)
 - .5 Density: 24 kg/m³ minimum
 - .6 k value: 0.055 W/m°C @ 93°C
 - .7 Acceptable Manufacturers
 - .1 Owens Corning - Pipe and Tank Insulation
 - .2 Johns Manville - Pipe and Tank Insulation
 - .3 Knauf Fibreglass

- .4 Manson Insulation Inc.
- .2 Type E2
 - .1 Inorganic mineral fibre: to ASTM C612
 - .2 Rigid board
 - .3 Laminated kraft-aluminum foil facing jacket
 - .4 Operating temperatures: -18 to 232°C (0 to 450°F)
 - .5 Density: 48 kg/m³
 - .6 k value: 0.033 W/m°C @ 24°C
 - .7 Acceptable Manufacturers
 - .1 Owens Corning - 703/AF530
 - .2 Johns Manville - Spin-Glas 814
 - .3 Knauf Fibreglass
- .3 Type E3
 - .1 Inorganic mineral fibre: to ASTM C553
 - .2 Flexible blanket
 - .3 Maximum operating temperature: 537°C(1000°F)
 - .4 Density: 48 kg/m³
 - .5 k value: 0.100 W/m°C @ 260°C
 - .6 Tie wire: 0.045 mm (16 ga) stainless steel with twisted ends, on maximum 300 mm centres
 - .7 Acceptable manufacturers
 - .1 Owens Corning - High Temperature 1230
 - .2 Johns Manville - HTB 23 Spin-Glas
 - .3 Calsilite
- .4 Type E4
 - .1 Inorganic mineral fibre: to ASTM C612
 - .2 Semi-rigid board
 - .3 Laminated kraft-aluminum foil facing jacket
 - .4 Maximum operating temperature: 648°C (1200°F)
 - .5 Density: 128/m³ (8lb/ft³)
 - .6 k value: 0.072 W/m°C @ 260°C
 - .7 Acceptable manufacturers
 - .1 Owens Corning - High Temperature 1280
 - .2 Johns Manville
 - .3 Calsilite

- .5 Type E5
 - .1 Closed cell elastomeric: to ASTM C534
 - .2 Self adhering roll sheets
 - .3 k value: 0.04 W/m°C @ 82°C
 - .4 Maximum operating temperature: 82°C (180°F)
 - .5 Acceptable manufacturers:
 - .1 Armstrong - AP/Armaflex Self-adhering sheet insulation
 - .2 Rubatex - 25-50
 - .3 Nomaco - IMC04 Polyolefin Foam

2.2 **INSULATION FINISH**

- .1 Canvas jacket
 - .1 ULC listed plain weave cotton fabric
 - .2 Weight: 220 gm/m²
 - .3 Acceptable manufacturers
 - .1 Fattal's Thermocanvas
- .2 PVC (Polyvinyl Chloride) jacket
 - .1 Minimum thickness: 20 mil
 - .2 Maximum permeability: 0.09 perms
 - .3 Premoulded one-piece fitting covers
 - .4 Tape: vinyl, pressure sensitive, colour matched
 - .5 Acceptable manufacturers:
 - .1 Johns Manville - Manville Zeston 2000
 - .2 ACWIL Insulations
 - .3 Sure Fit Systems
- .3 Metal jacket
 - .1 Aluminum: stucco embossed, minimum 0.45 mm thick
 - .2 Stainless steel: corrugated, minimum 0.25 mm thick
 - .3 Fittings: custom made, swaged ring or lobster back style on bends, die shaped over fittings, valves, strainers and flanges
 - .4 Bands: 13 mm wide stainless steel with mechanical fasteners
 - .5 Acceptable manufacturers:
 - .1 Alcan Canada Products - Thermo-clad Type 1
 - .2 Childers Products Inc - Fab straps

2.3 **ADHESIVES**

- .1 Contact bond cement
 - .1 Quick setting for metal surfaces
 - .2 Acceptable manufacturers:
 - .1 Monsey Bakor - 200-37
 - .2 Foster - 85-75
- .2 Lap seal adhesive
 - .1 For joints and lap sealing of vapour barriers
 - .2 Acceptable manufacturers:
 - .1 Monsey Bakor - 230-39
 - .2 Foster - 85-75
- .3 Contact adhesive
 - .1 Acceptable manufacturers:
 - .1 Foster - 85-20
- .4 Lagging adhesive
 - .1 Acceptable manufacturers:
 - .1 Monsey Bakor - 120-18
 - .2 Foster - 30-36

2.4 **MASTIC**

- .1 Interior:
 - .1 Acceptable manufacturers:
 - .1 Monsey Bakor - 120-19
 - .2 Foster - 30-35
- .2 Exterior, with vapour barrier:
 - .1 Acceptable manufacturers:
 - .1 Monsey Bakor - 130-11
 - .2 Foster - 65-07
- .3 Exterior, breather type:
 - .1 Acceptable manufacturers:
 - .1 Childers - CP-10
- .4 Exterior - aluminum colour finish:
 - .1 Acceptable manufacturers:
 - .1 USE Hickson - Hydroshield Mastic 451 with "Stormking" aluminum coating

2.5 **MISCELLANEOUS PRODUCTS**

- .1 Sealants:
 - .1 Acceptable manufacturers:
 - .1 Monsey Bakor - 230-39
 - .2 Foster - 30-80
 - .2 Vapour barrier tape
 - .1 Colour matched, foil faced vapour barrier tape
 - .2 75 mm wide
 - .3 Vinyl backed or foil backed to suit insulation
 - .4 Acceptable manufacturers:
 - .1 Johns Manville - Zeston Z-tape
 - .2 MacTac Canada Ltd - Vinyl Scrim or Foil Scrim Kraft
 - .3 Compac Corp
 - .4 Fattal Canvas Inc
 - .3 Bands
 - .1 Stainless steel or galvanized metal, 12 mm wide with mechanical cinch locks.
 - .4 Insulation cement
 - .1 Acceptable manufacturers:
 - .1 Partek - Hilcote
 - .5 Vapour barrier insulation coating
 - .1 Acceptable manufacturers:
 - .1 Monsey Bakor - 130-11
 - .2 Foster - 60-38
 - .6 Weld pins, studs and clips
 - .1 Acceptable manufacturers:
 - .1 Midwest Fasteners Inc
 - .2 Continental Studwelding
 - .3 AGM
 - .7 Caulking
 - .1 Fast-drying colour matched flexible butyl elastomer based vapour barrier sealant.

PART - 3 EXECUTION

3.1 APPLICATION

.1 General

- .1 Perform insulation work using qualified insulating applicators, in accordance with latest trade application methods and to the Consultant's approval.
- .2 Clean all surfaces to be insulated to remove grime, grease, oil, moisture or other matter to ensure that insulation is applied to clean and dry surfaces.
- .3 Apply insulation under ambient temperature conditions in accordance with insulation or adhesive manufacturer's recommendations.
- .4 Do not apply insulation until such time as installation and testing of piping, ductwork and equipment has been inspected, verified, and accepted by General Contractor.
- .5 Apply insulation neatly and tightly in unbroken lengths and with ends of sections firmly and squarely butted together. Lap canvas (or other specified wrapping) well over joints and cement down well with adhesive.
- .6 At wall sleeves: extend insulation through to make insulation continuous.
- .7 At fire walls: terminate insulation at wall, and pack space between wall sleeve and duct or pipe as specified in Section 23 05 01.

.2 Treatment of existing insulation

- .1 Where new piping or ductwork systems connect to existing and where existing insulation is damaged through installation of new work, remove damaged sections of insulation for a minimum of 1 m and replace and finish to match existing.

.3 Equipment

.1 Type E1

- .1 Apply insulation with manufacturer's recommended adhesive with 100% coverage.
- .2 Build up voids with insulation to allow finishing layer to be installed in a single plane.
- .3 Joints: file a longitudinal stapling flange and staple joints and seal with (mastic) (vapour barrier tape); seal butt end joints with (mastic) (vapour barrier tape).
- .4 Insulate fittings, unions, flanges and valves with preformed block insulation or with segments cut from insulation of same type and thickness as pipe insulation.
- .5 Form insulation on fittings and valves without voids. Secure in place with galvanized metal bands.

.2 Type E2

- .1 Fasten insulation onto pins welded onto equipment. Weld pins on 400 mm centres. **DO NOT WELD PINS TO PLATE HEAT EXCHANGERS.**
- .2 On round surfaces, cut insulation into sections and secure with bands and wire mesh. Build up voids with insulation to allow finishing layer to be installed in a single plane.

- .3 Insulate fittings, unions, flanges and valves with preformed block insulation or with segments cut from insulation of same type and thickness as pipe insulation.
- .4 Form insulation on fittings and valves without voids. Secure in place with galvanized metal bands.
- .3 Type E3 and E4
 - .1 Fasten insulation onto pins welded onto equipment. Weld pins on 400mm centres. **DO NOT WELD PINS TO PLATE HEAT EXCHANGERS.**
 - .2 Insulate fittings, unions, flanges and valves with preformed block insulation or with segments cut from insulation of same type and thickness as pipe insulation.
 - .3 Form insulation on fittings and valves without voids. Secure in place with galvanized metal bands.
- .4 Type E5
 - .1 Apply insulation with manufacturer's recommended adhesive with 100% coverage.
 - .2 Build up voids with insulation to allow finishing layer to be installed in a single plane.

3.2 **INSULATION SELECTION**

- .1 Plumbing equipment:
 - .1 Insulate the following systems:

System	Size	Max. Op. Temp °C (°F)	Insulation Type	Insulation Thickness mm
Water meters	All	16 (60)	E5	19

3.3 **FINISH**

- .1 Equipment
 - .1 Finish exposed equipment in accordance with the following:

System	Equipment	Fittings, Valves, etc
E1	Canvas	Canvas
E2	Canvas	Canvas
E3	Metal mesh, cement and canvas	Canvas
E4	Metal mesh, cement and canvas	Canvas
E5	None	None

- .2 General
 - .1 Canvas installation
 - .1 Do not apply canvas to elastomeric closed cell foam insulation.
 - .2 Securely paste canvas on with a two coat application of fire resistive lagging adhesive over the entire surface. Apply canvas between coats of adhesive, while first coat is still wet. Stretch canvas tightly and smoothly with overlapping seams located where least visible. Apply second coat of adhesive immediately following application of canvas. Do not use metal bands.
 - .3 Seal canvas with off-white sizing to leave a smooth non-porous surface ready to receive paint application.
 - .2 Equipment insulated with elastomeric foam insulation (E5):
 - .1 Finish with one coat of white acrylic latex as recommended by insulation manufacturer.
 - .3 Do not allow mastic materials to come in contact with single ply membrane roofs.
 - .4 Clean up accidentally spills immediately.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section including, but not limited to, the following:
 - .1 Thermal insulation to piping, ductwork and equipment.

1.2 WORK NOT INCLUDED

- .1 The following items are not to be insulated, or are factory insulated.
 - .1 Piping:
 - .1 Fire protection piping.
 - .2 Vertical sections of exposed sanitary drainage piping

1.3 RELATED WORK

- .1 The following work is provided under other Sections or Divisions of the Work:
 - .1 Cold piping insulation shields: Section 23 05 29.
 - .2 Internal acoustic insulation of ductwork: Section 23 33 00.
 - .3 Factory insulated ductwork: Section 23 33 00.

1.4 REFERENCE STANDARDS

- .1 General
 - .1 Provide insulation materials and adhesives of fire retardant type with flame spread and smoke developed ratings not exceeding ULC, Government, or Municipal standards.
 - .2 Fire retardant materials with flame spread/smoke developed ratings not exceeding 25/50 when tested in accordance with CAN/ULC-S102, and complying with the requirements stated in the building code having jurisdiction.
 - .3 Identify insulation, coverings and adhesives where required by Federal and/or Provincial health and safety WHMIS legislation.
 - .4 Asbestos-free materials.
 - .5 All sealants, mastics, and adhesives shall meet LEED requirements for low VOC emitting materials: 80 g/l for fibreglass, 250 g/l for sealants.
 - .6 Comply with ASHRAE 90.1 for energy losses thru piping insulation.
- .2 Reference Standards
 - .1 Comply with the latest edition of:
 - .1 NFPA 90-A
 - .2 NFPA 255, determination of flame spread rating and smoke development
 - .3 CAN/ULC-S102, determination of flame spread rating and smoke development
 - .4 ASTM C-411, materials testing

1.5 **SUBMITTALS**

- .1 Samples
 - .1 Before ordering insulation materials prepare sample board on which mount cross-section sample of types of insulation, including exterior jacket, properly identified for various services and equipment on project. State types of adhesives.
 - .2 Submit sample board to Consultant for review. After review and acceptance keep sample board in Consultant's site office for duration of project for reference. No deviation from accepted samples will be allowed.

1.6 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 General
 - .1 Retain insulation materials in original cartons or containers until immediately prior to application and store in dry location.
 - .2 Keep adhesives in their original containers with manufacturer's name and catalogue number clearly stated. Protect contents against freezing.

1.7 **DEFINITIONS**

- .1 For the purposes of this Section, the following definitions apply:
 - .1 "Conditioned supply ducts" - ductwork conveying air which has either been heated or cooled.
 - .2 "Concealed" - mechanical services and equipment located in: ceiling spaces above solid drywall and T-bar ceilings; space beneath raised floors; vertical service shafts; trenches; and non-accessible chases and furred spaces.
 - .3 "Exposed" - mechanical services and equipment in all other spaces not considered to be "concealed" as defined above.
 - .4 "Cold Piping" - piping carrying fluids at temperatures below 16°C (60°F).

PART - 2 PRODUCTS

2.1 **PIPE INSULATION**

- .1 Type P1
 - .1 Fiberglas: to ASTM C547
 - .2 Rigid, split formed with pressure sensitive longitudinal adhesion strip
 - .3 Reinforced all service vapour retarder jacket:
 - .4 Operating temperatures: -40 to 454°C (-40 to 850°F)
 - .5 k value: 0.042 W/m°C @ 93°C
 - .6 Acceptable Manufacturers
 - .1 Owens Corning - SSL-II
 - .2 Johns Manville - Micro-Lok with AP-T plus jacket
 - .3 Manson Alley - K with all purposed APT jacket
 - .4 Knauf Pipe Insulation with ASJ-SSI jacket

- .2 Type P2
 - .1 Inorganic mineral fibre: to ASTM C547
 - .2 Rigid, split formed, moulded insulation
 - .3 Maximum operating temperature: 648°C (1200°F)
 - .4 k value: 0.058 W/m°C @ 176°C
 - .5 Tie wire: 0.045 mm (16 ga) stainless steel with twisted ends, on maximum 300 mm centres
 - .6 Acceptable manufacturers
 - .1 Johns Manville - Thermo 12 Gold
 - .2 Calsilite
- .3 Type P3
 - .1 Closed cell elastomeric: to ASTM C534
 - .2 Preformed, with self closing adhesion strips
 - .3 k value: 0.04 W/m°C @ 82°C
 - .4 Maximum operating temperature: 82°C (180°F)
 - .5 Acceptable manufacturers:
 - .1 Armstrong - AP/Armaflex Self Seal Pipe Insulation
 - .2 Rubatex - 25-50
 - .3 Nomaco - IMC04 Polyolefin Foam
- .4 Type P4
 - .1 CFC-free rigid phenolic insulation: to ASTM C1126
 - .2 Rigid, split formed and sidewall segmented, depending on size
 - .3 Reinforced all service low permeance vapour retarder jacket
 - .4 Operating temperatures: -180°C to 120°C
 - .5 K value: 0.019 W/mK @ 24°C
 - .6 Density: 35 kg/m³
 - .7 Acceptable manufacturers:
 - .1 Kingspan - Koolphen K
- .5 Type P5 - Cold Piping Support Inserts
 - .1 CFC-free rigid phenolic insulation: to ASTM C1126
 - .2 Rigid, split formed and sidewall segmented, depending on size
 - .3 Reinforced all service low permeance vapour retarder jacket
 - .4 Operating temperatures: -180°C to 120°C
 - .5 K value: 0.019 W/mK @ 24°C
 - .6 Density, up to NPS 10: 60 kg/m³
 - .7 Density, NPS 12 and over: 80 kg/m³

- .8 Acceptable manufacturers:
 - .1 Kingspan - Koolphen K Pipe Support Inserts

2.2 **INSULATION FINISH**

- .1 Canvas jacket
 - .1 ULC listed plain weave cotton fabric
 - .2 Weight: 220 gm/m²
 - .3 Acceptable manufacturers:
 - .1 Fattal's Thermocanvas
- .2 PVC (Polyvinyl Chloride) jacket
 - .1 Minimum thickness: 20 mil
 - .2 Maximum permeability: 0.09 perms
 - .3 Premoulded one-piece fitting covers
 - .4 Tape: vinyl, pressure sensitive, colour matched
 - .5 Acceptable manufacturers:
 - .1 Johns Manville - Manville Zeston 2000
 - .2 ACWIL Insulations
 - .3 Sure Fit Systems
- .3 Metal jacket
 - .1 Aluminum: stucco embossed, minimum 0.45 mm thick
 - .2 Stainless steel: corrugated, minimum 0.25 mm thick
 - .3 Fittings: custom made, swaged ring or lobster back style on bends, die shaped over fittings, valves, strainers and flanges
 - .4 Bands: 13 mm wide stainless steel with mechanical fasteners
 - .5 Acceptable manufacturers:
 - .1 Alcan Canada Products - Thermo-clad Type 1
 - .2 Childers Products Inc - Fab straps

2.3 **ADHESIVES**

- .1 Contact bond cement
 - .1 Quick setting for metal surfaces
 - .2 Acceptable manufacturers:
 - .1 Monsey Bakor - 200-37
 - .2 Foster - 85-75
- .2 Lap seal adhesive
 - .1 For joints and lap sealing of vapour barriers

- .2 Acceptable manufacturers:
 - .1 Monsey Bakor - 230-39
 - .2 Foster - 85-75
- .3 Contact adhesive
 - .1 Acceptable manufacturers:
 - .1 Foster - 85-20
- .4 Lagging adhesive
 - .1 Acceptable manufacturers:
 - .1 Monsey Bakor - 120-18
 - .2 Foster - 30-36
- 2.4 **MASTIC**
 - .1 Interior:
 - .1 Acceptable manufacturers:
 - .1 Monsey Bakor - 120-19
 - .2 Foster - 30-35
 - .2 Exterior, with vapour barrier:
 - .1 Acceptable manufacturers:
 - .1 Monsey Bakor - 130-11
 - .2 Foster - 65-07
 - .3 Exterior, breather type:
 - .1 Acceptable manufacturers:
 - .1 Childers - CP-10
 - .4 Exterior - aluminum colour finish:
 - .1 Acceptable manufacturers:
 - .1 USE Hickson - Hydroshield Mastic 451 with "Stormking" aluminum coating
- 2.5 **MISCELLANEOUS PRODUCTS**
 - .1 Sealants:
 - .1 Acceptable manufacturers:
 - .1 Monsey Bakor - 230-39
 - .2 Foster - 30-80
 - .2 Vapour barrier tape
 - .1 Colour matched, foil faced vapour barrier tape
 - .2 75 mm wide
 - .3 Vinyl backed or foil backed to suit insulation

- .4 Acceptable manufacturers:
 - .1 Johns Manville - Zeston Z-tape
 - .2 MacTac Canada Ltd - Vinyl Scrim or Foil Scrim Kraft
 - .3 Compac Corp
 - .4 Fattal Canvas Inc
- .3 Bands
 - .1 Stainless steel or galvanized metal, 12 mm wide with mechanical cinch locks.
- .4 Insulation cement
 - .1 Acceptable manufacturers:
 - .1 Partek - Hilcote
- .5 Vapour barrier insulation coating
 - .1 Acceptable manufacturers:
 - .1 Monsey Bakor - 130-11
 - .2 Foster - 60-38
- .6 Weld pins, studs and clips
 - .1 Acceptable manufacturers:
 - .1 Midwest Fasteners Inc
 - .2 Continental Studwelding
 - .3 AGM
- .7 Caulking
 - .1 Fast-drying colour matched flexible butyl elastomer based vapour barrier sealant.

PART - 3 EXECUTION

3.1 APPLICATION

- .1 General
 - .1 Perform insulation work using qualified insulating applicators, in accordance with latest trade application methods and to the Consultant's approval.
 - .2 Clean all surfaces to be insulated to remove grime, grease, oil, moisture or other matter to ensure that insulation is applied to clean and dry surfaces.
 - .3 Apply insulation under ambient temperature conditions in accordance with insulation or adhesive manufacturer's recommendations.
 - .4 Do not apply insulation until such time as installation and testing of piping, ductwork and equipment has been inspected, verified, and accepted by General Contractor.
 - .5 Apply insulation neatly and tightly in unbroken lengths and with ends of sections firmly and squarely butted together. Lap canvas (or other specified wrapping) well over joints and cement down well with adhesive.
 - .6 At wall sleeves: extend insulation through to make insulation continuous.

- .7 At fire walls: terminate insulation at wall, and pack space between wall sleeve and duct or pipe as specified in Section 23 05 01.
- .2 Treatment of existing insulation
 - .1 Where new piping or ductwork systems connect to existing and where existing insulation is damaged through installation of new work, remove damaged sections of insulation for a minimum of 1 m and replace and finish to match existing.
- .3 Piping
 - .1 General
 - .1 Neatly finish insulation at pipe hangers, supports, sensors and interruptions.
 - .2 At expansion joints in piping: apply insulation over sleeve of 1.6 mm metal, fabricated to fit around expansion joint without restricting movement of joint.
 - .3 Provide sleeves which can be removed without damage to adjoining insulation to allow repacking and lubrication of expansion joint.
 - .4 Provide sleeves minimum of 75 mm longer than expansion joint and fitted with insulation retaining flanges and with means for maintaining position of sleeve over expansion joint.
 - .2 Type P1
 - .1 Lap and seal all joints (longitudinal and transverse). Use vapour barrier tape on transverse joints. Locate longitudinal joints on top of pipe.
 - .2 Insulate fittings, unions, flanges and valves with preformed block insulation or with segments cut from insulation of same type and thickness as pipe insulation.
 - .3 Form insulation on fittings and valves without voids. Secure in place with galvanized metal bands.
 - .3 Type P2
 - .1 Seal all joints (longitudinal and transverse). Secure in place with metal bands at 230 mm centres. Use vapour barrier tape on transverse joints.
 - .2 Insulate fittings, and flanges with preformed block insulation or with segments cut from insulation of same type and thickness as pipe insulation.
 - .1 Exception: steam valves NPS 2 and smaller on in low pressure steam piping
 - .2 Form insulation on fittings and valves without voids. Secure in place with metal bands.
 - .3 Finish with insulating and finishing cement.
 - .3 Insulate valves with removable "box" insulation blocks. Ensure top spindle and wheel/lever are free running and clear of insulation and covering.
 - .4 Stop insulation on each side of unions and at connections to equipment.
 - .4 Type P3
 - .1 Lap and seal all joints (longitudinal and transverse). Use vapour barrier tape on transverse joints. Locate longitudinal joints on top of pipe.

- .5 Type P4 and P5
 - .1 Lap and seal all joints (longitudinal and transverse). Use vapour barrier tape on transverse joints. Locate longitudinal joints on top of pipe.
 - .2 Seal ends of insulation with mastic matching finish colour of insulation.
- .6 Drainage systems
 - .1 Insulate above ground sanitary drainage systems (above finished ceiling areas).
- .7 Insulation termination points
 - .1 Terminate 75 mm from fittings, fittings to be covered with preformed block insulation.
 - .2 Bevel insulation at 45 degree angle away from fitting
 - .3 Finish exposed face with insulating and finishing cement
- .8 Insulation protection inserts - cold piping systems under 15°C
 - .1 Place an insert between support with insulation shield and pipe on cold piping NPS 1½ and larger
 - .2 Fabricate insert from Type P5 insulation
 - .3 Insert length: extending a minimum 150 mm beyond each end of insulation shield
 - .4 Insert circumference: 360 degrees
 - .5 Insulation shield: to Section 23 05 29
 - .6 Where insert material actual thickness is different from the actual thickness of the adjacent insulation, shave the insert to an equal thickness of the adjacent insulation
 - .7 Bond the insulation shield to the insulation insert with adhesive and finish and seal complete assembly with vapour barrier insulation coating to form an unbroken vapour barrier, or,
 - .8 Finish insulation insert as part of the main pipe insulation, and provide two metal band clamps for each insulation shield and strap the shield to the finished pipe insulation.

3.2 INSULATION SELECTION

- .1 HVAC piping: Insulate the following systems:

System	Max. Op. Temp °C (°F)	Pipe Size NPS	Insulation Type	Insulation Thickness mm
Equipment drain lines, safety valve vents, relief valve vents, etc.	110 (230)	All	P1	25
Chilled water piping	16 (60)	All	P1, P4	25
Hot water heating piping	93 (200)	All	P1	38

Note 1: two layers of 25 mm thickness, overlapped butt joints.

.2 Plumbing piping: Insulate the following systems:

System	Max. Op. Temp °C (°F)	Pipe Size	Insulation Type	Insulation Thickness mm
Domestic cold water piping	27 (80)	All	P1, P4	25
Domestic hot water piping	82 (180)	Up to 2 2½ and over	P1 P1	25 38
Sanitary drainage piping	38 (100)	All	P1	25
Hot water supplies to barrier free use lavatories	82 (180)	All	P1	12

3.3 **FINISH**

.1 Piping

.1 Finish exposed piping in accordance with the following:

System	Pipe	Fittings, Valves, etc
P1	Canvas	Canvas
P2	Canvas	Canvas
P3	None	None
P1 Barrier Free Use	Canvas	Canvas

.2 General

.1 Canvas installation

- .1 Do not apply canvas to elastomeric closed cell foam insulation.
- .2 Securely paste canvas on with a two coat application of fire resistive lagging adhesive over the entire surface. Apply canvas between coats of adhesive, while first coat is still wet. Stretch canvas tightly and smoothly with overlapping seams located where least visible. Apply second coat of adhesive immediately following application of canvas. Do not use metal bands.
- .3 Seal canvas with off-white sizing to leave a smooth non-porous surface ready to receive paint application.

.2 Piping insulated with elastomeric foam insulation (P3):

- .1 Indoors and outdoors - finish with one coat of white acrylic latex as recommended by insulation manufacturer.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

- .1 Labour, products, equipment and services necessary to complete the work of this Section including but not limited to the following:
 - .1 Performance testing liquid systems
 - .2 Survey of installed automatic controls and verification of functional performance
 - .3 Refer to other sections of this specification, especially 01 81 20, Commissioning General Requirements and 01 73 21, Equipment Procedures.
 - .4 The General Contractor shall hire directly the Commissioning Company/Contractor.
 - .5 Perform commissioning and start-up/performance testing of all new systems.

1.2 RELATED WORK

- .1 Factory testing, and calibrating of equipment or control systems.
- .2 Testing and checking of equipment supplied by other Divisions, except where such equipment forms an integral part of the mechanical systems.

1.3 RELATED WORK IN OTHER CONTRACTS

- .1 Air and water balancing: separate contract, covered in Sections 01 81 20 and 23 08 16.

1.4 SUBMITTALS

- .1 Submit layout drawings and Report Format a minimum 14 days prior to start of air and water balancing on-site.
 - .1 Report Format
 - .1 Submit proposed format of initial report.
 - .2 Include a complete list of instruments and tests for which they are to be used as they relate to this project, including date of last calibration

PART - 2 PRODUCTS

2.1 NOT APPLICABLE

PART - 3 EXECUTION

3.1 REQUIRED REPORTS

- .1 Provide the following Start-Up and Performance Testing reports:
 - .1 Equipment start-up report
 - .2 Authorities report

- .3 Controls / BMS operation report
 - .2 Report Format
 - .1 Prepare test forms in MS Excel or Word format. Results of tests may be filled in by hand.
 - .2 Include the following header information for each test report:
 - .1 Owner Name
 - .2 Project Name
 - .3 Contractor Name
 - .4 Consultant Name
 - .5 Name of Test Report
 - .3 Include the following on the front sheet of the consolidated report:
 - .1 Contractor Company Name
 - .2 Name and signature of the person submitting the report
 - .3 Date of report
 - .4 The following statement: "The undersigned certifies that the test results recorded in this report are correct, and that results have been witnessed by the trade responsible for the test".
 - .3 Submit the above tests in a hardcopy form, separately bound from the Operations and Maintenance manuals, and in Adobe Acrobat PDF format, in accordance with Section 01 45 00.
- 3.2 **EQUIPMENT START-UP REPORT**
- .1 Provide a consolidated test report for all equipment, including the following start-up tests:
 - .1 Equipment/System Summary tests
 - .2 Equipment/System start-up test.
 - .3 Manufacturer's start-up test
 - .2 Equipment/System Summary Tests
 - .1 Provide a test report in spreadsheet format which summarizes the following data for each piece of equipment which is powered or has automatic controls:
 - .1 Equipment ID and name
 - .2 Motor rotation (bump test) - result and initialed by contractor
 - .3 Equipment Start-Up report status - status and initialed by contractor
 - .4 Manufacturer Start-Up report status – status and initialed by contractor
 - .5 Test completion date
 - .2 Provide a test report in spreadsheet format which summarizes the following data for pressure testing of piping systems:
 - .1 System name
 - .2 System limits (if system is not tested in its entirety)
 - .3 Type of test (pneumatic, hydrostatic)

- .4 Pressure at start of test
- .5 Pressure at end of test
- .6 Duration of test
- .7 Contractor dated and initialed.
- .3 Provide a test report in spreadsheet format which summarizes the following tests for equipment served by liquid.
 - .1 Equipment ID and name
 - .2 Isolation valves are in the open position – status and initialed by contractor
- .3 Equipment/System Start-Up Test Report
 - .1 Provide a separate start-up report for each piece of the following equipment. The SMACNA “Systems Ready to Balance Check List”, where applicable, may be used for this report.
 - .1 Pumps
- 3.3 **AUTHORITIES REVIEW**
 - .1 Submit copies of authorities-having-jurisdiction inspection and test reports, including:
 - .1 Plumbing and drainage municipal inspector reports
 - .2 ESA field certification reports
- 3.4 **CONROLS / BUILDING MANAGEMENT SYSTEM**
 - .1 Provide controls test reports.
- 3.5 **DEFICIENCIES**
 - .1 Immediately report to Consultant, any deficiencies in the systems or equipment performance resulting in design requirements being unobtainable.
- 3.6 **DRAFT REPORT**
 - .1 On completion of the start-up, testing, adjusting and balancing of all systems, submit to the Consultant, two (2) typewritten copies of a full report on all tests, adjustments, and balancing performed, including the following:
 - .1 Summary of all systems
 - .2 Testing methods and instrumentation
 - .3 Start-up reports
 - .4 Authorities having jurisdiction reports
 - .2 After review by the Consultant and at the Consultants direction, retest up to 10% of all measurements in locations as directed by the Consultant, at no cost extra to the contract.
- 3.7 **INTERIM REPORT**
 - .1 After completion of any retesting described above, submit three (3) typewritten copies of the interim report, in a 3-hole “D” style binder, and electronic copy in Adobe Acrobat PDF format.
 - .2 This report is required to obtain Substantial Performance of the Contract.

3.8 **FINAL REPORT**

- .1 Submit to Consultant following completion of alternate season testing and balancing. Submit three (3) typewritten copies and Adobe PDF in the same formats as the initial report specified above.

3.9 **SPOT CHECKS**

- .1 Before acceptance of the air and water balancing report, the Consultant may request to witness spot-checks of the report results.
- .2 If results indicate unusual testing inaccuracy, omissions, or incomplete balancing/adjustment, in the opinion of the Consultant, re-balance entire affected system(s) at no increase in Contract Price.

3.10 **ACCEPTANCE**

- .1 The Substantial Performance of the Mechanical Work will be considered reached when the interim Start-Up and Performance Testing report is accepted by the Consultant and in the opinion of the Consultant all systems have been satisfactorily installed, operated tested, balanced, and adjusted to meet the specified and intended performance.
- .2 The substantial performance will not depend upon alternate season testing as specified hereafter, however, make such relevant repairs or modifications deemed necessary during this re-checking as part of the guarantee of the work.
- .3 The total performance of the Mechanical Subcontract (Contract) will not be considered reached until the alternate season testing and balancing is completed and the final report submitted and accepted by the Consultant.

3.11 **ADDITIONAL TESTING**

- .1 The Consultant may request such additional testing in connection with this project as he deems necessary.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

- .1 Labour, products, equipment and services necessary to complete the work of this Section including but not limited to the following:
 - .1 Performance testing and balancing of heating, ventilating, air conditioning and liquid systems – hydronic. Include labour for sheaves replacement and coordination of works with related Mechanical and Trades. The Mechanical Contractor shall provide the sheaves to the Balancing Contractor.
 - .2 Balance and Test systems installed under this Contract.
 - .3 Measuring and reporting all specified space noise levels
 - .4 Rechecking of testing and balancing during the alternate (heating/cooling) season
 - .5 Also refer to Sections 01 81 20, Commissioning General Requirements, and 01 73 21 - Equipment Procedures.
 - .6 General Contractor shall hire directly the Testing and Balancing Contractor.

1.2 RELATED WORK IN OTHER SECTIONS

- .1 Factory testing, and calibrating of equipment or control systems.
- .2 Testing and checking of equipment supplied by other Divisions, except where such equipment forms an integral part of the mechanical systems.

1.3 EXCLUDED SYSTEMS/EQUIPMENT

- .1 The following systems do not require air and water balancing:
 - .1 Domestic cold water
 - .2 Domestic hot water

1.4 QUALIFICATIONS

- .1 Perform testing and balancing of air and water systems by an accredited Testing and Balancing Firm who is a member of the Associated Air Balance Council (AABC), and/or National Environmental Balancing Bureau (NEBB).
 - .1 Acoustic and vibration measurements may be performed by a specialist sub-contractor to the Testing and Balancing Firm.

1.5 PERFORMANCE STANDARDS

- .1 Perform testing and balancing in accordance with the current issue of:
 - .1 Associated Air Balance Council Standards for Total System Balance
 - .2 SMACNA “*Testing, Adjusting and Balancing*” guidelines.
- .2 Instruments: recently calibrated; state date of calibration in the report.

1.6 **COORDINATION**

.1 General

- .1 Review with affected Trades before fabrication, the location of balancing devices, test connections and access openings and report conditions which could affect optimum system performance.
- .2 By inspection, assure that all testing, balancing and metering devices are installed properly and in pre-selected locations.
- .3 The Mechanical Subcontractor will obtain the approval of the Testing and Balancing Firm before relocating these devices due to field conditions.
- .4 Coordinate efforts so that items requiring replacement and/or delivery time (sheaves, motors, etc.) are tested as early as possible.

.2 The Mechanical Subcontractor and/or associated sub-contractors will provide the following assistance and/or services to the Testing and Balancing firm.

- .1 Schedule sufficient time so that initial testing and balancing can be completed before occupancy begins and coordinate with trades involved.
- .2 Keep Testing and Balancing firm informed of any major changes made during construction and furnish same with a set of project drawings and reviewed Shop Drawings.
- .3 Furnish balancing devices, test connections access openings, balancing probe inlets and plugs.
- .4 Clean and pre-run all equipment, filters, etc. and place all heating, ventilating and air conditioning systems into full operation and continue same during each working day of testing and balancing.
- .5 Provide immediate labour from pertinent mechanical trades and tools, equipment and materials to make equipment and system alterations and adjustments, as required including control adjustments.
- .6 Building Management System technical representative to operate the BMS during air and water balancing testing.
- .7 Make available all equipment data (Shop Drawing Performance Data and operating instructions) to the Testing and Balancing Firm.

.3 As part of the coordination effort, the Mechanical Subcontractor will be fully responsible for systems constructed, installed and adjusted to provide optimum performance as required by design intent. Any re-adjusting required as the result of spot checks by the Consultant shall be done at no increase in Contract Price.

1.7 **DEFINITIONS**

.1 "Balancing"

- .1 To proportion and regulate flows within the distribution system (subsystems, branches, mains, terminals, etc.) at appropriate pressures in accordance with the design intent. This includes setting discharge volume and patterns of terminal devices, and individual return and exhaust air volumes.

.2 "Testing"

- .1 To measure, interpret and report in writing, such parameters as may be required to verify design compliance and as specified herein.

1.8 SUBMITTALS

- .1 Submit layout drawings and Report Format a minimum 14 days prior to start of air and water balancing on-site.
 - .1 Layout Drawings
 - .1 Identify specific locations of all adjusting, balancing and permanent measuring devices, neatly marked on a set of plans for approval by the Consultant. A set of reproducible drawings will be furnished by the Consultant for this purpose.
 - .2 Propose, for review by the Consultant, additional devices deemed advisable for satisfactory operation and completion of the mechanical work of the Mechanical Division.
 - .2 Report Format
 - .1 Submit proposed format of initial report.
 - .2 Include a complete list of instruments and tests for which they are to be used as they relate to this project, including date of last calibration

PART - 2 PRODUCTS

2.1 **NOT APPLICABLE**

PART - 3 EXECUTION

3.1 REQUIRED REPORTS

- .1 Provide the following Start-Up and Performance Testing reports:
 - .1 Air and water balancing report
 - .2 Acoustic survey report
 - .3 Alternate Season test report; Heating Season, Cooling Season.
- .2 Report Format
 - .1 Prepare test forms in MS Excel or Word format.
 - .2 Include the following header information for each test report:
 - .1 Owner Name
 - .2 Project Name
 - .3 Contractor Name
 - .4 Consultant Name
 - .5 Name of Test Report
- .3 Submit the above tests in a hardcopy form, separately bound from the Operations and Maintenance manuals, and in Adobe Acrobat PDF format.

3.2 AIR AND WATER BALANCING

.1 Site Visits

- .1 Visit the site as required prior to testing and balancing systems and advise respective trades of this Section's requirements for probe inlets etc. Submit a report to the Consultant after each site visit.
- .2 Testing and balancing shall be performed on systems installed under this Contract.
- .3 Test and balance flows from new hydronic system.

.2 Balancing Tolerances

- .1 Balance all systems to the performance parameters indicated on drawings and in the specifications.
- .2 If interpretation, clarification or additions to performance parameters are required, request such information from the Consultant.

.3 Balancing Tolerances

.1 Air Flow Rates

Under 70 L/S	10% of flow
Over/at 70 L/S	5% of flow

.2 Water Flow Rates

Hydronic Heating	5% of flow
Chilled Water	2% of flow

.4 Drawing Review

- .1 Review all pertinent plans, specifications, Shop Drawings, interference drawings and other documentation to become fully familiar with the systems and their specified and intended performance.

.5 Air Systems

- .1 Simulate full heating and cooling conditions. Record sufficient data to verify compliance with design requirements.
- .2 Balance air systems within acceptable tolerances before water systems are balanced.

.6 Hydronic Systems

- .1 Simulate full heating and cooling conditions. Record sufficient data to verify compliance with design requirements.
- .2 Balance water systems within acceptable tolerances before air systems are balanced.

.7 Data Required

- .1 Submit the following data as a minimum. If contractor's standard forms provide for additional data, also submit such additional data. Indicate if tests were not specifically made. Do not repeat design data or other values not specifically tested.
- .2 Motors:
 - .1 Manufacturer

- .2 Model or Serial number
- .3 Rated amperage and voltage
- .4 Rated horsepower
- .5 Rated RPM
- .6 Corrected full load amperage
- .7 Measured amperage and voltage
- .8 Calculated BHP (kW)
- .9 Measured RPM
- .10 Sheave size, type and manufacturer
- .3 Fans:
 - .1 Manufacturer
 - .2 Model or Serial number
 - .3 Rated CFM (L/S)
 - .4 Rated RPM
 - .5 Rated pressures (suction and discharge)
 - .6 Measured CFM (L/S)
 - .7 Measured RPM
 - .8 Measured pressures (suction and discharge)
 - .9 Pulley size, type and manufacturer
 - .10 Belt size and quantity
- .4 Air Systems (Including inlets and outlets):
 - .1 Grille, register or diffuser reference number and manufacturer
 - .2 Grille, register or diffuser location
 - .3 Design velocity
 - .4 Design CFM (L/S)
 - .5 Effective (or free) area factor and size
 - .6 Measured velocity
 - .7 Measured CFM (L/S)

3.3 **ALTERNATE SEASON TESTING**

- .1 Requirements
 - .1 Re-check testing and balancing of the heating, ventilating and air conditioning systems and water flow conditions at flow meter locations at approximately six months after initial testing and balancing has been performed and accepted, as advised by the Consultant.
 - .2 Include items which, because of their seasonal character could not be adequately completed during the initial balancing.
 - .3 Include the reading and recording of temperatures and pressures at all gauges, as well as outdoor and indoor conditions.

- .4 Measure and record the motor amperages and drive RPM of all fans and pumps during re-checking.
- .2 Report
 - .1 Provide an addendum report to the original balancing report, in accordance with the reporting requirements described herein.
- 3.4 **DEFICIENCIES**
 - .1 Immediately report to Consultant, any deficiencies in the systems or equipment performance resulting in design requirements being unobtainable.
- 3.5 **DRAFT REPORT**
 - .1 On completion of the start-up, testing, adjusting and balancing of all systems, submit to the Consultant, two (2) typewritten copies of a full report on all tests, adjustments, and balancing performed, including the following:
 - .1 Summary of all systems
 - .2 Testing methods and instrumentation
 - .3 Air systems testing and balancing data
 - .4 Liquid systems testing and balancing data
 - .5 Attachments including systems schematics with numbered terminals for referring to data above.
 - .2 After review by the Consultant and at the Consultants direction, retest up to 10% of all measurements in locations as directed by the Consultant, at no cost extra to the contract.
- 3.6 **INTERIM REPORT**
 - .1 After completion of any retesting described above, submit three (3) typewritten copies of the interim report, in a 3-hole "D" style binder, and electronic copy in Adobe Acrobat PDF format.
 - .2 This report is required to obtain Substantial Performance of the Contract.
- 3.7 **FINAL REPORT**
 - .1 Submit to Consultant following completion of alternate season testing and balancing. Submit three (3) typewritten copies and two (2) CD-R Adobe PDF in the same formats as the initial report specified above.
- 3.8 **SPOT CHECKS**
 - .1 Before acceptance of the air and water balancing report, the Consultant may request to witness spot-checks of the report results.
 - .2 If results indicate unusual testing inaccuracy, omissions, or incomplete balancing/adjustment, in the opinion of the Consultant, re-balance entire affected system(s) at no increase in Contract Price.
- 3.9 **ACCEPTANCE**
 - .1 The Substantial Performance of the Mechanical Work will be considered reached when the initial Start-Up and Performance Testing report is accepted by the Consultant and in the

opinion of the Consultant all systems have been satisfactorily installed, operated tested, balanced, and adjusted to meet the specified and intended performance.

- .2 The substantial performance will not depend upon alternate season testing, however, make such relevant repairs or modifications deemed necessary during this re-checking as part of the guarantee of the work.
- .3 The total performance of the Mechanical Subcontract (Contract) will not be considered reached until the alternate season testing and balancing is completed and the final report submitted and accepted by the Consultant.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.
 - .2 Refer to other sections of these specifications, especially section 01 81 20, Commissioning General Requirements

1.2 GENERAL

- .1 Provide work of this Section in accordance with the Contract Documents.
- .2 This specification covers commissioning of mechanical systems which are part of the Work.
- .3 Commissioning work shall be a team effort to ensure that all equipment and systems have been completely and properly installed, function correctly to meet the design intent, and to document system performance parameters for fine tuning of control sequences and operational procedures.
- .4 The Commissioning process develops, coordinates, and documents the following:
 - .1 Equipment start-up
 - .2 Control system calibration
 - .3 Testing and balancing
 - .4 Verification and Performance Testing
 - .5 Operation documentation
 - .6 Operator training
- .5 Mechanical system installation, start-up, testing, balancing, preparation of O&M manuals and operator training are the responsibility of the Mechanical Division Subcontractor, with the coordination of the commissioning process the responsibility of the Commissioning Authority in conjunction with the Contractor.
- .6 The Commissioning Program is divided into four parts:
 - .1 Part 1: Verification Testing
 - .2 Part 2: Performance Testing
 - .3 Part 3: Systems Operating Manuals
 - .4 Part 4: Operator Training

1.3 SUBSTANTIAL COMPLETION

- .1 Substantial completion of the Mechanical work requires the following parts of the Commissioning Program to be completed and accepted by the Owner:
 - .1 Part 1: Verification Testing
 - .2 Part 4: Operator Training

- .2 Part 2 – Performance Testing may begin before Substantial Completion and extend upwards of nine (9) months after Substantial Completion, based on seasonal conditions required to obtain test load conditions.

1.4 **WORK INCLUDED**

- .1 Commissioning work of Mechanical Division includes, but is not limited to:
 - .1 Testing and start-up of equipment.
 - .2 Testing, adjusting and balancing of hydronic and air systems.
 - .3 Cooperation with the Commissioning Authority in developing and implementation of the commissioning plan.
 - .4 Providing qualified personnel for participation in commissioning tests, including seasonal testing required after the initial testing.
 - .5 Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the commissioning process.
 - .6 Providing operation and maintenance manuals, (Systems Operating Manuals), and as-built drawings to the Commissioning Authority for verification.
 - .7 Providing training and demonstrations for the systems specified in this Division.
- .2 Conduct complete and thorough evaluation and documentation of the operation and performance of all components, systems, and sub-systems, including the following equipment and systems:
 - .1 Automatic temperature control
 - .2 Air handling systems
 - .3 Cooling generation systems
 - .4 Heating generation systems
 - .5 Hydronic distribution systems
 - .6 Air distribution and exhaust systems
 - .7 Domestic hot water systems
 - .8 Domestic cold water systems
 - .9 Fire protection system
 - .10 Building Management Systems
 - .11 Indoor air quality (IAQ) systems
- .3 Commissioning documentation includes but is not limited to:
 - .1 Progress and status reports, including deficiency lists
 - .2 Verification of Pre-start and Start-up procedures and results
 - .3 Performance testing procedures and results
 - .4 Training agenda and materials
 - .5 As-built records
 - .6 Final Commissioning report
 - .7 Systems Operating Manuals

.8 Operation and maintenance manuals

1.5 **RELATED WORK**

.1 Section 23 08 13 – Start-Up and Performance Testing

1.6 **REFERENCE STANDARDS**

.1 Comply with the latest edition of the following:

.1 ASHRAE Guideline 1-1996 The HVAC Commissioning Process, as amended herein.

1.7 **REPORTING SOFTWARE**

.1 Commissioning documentation to be developed and recorded using the following software:

.1 MS Word

.2 MS Excel

.3 MS Access

.4 Adobe Acrobat – for scanned documents

.5 Photos – scanned or digital - *.jpg format

1.8 **DOCUMENTATION DELIVERABLES**

.1 Identify documents including test documents, binder covers, etc. using equipment ID numbers provided on equipment schedules.

.2 Scan original signed test reports, including verification and performance test reports, manufacturers service reports, etc. in Adobe Acrobat *.pdf format. For original document chapters, provide Adobe chapter referencing.

.3 Digital File Naming Convention:

.1 Store documents with filenames which include the equipment type, ID number, and type of document.

.2 Equipment Type

.1 FP – Fire Protection

.2 PD – Plumbing and Drainage

.3 HG – Heating Generation

.4 CG - Cooling Generation

.5 HV – HVAC

.6 BMS – Building Management System

.3 Equipment ID:

.1 As per equipment schedules / drawings

.4 Document Type:

.1 VT – Verification Test

.2 PT – Performance Test

.3 SOM – Systems Operating Manual

- .4 TM – Training Manual/Material
- .5 Example: A verification test report for air conditioning unit No. 1 tagged AC1
 - .1 HV-AC1-VT.*
- .4 Submit three (3) copies of each Verification and Functional Performance Test reports, both preliminary and final issues.
 - .1 Collate final, accepted and signed test results in separate binders as follows:
 - .1 Fire Protection
 - .2 Plumbing and Drainage
 - .3 HVAC Systems
 - .4 Building Management Systems
 - .5 Submit one (1) draft copy of the SOM in a 8½" x 11" D-ring binder for review. All documents are to be stamped or watermarked as "DRAFT" and identified by issue date and revision letter.
 - .6 Submit the final three (3) copies of the SOM in a 8½" x 11" D-ring binder, white, with insert sleeves on the cover and spine. Provide inserts for the front cover and spine in a form approved by the Commissioning Authority.
 - .7 Provide three (3) CD-R or DVD-R copies of all commissioning documentation. File the documents in directories as follows:
 - .1 Primary directories: Verification / Performance / SOMS / Training
 - .2 Sub-directories: Fire / Plumbing / HVAC / BMS
- 1.9 **SUBMITTALS**
 - .1 Report Samples
 - .1 Provide sample test documentation for each type of equipment and system for review by the Commissioning Authority prior to the start of the Verification Process
 - .1 Pre-start and start-up procedure check list form
 - .2 Verification Test method and results form
 - .3 Functional Performance Test method and results form
 - .4 Operating and Maintenance Manual
- PART - 2 PRODUCTS**
 - 2.1 **TEST EQUIPMENT - GENERAL**
 - .1 Furnish all special tools and equipment required during the commissioning process.
 - .2 Submit a list of tools and equipment to be used during the commissioning process to the Commissioning Authority for approval.
 - .3 Utilities (water, electrical power) will be provided by the Owner
 - 2.2 **TEST EQUIPMENT – PROPRIETARY**
 - .1 Provide any proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not.

- .2 The Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed.
- .3 Proprietary test equipment and software shall become the property of the Owner upon completion of the commissioning process.

PART - 3 EXECUTION

3.1 GENERAL

- .1 Complete all phases of work so that the systems can be started, tested, balanced, and owner's acceptance procedures be undertaken.
- .2 Participate and assist in the development of the Commissioning Plan by the Commissioning Authority, by providing all necessary information pertaining to the equipment and installation. Provide commissioning schedule information to be incorporated into the overall Commissioning Plan schedule.
- .3 Acceptance procedures may begin prior to completion of a system and/or sub-system. Start of acceptance procedures before system completion does not relieve the Contractor from completing those systems in accordance with the commissioning and construction schedule.

3.2 COMMISSIONING MEETINGS

- .1 Pre-construction
 - .1 Participate in a pre-construction meeting of all commissioning team members, to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.
- .2 Construction and Post-Construction
 - .1 Participate in commissioning meetings as scheduled by the Commissioning Authority and Contractor. Identify to the commissioning group problems relating to the commissioning schedule, identification of start-up issues, etc, and participate in the resolution of these problems.

3.3 PARTICIPATION IN ACCEPTANCE PROCEDURES

- .1 Provide skilled technicians to start-up and debug all systems within the Mechanical Division scope of Work. Include for labour, materials, and subsistence costs for these same technicians to assist the Commissioning Authority in completing the commissioning program.
- .2 Provide details regarding work schedules, time commitments, work sequence programming, etc., to the Commissioning Authority, to permit the development and monitoring of a coordinated commissioning schedule.
- .3 Ensure the qualified technician(s) are available and present during commissioning testing to complete the tests, make adjustments and to assist in problem resolutions.
- .4 Should any equipment or system experience performance problems and/or reconstruction or replacement of components is required, include for additional technician time for subsequent retesting of systems until required system performance is achieved.

- .5 The Commissioning Authority reserves the right to approve proposed technicians with regard to the technical skill level required for each type of equipment and/or system, and a willingness by the individual(s) to work within the Commissioning Group.

3.4 **PROBLEM RESOLUTION**

- .1 In the event that additional work is required to correct systems, misapplied equipment, and/or deficient performance under varying load conditions, this work will be carried out under the direction of the Owner. Assist the Owner and Commissioning Authority in developing an acceptable resolution to the problem, including the resources of equipment suppliers.
- .2 The Owner and/or the Consultant has final jurisdiction over any additional work required to achieve the required level of performance.
- .3 Complete corrective work in a timely fashion to permit the completion of the commissioning process.

3.5 **ADDITIONAL COMMISSIONING**

- .1 Additional commissioning activities may be required after completion of system performance testing. Include in the tender cost a reasonable reserve to complete this work, including assistance from manufacturers' service technicians.

3.6 **SEASONAL COMMISSIONING**

- .1 Commence initial performance testing commissioning at the completion of the installation Work and verification testing phase. Conduct performance testing, which is weather dependent, as applicable to current seasonal conditions. Complete performance testing on non-weather dependant systems in accordance with the agreed commissioning plan schedule.
- .2 For out-of-season system performance testing, conduct initial performance tests to demonstrate off-peak load performance. Schedule peak load performance testing over the succeeding nine (9) months to ensure all equipment is tested at peak load prior to the expiry of the construction contract warranty.
 - .1 Test heating equipment/systems during winter design extremes.
 - .2 Test cooling systems during summer design extremes with a fully occupied building.
 - .3 Alternatively, provide temporary equipment (load banks, etc) to simulate full load conditions. Submit proposed methodology for review by the Commissioning Authority and Consultant.

3.7 **REPORT FORMAT**

- .1 Provide separate checklists for each piece of equipment and system tested, including interfaces, interlocks, etc.
 - .1 For checklists generated in MS Excel format, provide a separate file for each piece of equipment; do not store multiple pieces of equipment on separate worksheets in the same file.
- .2 Each item to be checked will be recorded on a separate entry line and include the following information, reading from left to right across the entry:
 - .1 Checklist item No.

- .2 Test description
- .3 Test status – “Pass”, “Fail”, “Not Applicable”
- .4 Deficiency status – “Major”, “Minor”
- .5 Comments
- .3 Deficiency definitions:
 - .1 “Major” – an item which if not corrected renders the equipment or system unsuitable or un-safe for use by the Owner. Major deficiencies must be corrected as a condition for achieving Substantial Completion.
 - .2 “Minor” – an item which does not impact on the operation of the equipment or system and will allow the Owner to use the system safely. Minor deficiencies may be corrected before or after Substantial Completion, but will not prevent certification of Substantial Completion of the Work.

3.8 VERIFICATION TESTS (PART 1)

- .1 Scope of Work
 - .1 Conduct operating tests and checks to verify that all components, equipment, systems, and interfaces between systems, operate in accordance with contract documents.
 - .2 Tests to demonstrate and verify all operating modes, interlocks, specified control sequences, specific responses to abnormal or emergency conditions, and verification of the proper response of the Building Automation System.
 - .3 Validate the results of the TAB report.
 - .1 Roles and Responsibilities:

Verification Testing	
Organized by:	Commissioning Authority
Test sheets provided by:	Mechanical Division contractors
Testing Conducted by:	Mechanical Division contractors
Testing Recorded by:	Mechanical Division contractors
Tests Witnessed by:	Commissioning Authority Design Consultant (optional) Owner (optional)
Reports reviewed by:	Contractor Commissioning Authority Design Consultant
Reports accepted by:	Owner

- .2 Submittals:
 - .1 Submit a copy of each type of equipment and system verification report for approval by the Owner prior to commencement of the Verification Tests.
 - .2 Include any specific test requirements provided by the Owner and/or Consultant in the test reports. These requirements will be provided in MS Word or Excel format.

- .3 Participants in Verification tests:
 - .1 Commissioning Authority: schedules tests and assemblies commissioning team members who are responsible for the implementation, witnessing and documenting the tests.
 - .2 Mechanical Subcontractor: provide the services of qualified technician(s) who are familiar with the construction and operation of the system. Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.
 - .3 Controls Contractor: provide the services of qualified technician(s) who are familiar with the Work. Provide details of the control system, schematics, and a narrative description of control sequences of operation.
 - .4 Electrical Contractor: provide a foreman electrician familiar with the electrical interlocks, interfaces with emergency power supply. Provide access to the contract plans, and all as-built schematics of sub-systems, interfaces and interlocks.
 - .5 Equipment suppliers: provide the services of manufacturers' service personnel to provide assistance with pre-start and initial start-up of the equipment, as required.
- .4 Documentation and Reporting Requirements.
 - .1 Provide separate test records for each piece of equipment and system.
 - .2 Information used to develop the check lists are to include material from the following sources:
 - .1 Manufacturers installation requirements
 - .2 Contractor's own checklists
 - .3 Design consultants checklists
 - .4 Owners checklists
 - .3 Checklists to include the following information:
 - .4 Front cover sheet – Project name, Owner name, equipment ID and name, test date(s), and space for sign-off signatures and dates as follows:
 - .1 Mechanical Subcontractor – “Submitted by”
 - .2 Contractor – “Reviewed by”
 - .3 Design Consultant – “Reviewed by”
 - .4 Commissioning Authority – “Reviewed by”
 - .5 Owner – “Accepted by”
 - .5 Second and subsequent pages to include tests as defined below.
 - .6 Equipment Checklists:
 - .1 Motor, power and drives
 - .2 Equipment piping, between equipment isolation valves
 - .3 Installation pre-start tests specific to the class of equipment
 - .4 Equipment start-up tests specific to the class of equipment
 - .5 Electrical audit for CSA label or ESA field approval label
 - .6 Operator training, including attendee names and dates, and details of manufacturers equipment demonstrations

- .7 Status of As-built documentation, and Operating and Maintenance Manuals reviews
- .7 Piping System Checklists:
 - .1 Hydrostatic and/or pneumatic pressure tests, including date of test, duration, starting and ending pressures, and TSSA inspection reports where required.
 - .2 Municipal plumbing inspector reports attached.
 - .3 NFPA certificates attached (sprinklers)
 - .4 Flushing and cleaning records, including date of cleaning, chemical treatment contractors test reports, volume of fluid in the system and amount of cleaner used.
 - .5 Chemical treatment added; type and quantity, chemical treatment contractor's test reports included.
 - .6 Piping installation, including supports, insulation, vibration isolation, piping identification, valve tagging, valve chains, etc.
 - .7 TAB balancing report, by system.
 - .8 Operator training, including attendee names and dates, and details of manufacturers equipment demonstrations
 - .9 Status of As-built documentation, and Operating and Maintenance Manuals reviews
- .8 Ductwork System Checklists:
 - .1 Ductwork pressure test results
 - .2 Inspection of fire damper linkages.
 - .3 TAB balancing report.
 - .4 Operator training, including attendee names and dates, and details of manufacturers equipment demonstrations
 - .5 Status of As-built documentation, and Operating and Maintenance Manuals reviews
- .9 Building Management System:
 - .1 Operating check of each I/O and control loop.
 - .2 Operating check of each control sequence.
 - .3 Operator training, including attendee names and dates, and details of manufacturers equipment demonstrations
 - .4 Status of As-built documentation, and Operating and Maintenance Manuals reviews
- .5 Instrumentation:
 - .1 Provide all measurement instrumentation for conducting the verification tests.
 - .2 All instruments will have been calibrated within the six month period prior to the start of the tests.
- .6 Verification Procedures:

- .1 The Commissioning Authority shall direct and witness as required the verification operating tests and checks for selected or all equipment and systems.
- .2 Set the system equipment into operating mode to be tested including but not limited to:
 - .1 Normal shut-down
 - .2 Normal auto position
 - .3 Normal manual position
 - .4 Unoccupied cycle
 - .5 Emergency power operation, including transition states.
 - .6 Alarm conditions
- .3 Inspect and verify the position of each device and interlock identified on the checklist.
- .4 Repeat the above tests for each operating cycle that applies to the system being tested.
- .5 Check the operating condition of the following elements during all modes of operation of the system:
 - .1 Safety interlocks
 - .2 Alarms
- .6 For failed test items, provide appropriate comments to the checklist data sheet and identify whether it is a "Major" or "Minor" deficiency.
 - .1 The Consultant retains the right to make the final decision regarding classifications of deficiencies.
- .7 Verify the operational control of the systems through the Building Management System as follows:
 - .1 TAB airflow rates.
 - .2 Equipment operation in both heating and cooling modes.
- .8 The Commissioning Authority shall direct and witness the field verification of the final TAB report as follows:
 - .1 Select, at random, 10% of the report data for verification.
 - .2 The TAB contractor will be provided advance notice of the date of retesting, but not the equipment to be tested.
 - .3 The TAB to provide and use the same equipment and instruments used for collecting the original data.
 - .4 Test failure is defined as:
 - .1 For all readings other than sound, a deviation of more than 10 percent from the TAB report results.
 - .2 For sound pressure readings, a deviation of 3 dB at any bandwidth, not including differences in background noise readings.
 - .5 A failure rate greater than 10% of the selected items (1% of all TAB test results) will result in rejection of the final TAB report.

.7 Acceptance

- .1 The final reports will be reviewed by the Commissioning Authority and the Consultant, to determine if verification is complete and the operating systems are functioning in accordance with the contract documents.
- .2 The Commissioning Authority, in conjunction with the Consultant, shall review and make final classification of all noted deficiencies. Deficiencies classified as “Major” shall be corrected before acceptance of the Verification stage.

3.9 **PERFORMANCE TESTING (PART 2)**

.1 Scope of Work

- .1 Conduct performance tests and checks to verify that all equipment and system components are providing the required heating and cooling performance (capacity) in accordance with the Contract Documents, including but not limited to:
 - .1 Capability of the hydronic water heating system to deliver the required flow rate, and temperature.
 - .2 Confirm the ability of the HVAC systems to deliver the required cooling/heating services, at the design supply air temperature, required static pressure, and proper outside air ventilation rate.
- .2 Roles and Responsibilities:

Functional Performance Testing	
Organized by:	Commissioning Authority
Test sheets provided by:	Mechanical Division contractors
Testing Conducted by:	Mechanical Division contractors
Testing Recorded by:	Mechanical Division contractors
Tests Witnessed by:	Commissioning Authority Design Consultant (optional) Owner (optional)
Reports reviewed by:	Contractor Commissioning Authority Design Consultant
Reports accepted by:	Owner

- .2 Submittals:
 - .1 Submit detailed test procedures and methodology to the Commissioning Authority for review and acceptance. Include samples of data record sheets.
- .3 Participants:
 - .1 Participants are the same as that described for the Verification stage.
- .4 Documentation and Reporting Requirements
 - .1 Provide separate test records for each piece of equipment and system.
 - .2 Checklists to include the following information:

- .3 Front cover sheet – Project name, Owner name, equipment ID and name, test date(s), and space for sign-off signatures and dates as follows:
 - .1 Mechanical Subcontractor – “Submitted by”
 - .2 Contractor – “Reviewed by”
 - .3 Design Consultant – “Reviewed by”
 - .4 Commissioning Authority – “Reviewed by”
 - .5 Owner – “Accepted by”
- .4 Second and subsequent pages to include tests as defined below.
 - .1 Description of test methodology, including reference standards (SMACNA, ARI, ASME, etc).
 - .2 Permanent and temporary resource requirements to implement the test (power, temporary drains, etc).
 - .3 Summary of results.
 - .4 Test data sheets and measured data.
 - .5 Ambient temperature conditions at time of test.
 - .6 Load simulation method used, if required.
- .5 Provide a preliminary test report for review by the Commissioning Authority and the Consultant prior to conducting the performance test.
- .5 Instrumentation
 - .1 Refer to the Instrumentation requirements for the Verification stage.
- .6 Functional Performance Test Procedures
 - .1 The Commissioning Authority shall direct and witness as required the performance tests for selected or all equipment and systems.
 - .2 For each test, provide instrumentation required to calculate the total capacity of the system.
- .7 Acceptance
 - .1 Any identified deficiencies will be reviewed by the Consultant in conjunction with the Contractor to determine if correction of the deficiency is part of the contractor’s or sub-contractor’s contractual obligations.
 - .2 If it is determined the performance deficiency is part of the contract documents, the contractor will rectify the deficiency and repeat the performance test until the required performance levels are achieved.
 - .3 If it is determined the mechanical system is constructed in accordance with the contract documents, and the performance deficiency is not part of the contract documents, the Owner will decide whether to accept the performance as is, or, direct the installation contractor to make changes to the system as required to obtain performance levels which meet the design intent.
 - .4 Should remedial work to correct the not-in-contract deficiency be implemented, the Owner will decide whether all or part of the performance testing is to be repeated. If repeated, complete the retesting and submit a revised report.

3.10 **SYSTEMS OPERATING MANUALS (PART 3)**

.1 Scope of Work:

- .1 The Systems Operating Manuals (SOM) are in addition to the Operating and Maintenance Manuals (OMM) required under Section 23 05 01.
- .2 The SOM provides operational information relating to the system, while the OMM provides information relating to the equipment in the system.
- .3 Obtain information from the Consultant with respect to the design criteria and operational requirements of the system, for incorporation into the SOM.
- .4 Roles and Responsibilities:

Systems Operating Manuals	
Organized by:	Mechanical Subcontractor
O&M Manuals provided by:	Mechanical Subcontractor
SOM Manuals provided by:	Mechanical Subcontractor
Manuals reviewed by:	Commissioning Authority Design Consultant
Manuals accepted by:	Owner

.2 Submittals:

- .1 Submit a table of contents to the Commissioning Authority for review and approval, listing all Volume/Chapter/System documents specific to this project, prior to preparation of the SOM. A template table of contents is not acceptable.

.3 SOM Manuals Structure:

- .1 The SOM is divided into Volumes/Chapters/Systems as follows:
 - .1 Volume 1: Fire Protection
 - .2 Volume 2: Plumbing
 - .3 Volume 3: HVAC
 - .4 Volume 4: Building Management System
- .2 Each volume is divided into chapters as follows:
 - .1 Volume 1: Fire Protection
 - .1 Sprinkler systems
 - .2 Volume 2: Plumbing
 - .1 Domestic hot and cold water
 - .2 Sanitary drainage
 - .3 Volume 3: HVAC
 - .1 Heating generation
 - .2 Cooling generation
 - .3 Air Distribution System

- .4 Volume 4: Building Management System
 - .1 System architecture
 - .2 Control Sequences
- .3 Each chapter topic is divided into individual System documents as required for multiple system types, or break-down a major system into a series of sub-systems.
- .4 Each System document provides the following information:
 - .1 Systems Description
 - .2 Operating Instructions, manual and automatic
 - .3 Ongoing and Preventative Maintenance
 - .4 Operators' Notes
- .4 System Descriptions
 - .1 Provide general descriptions of each System including:
 - .1 Major equipment components
 - .2 Interconnections
 - .3 Theory of operation (provided by the Consultant)
 - .4 Design criteria (provided by the Consultant)
 - .5 Redundancy level/equipment
 - .6 Cross-reference to system schematic As-Built drawing(s).
- .5 Operating Instructions:
 - .1 Provide system operating instructions including:
 - .1 Starting up the system
 - .2 Shutting down the system
 - .3 Emergency or unusual conditions
 - .4 Safety precautions
 - .5 Trouble shooting suggestions
 - .6 Automatic control sequences (copied from BMS shop drawings)
- .6 Ongoing and Preventative Maintenance:
 - .1 Equipment manufacturers recommended preventative maintenance information is included as part of the Operating and Maintenance manuals provided under Section 23 05 01.
 - .2 Provide a cross-reference listing of equipment maintenance instructions in the Operating and Maintenance manuals for each piece of equipment.
- .7 Operators' Notes:
 - .1 Provide an Operators Notes section at the end of each SOM to allow the Operations staff to update the SOM with operating tips, warnings, etc.

3.11 **OPERATING AND MAINTENANCE TRAINING (PART 4)**

.1 Scope of Work

.1 Provide systems training in addition to the requirements of Section 23 05 01.

.2 Roles and Responsibilities:

Systems Operating Manuals	
Organized by:	Mechanical Subcontractor
Lecture material provided by:	Mechanical Subcontractor
Systems training provided by:	Mechanical Subcontractor
Resource material by:	Sub-Contractors Manufacturers Design Consultant
Training Manuals reviewed by:	Commissioning Authority Design Consultant
Manuals accepted by:	Owner

.2 Equipment Training

.1 Provide equipment training in accordance with Section 23 05 01. The manufacturer's representative training will emphasize operating instructions and preventative maintenance.

.3 Systems Training

.1 In addition to the equipment training described above, provide additional training to describe the operational requirements and design intent.

.2 Include classroom instruction, delivered by competent instructors, based upon the contents of the SOM manuals. Place emphasis on overall systems diagrams and descriptions, and design criteria and conditions.

.3 If required, obtain and pay for the services of the Design Consultant to provide the instructor services and to provide lecture material for inclusion in the training manual.

.4 Training topics to include:

- .1 Types of installed system
- .2 Design intent and design criteria
- .3 Design constraints
- .4 Different operating modes – occupied, unoccupied, emergency conditions, etc.
- .5 Seasonal operating modes
- .6 IAQ
- .7 Energy efficiency
- .8 System operation
- .9 Automatic controls

- .10 Service, maintenance, diagnostics and repairs
 - .11 Use of reports and logs
 - .12 Troubleshooting
 - .5 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each equipment, with the services of the manufacturers' representative as required. Demonstrate the start-up and shut-down of each system.
 - .6 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Allow for three (3) training sessions for each topic, separated by approximately one week each, to allow for shift coverage.
 - .7 Structure each training session based on type of maintenance personnel attending the training session, i.e. plumbers, fitters, general maintenance, controls technicians, etc. Develop the proposed training plan and obtain approval from the Owner before commencing the training.
 - .8 Complete the training as close to Substantial Completion as possible, so that the Owner's operations staff are prepared to operate the system after Substantial Completion is certified.
- .4 Training Manuals
- .1 Provide training material hand-outs for each session. This information will be abstracted from the SOM's and shall be presented in abbreviated form (ie bullet points).
 - .2 Collect training material and bind into separate binders in accordance with the requirements for the SOM manuals.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 SUBSTANTIAL PERFORMANCE

- .1 Complete the Substantial Performance Checklist and submit with required documentation when applying for Substantial Performance of the Work.
 - .1 Where the work is sub-divided into separate scopes of Work, each requiring a separate Substantial Performance application, provide a separate checklist for each application.
 - .2 Prepare and submit to the Consultant a comprehensive deficiency list of items to be completed or corrected, as part of the application for a review by the Consultant to establish Substantial Performance of the Work, or designated portion of the Work.
 - .1 Failure to include an item on the list does not alter the Contractor's responsibility to complete the Work.
 - .3 Within five working days of the Consultant's review report which indicates that Substantial Performance of the Work has been achieved, provide a detailed schedule for completion and/or correction of the Work of all items described in the Contractors' and the Consultants' deficiency list.

1.3 TOTAL PERFORMANCE

- .1 Complete the Total Performance Checklist and submit required documentation when applying for Substantial Performance of the Work.
- .2 Submit the following documentation with the application for Total Performance. Application for Total Performance cannot be submitted any earlier than the date of Alternate Season testing.
- .3 The following documentation is included with this application for Total Performance, or, has already been submitted to the Owner and a copy of the transmittal is included with this application.

PART - 2 SUBSTANTIAL PERFORMANCE APPLICATION CHECKLIST

Project Information		
Project Name:		
Contract:		
Contract Scope:		
Application Date:		
Signed:		
Required Documentation		
No.	Item	Included
1.	Contractor has compiled and submitted a detailed deficiency list, identifying work still to be completed, incomplete, or requires correction.	
2.	Equipment start-up reports (Interim)	
3.	Authorities report (Interim)	
4.	Air and Water Balancing reports (Interim)	
5.	Acoustic survey report (Interim)	
6.	Vibration survey report (Interim) - <i>if specified</i>	
7.	Controls / BMS operation report (Interim)	
8.	Operating and Maintenance Manuals, draft, submitted.	
9.	Training, completed	
10.	Commissioning Report – Verification and Training (if part of contract)	
Reviewed by Consultant		
Status	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit	
Signed:		
Date:		

PART - 3 TOTAL PERFORMANCE APPLICATION CHECKLIST

Project Information		
Project Name:		
Contract:		
Contract Scope:		
Application Date:		
Signed:		
Required Documentation		
No.	Item	Included
1.	Contractor submits a statutory declaration that all know deficiencies have been corrected, including latent deficiencies reported by the Owner.	
2.	Equipment start-up reports – updated and final	
3.	Authorities report – updated and final	
4.	Air and Water Balancing reports – updated and final	
5.	Acoustic survey report – updated and final	
6.	Vibration survey report – updated and final - <i>if specified</i>	
7.	Controls / BMS operation report – updated and final	
8.	Operating and Maintenance Manuals – updated and final	
9.	As-Built drawings – final	
10.	Commissioning Report – Performance Testing (if part of contract)	
Reviewed by Consultant		
Status	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit	
Signed:		
Date:		

End of Section

PART - 1 GENERAL

1.1 SUMMARY

- .1 Sections 20 00 13 – Mechanical General Provisions and 23 05 00 - Common Works for HVAC shall apply to and govern this Section.
- .2 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.
- .3 Scope of Work:
 - .1 Design, supply, install, test and adjust all local control and monitoring systems specified under the diverse Sections of Division 23 – HVAC.

1.2 RELATED WORK

- .1 The following work is provided under other Sections or Divisions of the Work:
 - .1 Centralized control and monitoring of HVAC systems and equipment: Division 25 – Building Automation.
 - .2 Power supply to HVAC equipment and to associated control equipment: Division 26 – Electrical.

1.3 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit product data for all control components including technical specification data sheets for each system component, sequence of operation, wiring diagrams, control device arrangements, control device locations on floor plans to scale.

1.4 REFERENCE STANDARDS

- .1 Ontario Electrical Safety Code

1.5 QUALITY ASSURANCE

- .1 Provide electrical and electronic equipment which is CSA approved where such approval is required by the authorities having jurisdiction.
- .2 Conduit and wiring materials and methods shall be in strict accordance with the requirements of Division 26 – Electrical and the applicable provincial and federal electrical codes and standards.

PART - 2 PRODUCTS

2.1 CONTROL AND INTERLOCK WIRING

- .1 Provide control and interlock wiring for HVAC equipment with local control components supplied loose. Refer to specific requirements under the diverse Sections of Division 23 – HVAC.

- .2 Wiring shall be in accordance with the requirements of Section 20 05 13 – Common Wiring Requirements and Division 26 – Electrical.

2.2 **ELECTRICAL CONTROL DEVICES**

.1 Switches

- .1 Provide switches for system monitoring, safety and operational interlocks.

.2 Relays

- .1 Provide electric switching relays, ULC listed, as required and where indicated. Unless otherwise indicated, install relays within control cabinet. Provide line voltage or low voltage general purpose type relays unless heavy duty type are indicated.

.3 Control cabinets and panels

- .1 Provide control cabinets and panels with mounting brackets sized to house all local control devices.

PART - 3 EXECUTION

3.1 **INSTALLATION**

- .1 Install all components and make interconnections.
- .2 Connect electric control equipment and interlocks in accordance with the requirements of Division 26 – Electrical.
- .3 Post a control diagram of each local control system, as prepared by manufacturer, on the wall of the associated equipment rooms.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section including, but not limited to, the following:
 - .1 Hot Water Heating Systems.
 - .2 Chilled water system.

1.2 RELATED WORK

- .1 Piping Specialties (general items): to Section 23 05 24
- .2 Pipes, Valves and Fittings: to Section 23 05 23

1.3 REFERENCE STANDARDS

- .1 Comply with the following:
 - .1 Technical Standards & Safety Act
 - .2 CSA B51-97: Boiler, Pressure Vessel, and Pressure Piping Code, as amended

	B31.1	B31.9
Liquids	> 250°F	≤ 250°F

- .3 ANSI/ASME B31.9 - Building Services Piping Code, as specified
- .4 ANSI/ASME B31.1 - Power Piping Code, as specified
- .2 Materials
 - .1 To CSA B51 - M1991 with:
 - .1 Cast iron to ASTM A-278-84, Class 30 or ASTM A-126-84 Class B.
 - .2 Bronze to ASTM B62-82a.
 - .3 Stainless steel: to ASTM A351-84b, ASTM A-167-84, ASTM A-276-84 or ASTM A-564-79.
 - .2 Bolting requirements:
 - .1 To ASTM A307-84.

1.4 PERMITS, EQUIPMENT REGISTRATION AND FEES

- .1 Contractor Certification
 - .1 Contractors providing Work regulated under the Boilers and Pressure Vessels O.Reg. 220/01 are to be holders of a TSSA Certificate of Authorization to conduct this work, including:
 - .1 Pressure piping fabrication and installation
 - .2 Boiler and Pressure Vessel repairs and alterations

- .2 Equipment Certification
 - .1 Equipment and fittings designated as pressure vessels or Class “H” fittings as per CSA B51-97, Part 1, require:
 - .1 ASME stamped
 - .2 CRN registration
 - .3 Registration
 - .1 Register the following pressure vessel and pressure piping systems:
 - .1 Building heating and cooling water systems operating at: pressures exceeding 1100 kPa; or temperatures exceeding 121°C.
- 1.5 **DESIGN CRITERIA**
 - .1 Hot Water Heating Systems (Scheduled Temperature)
 - .1 Operating Temperatures:
 - .1 Supply: 88°C (190°F)
 - .2 Return: 71°C (160°F)
 - .2 Design Pressures: 860 kPa
 - .2 Chilled Water Systems
 - .1 Operating Temperatures:
 - .1 Supply: 5.5°C (42°F)
 - .2 Return: 14.5°C (58°F)
 - .2 Design Pressures: 860 kPa
- 1.6 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Submit shop drawings as required by the Consultant.
 - .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data.
- 1.7 **TESTING**
 - .1 General
 - .1 Test piping in Consultant's presence, in accordance with testing requirements specified in Section 23 05 23 and with tests and test pressures hereinafter specified for various services.
 - .2 Lines may be tested in sections as authorized by the Consultant to accommodate construction schedule. However, test complete systems on completion.
 - .2 Hydronic Systems
 - .1 Hydrostatically test hydronic (water) piping at 862 kPa pressure.

PART - 2 PRODUCTS

2.1 PIPELINE SPECIALTIES

- .1 Automatic Air Vents
 - .1 Construction:
 - .1 Float operated with brass or cast iron body
 - .2 Rated working pressure: (10 kPa) (690 kPa)(1035 kPa (2070 kPa)
 - .2 Acceptable Manufacturers:
 - .1 Maid-O-Mist No. 7 (75 to 150 psi)
 - .2 Taco Hy-Vent (35 to 150 psi, 240 F)
- .2 Circuit Balancing Valves
 - .1 Construction:
 - .1 Positive shut-off calibrated balancing valves with handwheel and division ring scale
 - .2 Flow measuring disconnects
 - .3 Metal tag with chain listing design flow rate, metered fluid, and meter reading for design flow rate
 - .4 Minimum working pressure: 1035 kPa
 - .5 Combined accuracy of valve and meter: manufacturer certified to be within $\pm 2\%$ of actual flow
 - .6 NPS 2 and smaller: brass body with screwed ends

PART - 3 EXECUTION

3.1 CONNECTIONS TO EXISTING SERVICES

- .1 Tie-Ins
 - .1 Make arrangements with the Owner and obtain permission to tie into existing services at a time acceptable to all parties.
- .2 Insulation Repair
 - .1 Repair or replace any insulation or covering removed from existing lines to permit tie-ins. Use only new materials as specified for new work.

3.2 PIPELINE SPECIALTIES

- .1 Air Vents
 - .1 Install automatic air vents at high points of water piping systems and also in any other location noted on Drawings.
 - .2 Install automatic air vent with 150 mm high, line size or NPS 4 size air pocket, whichever is smaller, and NPS $\frac{3}{4}$ isolating gate valve and piping to inlet connection of air vent.
 - .3 Connect discharge to nearest funnel or hub drain or as shown on Drawings.
 - .4 Provide manual air vents in locations noted on Drawings.

- .2 Drain Valves
 - .1 Install drain valves at low points of water and compressed air piping systems in order to completely drain each system, and also in any other location noted on Drawings.

- .3 Circuit Balancing Valves
 - .1 Provide balancing valves at all locations shown on the Drawings and as required to result in accurate flow balancing.
 - .2 Install valves in accordance with supplier's instructions.
 - .3 Make meters available to the Testing and Balancing Contractor during the balancing of the systems.
 - .4 Turn over meters to Owner at Substantial Completion.

3.3 **FLUSHING OF PIPING SYSTEMS**

- .1 Applicable Systems
 - .1 Flush hydronic piping systems in accordance with Section 23 05 23.
 - .1 Flush water piping with water flowing at a velocity of not less than 1.8m/sec, for a period of 15 minutes or longer as required to remove all dirt, scale, and cuttings from the entire length of the piping.
 - .2 Thoroughly clean, prior to fabrication, sections of new piping which cannot be isolated for flushing purposes.
 - .3 Thoroughly clean, insofar as possible, welded joints by swabbing interior of pipe with swabs soaked with a caustic solution.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section, including but not limited to, the following:

.1 Duct Work Systems

.2 All ductwork shall be constructed, reinforced, supported and installed in accordance with ASHRAE Standards for ductwork construction and installation and with SMACNA "HVAC Duct Construction Standards - Metal and Flexible".

1.2 SUBMITTALS

.1 Shop Drawings

.1 Submit shop drawings as required by the Consultant.

1.3 COORDINATION

.1 Prepare coordination and fabrication drawings at a minimum scale of 1:50 and coordinate with other trades affected by this work to ensure access to other portions of the work is not impeded by the duct work systems.

.2 Maintain these drawings on site and make them available for review by the Owner's Representative when requested.

1.4 PROJECT CONDITIONS

.1 Environmental Requirements

.1 Maintain a space work temperature not less than the minimum ambient working temperature as required by the duct sealant manufacturer requirements. Any duct work sealant installed where the space temperature is less than these recommendations will be removed and replaced.

.2 Field Measurements

.1 In existing buildings, make detailed field measurements for routing of new duct work, and provide all offsets and transitions which may be required to accommodate the new work with existing and new services.

.3 Protection

.1 Temporarily cap-off duct work openings to protect against dirt accumulation inside the duct work.

PART - 2 PRODUCTS

2.1 DUCT WORK

.1 Materials

.1 Galvanized steel sheet:

.1 Z275 (G60) for unpainted duct work, indoor

.2 ZF075 (A25) designation zinc coating to ASTM A653/A653M for painted

- duct work
- .2 Stainless steel sheet:
 - .1 Type 304L / Type 316L to ASTM A167
- .3 Flexible Duct work
 - .1 Return air plenums: ULC approved, single ply aluminum construction with mechanical lock spiral joints
 - .1 Flexmaster "Triple-Lock"
 - .2 Thermoflex

PART - 3 EXECUTION

3.1 DUCT WORK

- .1 General
 - .1 Install duct work in arrangement shown on Drawings in accordance with standards and recommended practices of ASHRAE and SMACNA. Provide required offsets and transitions, whether specifically indicated or not, to facilitate duct installation and to avoid interference with building structure, piping, equipment and services.
 - .2 Duct sizes as shown on Drawings. Where ducts are to have internal acoustical liner, adjust duct size to accommodate acoustic liner thickness; clear inside dimensions as shown on Drawings.
 - .3 Fabricate duct work free from vibration, rattle or drumming under operating conditions; reinforce, brace, frame, place gaskets, etc. to comply with performance criteria.
 - .4 Place galvanized screens of 13 mm x 13 mm mesh x 2.7 mm diameter wire for air intakes, exhausts and open ends of duct work.
 - .5 Install duct work in locations and at elevations appropriate to ceiling heights shown on Drawings. Where required to be concealed, install duct work in furred spaces provided in walls and ceilings. Where there is no provision for concealment install duct as close as possible to walls, partitions and overhead structures to attain maximum headroom and clearance.
 - .6 Where shape of duct changes, install transition piece so that angle of side of transition piece does not exceed 15 degrees from straight run of duct being connected, unless shown otherwise on Drawings.
- .2 Pressure Class / Seal Class
 - .1 Fabricate duct work to SMACNA pressure classification as follows unless otherwise noted on Drawings.
 - .2 Seal duct work in accordance with SMACNA sealing requirements as follows:
 - .1 Seal Class "A": All transverse joints, longitudinal seams, and duct wall penetrations.
 - .2 Seal Class "B": All transverse joints, and longitudinal seams only
 - .3 Seal Class "C": Transverse joints only
 - .4 Seal Class "D": None

System	Pressure Class	Sealing Class
Constant Volume Supply	+2" (500 Pa)	A
Constant Volume Return	+/-2" (500 Pa)	A
Building Exhaust (Washroom exhaust) locker exhaust	+/-2" (500 Pa)	C

- .3 Sleeves
 - .1 Install sleeves where ducts pass through walls or floors. Pack space between duct and sleeve with mineral wool and seal both ends with non-inflammable fire resistant sealing compound. Install sheet metal closure plates on each side of wall to cover sleeve.
 - .2 Sleeves: of the same sheet material and thickness as for duct work.
- .4 Exhausts
 - .1 At exhausts and open ends in duct work install removable galvanized screens securely fastened in place.
- .5 Equipment Connections
 - .1 Install neoprene gasketed flanged joints at duct connections to air conditioning units, coils, etc. Fabricate flanges from mild steel angles to match equipment flanges.
- .6 Paint Finish and Touch-Up
 - .1 In office areas paint interior of duct work for at least 300 mm behind supply and exhaust grilles with matte black paint to render duct work invisible from occupied space.
 - .2 Touch-up galvanized steel damaged as a result of fabrication, including welding, with zinc dust galvanized primer.
- .7 Supports and Hangers
 - .1 Support intervals:
 - .1 Ducts up to 1500 mm in width: minimum 2400 mm centres
 - .2 Ducts 1500 mm in width and over: 1200 mm centres
 - .2 Strap Hangers:
 - .1 For duct size up through 760 mm width
 - .2 3 mm x 25 mm mild steel bar stock. Bend strap hanger around bottom of duct for a minimum of 38 mm and attach to sides and bottom of duct.
 - .3 Steel Angle Hangers:
 - .1 For duct sizes over 760 mm in width
 - .2 Mild steel rod hangers of 10 mm dia. minimum size, with 38 mm x 38 mm x 3 mm steel angle across bottom of duct and attach hanger to angle (not the duct).
 - .4 Install miscellaneous steel angles or channels as required between joists or building steel for structural support of duct where building framing spacing does not coincide with the required hanger spacing.

3.2 **RECTANGULAR DUCT WORK**

.1 General

- .1 Material: galvanized steel for unpainted duct work, unless otherwise shown on drawings.
- .2 Metal thickness and construction methods as specified herein for various size ranges of ducts.
- .3 Cross-break flat surfaces of uninsulated duct between joints, or between joints and intermediate reinforcements, to prevent vibration or buckling.
- .4 Seal joints on all rectangular duct work with high velocity duct sealer. Duct-tape will not be allowed.

.2 Joints

- .1 Longitudinal joints: Pittsburgh Lock joints tightly closed along full length of seam.
- .2 Transverse joints: Ductmate, Nexus or TDC connections of class to suit size of duct and pressure of system.

.3 Fittings

- .1 Elbows, transition sections and take-off fittings: use metal one gauge heavier than thickness specified for duct in which they are installed.
- .2 Radius elbows: standard radius design with inner radius equal to width of elbow unless shown otherwise, Pittsburgh Lock seams, and with ends to match transverse joints of duct.
- .3 Square elbows: where elbows are shown as square type, fit elbows with air turning vanes of double blade construction.

3.3 **ROUND DUCT WORK**

.1 General

- .1 Shop fabricate round duct work from helically wound galvanized steel sheet strips with spiral lock seam, of following thicknesses:

Duct Diameter	Thickness of Sheet Metal
200 mm or less	0.5 mm (26 ga.)
228 mm to 560 mm	0.6 mm (24 ga.)
600 mm to 810 mm	0.8 mm (22 ga.)

- .2 In lieu of standard spiral lock seam duct work, "Uni-Rib" duct as manufactured by United Sheet Metal may be furnished for above floor installations in sizes 375 mm and larger.
- .3 Secure joints with sheet metal screws and seal with approved sealant.

.2 Joints

- .1 Longitudinal seam: spiral wound seam type RL-1 (grooved lock) or RL-4 (butt weld)
- .2 Transverse seam: Van Stone flange joint RT-2 or RT-2A
 - .1 Exception: downstream of VAV boxes flange joint type RT-1 (beaded sleeve joint) may be used, with minimum 3 mechanical fasteners each side of joint.

- .3 Seal joints in round duct work with high velocity duct sealer as specified for rectangular duct work.

- .3 Fittings

- .1 Ninety degree (90°) elbows: smooth centre line radius of 1.5 times duct diameter. Alternatively, use elbows of five piece construction, subject to prior approval of Consultant.
- .2 Forty five degree (45°) elbows: use three piece construction.
- .3 Branch connections to mains: eccentric conical configuration.

3.4 **SPECIALTY DUCT WORK SYSTEMS**

- .1 Flexible Type Round Ducts

- .1 Provide flexible duct work of max 3' length as follows:
 - .1 At connection to ceiling diffusers
 - .2 Where shown on Drawings.
- .2 Use insulated type flexible duct work in non-return air plenums.
- .3 Use non-insulated type flexible duct work in return air plenums.
- .4 Seal joints between flexible duct and rigid duct work or equipment with non-flammable high velocity duct sealer, applied in accordance with duct manufacturer's recommendations, and make secure with gear type nylon strap connectors.

3.5 **INSPECTION, TESTING AND BALANCING**

- .1 Cleaning

- .1 Prior to start-up of fans, blow out complete systems of duct work with high velocity air for not less than two hours using where possible the installed air handling equipment to full capacity and by blanking off duct sections to achieve required velocity. Do not install air filters prior to blow-out of duct work systems. Use auxiliary portable blowers for cleaning where installed fan systems are not adequate to blow out complete system free from dust and dirt.
- .2 After duct systems have been blown out, clean interior of plenums, coils, and register, grille or diffuser outlet collars with industrial type vacuum cleaner. On completion of cleaning process, install filters before placing systems in final operation.

- .2 Testing

- .1 Test Pressure: equal to duct work pressure class.
- .2 Conduct pressure tests based on SMACNA Leakage Test Manual as follows:
 - .1 Allowable leakage per area of duct work: $F = C_L \times P^{0.65}$
 - .2 F = leakage rate l/s /10 sq.m of duct surface area
 - .3 C_L = leakage class based on pressure class
 - .4 P = static pressure, Pa

.5 Leakage Class, CL:

Duct Construction Class			
Duct Class	Up to 500 Pa	750 Pa	Over 750 Pa
Seal Class	C	B	A
Leakage Class, CL (Metric)			
Rectangular Metal	0.34	0.17	0.08
Round Metal	0.17	0.08	0.04

- .3 Visually inspect duct work for air leakage at joints and connections to equipment, under normal operating conditions.
- .4 Test duct work systems before they are insulated, painted or concealed.
- .5 Immediately correct defects discovered during tests and retest systems to complete satisfaction of Consultant.

.3 Balancing of Air Systems

- .1 Balance air handling systems in accordance with Section 23 08 16 and 23 08 13.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section including, but not limited to, the following:

.1 Balancing, backdraft, and fire dampers

.2 Flexible duct connections

.3 Turning vanes and extractors

1.2 RELATED WORK

.1 Section 23 05 48, Noise and Vibration Controls.

1.3 REFERENCE STANDARDS

.1 Codes:

.1 NFPA 90A

.2 NFPA

.2 Standards

.1 SMACNA HVAC Construction Standards – Metal and Flexible.

1.4 SUBMITTALS

.1 Shop Drawings

.1 Submit shop drawings in accordance as required by the Consultant.

PART - 2 PRODUCTS

2.1 DUCT WORK ACCESSORIES

.1 Flexible Duct Connections

.1 Material:

.1 Heavy glass fabric double coated with neoprene and attached to 0.6 mm (24 ga) metal strips 75 mm wide.

.2 Fabric length between metal strips:

.1 Minimum 75 mm for ducts of maximum size in either dimension or diameter of 750 mm or less

.2 150 mm for ducts of 775 mm size and larger.

.2 Acceptable Manufacturers:

.1 Duro-Dyne "Grip-Loc Type SMFN"

.2 Ventfabrics "Ventglas"

- .2 Turning Vanes
 - .1 Material: Hollow airfoil type, fabricated of same material as duct in which they are installed.
 - .2 Acceptable Manufacturers:
 - .1 Duro-Dyne
- .3 Access Doors in Duct Work and Plenums
 - .1 Hand Door:
 - .1 Construction: 0.7 mm (24 ga) galvanized steel, double flanged frame and insulated door complete with insulation backing plate.
 - .2 Fasteners: zinc plated cam-lock fasteners, minimum two per door, with safety retaining chain.
 - .2 Equipment and Man Doors:
 - .1 Minimum size, Equipment: where motors are installed within unit or duct, use an access door large enough to permit removal of motor.
 - .2 Minimum size, Man Door: 450 mm x 1200 mm or as shown on drawings
 - .3 Construction: 0.8 mm (22 ga) thick galvanized steel sheet double panel construction with approved 25 mm thick insulating filler, mounted in flanged die-formed collar flush with face of finished insulation, with flanged door frames welded in place.
 - .4 Hinges: heavy zinc plated continuous hinge
 - .5 Fasteners: three heavy sash fasteners and neoprene gaskets
- .4 Probe Inlets
 - .1 Material:
 - .1 Ventlok No. 699 or Duro-Dyne IP-1 or IP-2 Test Opening Enclosures complete with locking cap, chain, gaskets, insulating plug and extensions for insulated duct work.

2.2 **OPERATING DAMPERS**

- .1 Manual Balancing Dampers
 - .1 Rectangular Duct Work:
 - .1 Galvanized channel type frames, non-binding pre-lubricated type interconnecting and operating linkages
 - .2 Blades: minimum 1.6 mm (16 ga) thick material, opposed blade style
 - .3 Manual operator and locking type quadrant as required for synchronous operation and setting of blades.
 - .4 Blade width: maximum 200 mm.
 - .5 Blade length: length coinciding with frame opening on horizontal plane to maximum length of 1200 mm.
 - .6 Locking quadrant: Galvanized steel locking quadrant with "Open – Closed" labels, 50 mm insulation stand-off.

- .7 Acceptable Manufacturers:
 - .1 Nailor – Series 1810/1820 with HL2 quadrant
- .2 Round Duct Work - Low Pressure Butterfly Damper
 - .1 Galvanized steel frame 0.9 mm (22 ga) with stiffening beads up to 300 mm dia.; 0.9 mm (20 ga) over 300 mm duct size.
 - .2 Blade: galvanized steel 0.9mm (22 ga) up to 300 mm dia.; 0.9 mm (20 ga) over 300 mm duct size, 6 mm dia drive shaft
 - .3 Locking quadrant: Galvanized steel locking quadrant with “Open – Closed” labels, 50 mm insulation stand-off.
 - .4 Acceptable Manufacturers:
 - .1 Nailor – Series 1890 with HLQ-SB quadrant
- .3 Splitter damper:
 - .1 Material: same material and thickness as ducts in which they are to be installed, minimum of 0.8 mm (22 ga).
 - .2 Form splitters of double thickness of metal and with rounded surface at air entering edge.
 - .3 Splitter length: at least 1½ times width of smaller branch duct, but in no case less than 300 mm.
 - .4 Provide with locking type quadrant.

2.3 **FIRE DAMPERS**

- .1 Fire Dampers
 - .1 ULC labelled fire dampers of hinged, fusible link type with channel frames, blades and housing and conforming to NFPA 90A and UL555 requirements. Use "Type B" fire dampers for rectangular or square duct work and "Type C" fire dampers for round duct work.
 - .2 Dynamic dampers: designed to close while the system fans are operating.
 - .3 Static dampers: designed to close with no airflow through damper.
 - .4 Closure link: fusible link which can be released, tested and relatched for testing.
 - .5 Construct fire dampers and frames of same material as duct in which they are installed.
 - .6 Acceptable Manufacturers:
 - .1 Nailor – “D” series
 - .2 Ruskin
 - .3 Arrow

2.4 **ACOUSTIC TREATMENT**

- .1 Acoustic Duct Insulation
 - .1 Material:
 - .1 Rigid coated duct liner conforming to NFPA 90A and 90B, 25 mm thick and 72 kg/m³ density.

- .2 In duct work at velocities over 15 m/s, provide a perforated or expanded metal inner liner over acoustic insulation.
- .2 Fasteners:
 - .1 Fasten acoustic liner to inside of duct with plate type impaling pins and self-locking washers, by Eckels Industries "Stic-Klips", "Tactoo Series T", or Continental Stud Welding weld pins and self locking washers.
 - .2 Use fasteners or securing pins of size and length as required by insulation weight, thickness, fastener spacing and design.
 - .3 In addition to mechanical type fasteners, adhere insulation to inside of duct with Foster No. 82-00 or Monsey Bakor No. 230-04 fire retardant adhesive. Seal all joints with Foster No. 30-36 or Monsey Bakor No. 120-09 mastic sealant.
- .3 Acceptable Manufacturers:
 - .1 Owens Corning
 - .2 Manson
 - .3 Knauf
 - .4 Manville

PART - 3 EXECUTION

3.1 GENERAL

- .1 Refer to and comply with applicable requirements specified in Section 23 05 01.
- .2 Install miscellaneous steel framing, supports, braces, etc. as required to hang or support equipment and duct work as specified herein, and as shown on Drawings.

3.2 FLEXIBLE DUCT CONNECTIONS

- .1 Use flexible duct connections between fans and/or air handling units and connecting duct work, between unit components, in ducts at building expansion joints, and in other locations shown on Drawings
- .2 Install flexible connectors with fabric in folds, not drawn tight.
- .3 Install internal guides to prevent flexible connection from collapsing on suction side of fans.

3.3 TURNING VANES

- .1 Provide hollow airfoil type turning vanes in duct work where shown on Drawings and in 90 degree square duct elbows, fabricated of same material as duct in which they are installed.

3.4 ACCESS DOORS

- .1 Provide access doors in duct work and for plenums to allow servicing, maintenance, and inspection of:
 - .1 Control dampers
 - .2 Fire dampers
 - .3 Motors
 - .4 Bearings

.5 As shown on Drawings

.2 Provide "Hand Doors" in duct work of sizes as follows:

Access Type	Duct Dimension	Access Door Size
One hand and sight	Less than 400 mm	300x150 mm
Two hands and sight	Between 400 mm and 500 mm	450x250 mm
Head and Shoulders	Between 500 mm and 760 mm	530x356 mm
Body plus ladder	Between 760 mm and 1320 mm	635x430 mm

3.5 **BALANCING DAMPERS**

.1 Use rectangular opposed blade dampers at the following locations:

- .1 In supply and return duct work where main ducts are split into two more trunks
- .2 At rectangular branch duct connections to main or trunk ducts.
- .3 As shown.

.2 Use splitter dampers only where specifically shown on drawings.

.3 Use low pressure butterfly dampers at the following locations:

- .1 At individual branch outlets serving grilles or diffusers

.4 Dampers supplied with diffusers or grilles are to be used to balance $\pm 10\%$ of indicated airflow, are NOT in lieu of branch dampers

3.6 **FIRE DAMPERS**

.1 Install fire dampers in accordance with suppliers instructions, and with retaining angles on both sides of wall or floor and fastened to damper collars.

.2 Install fire dampers with adjacent access door as required to permit re-opening of damper and replacement of fusible link.

.3 Provide dynamic fire dampers on all systems, unless otherwise shown on drawings and specified below.

3.7 **PROBE INLETS**

.1 Install probe inlets in duct work at locations as follows:

- .1 In main supply and return ducts
- .2 Inlet and outlet side of fans
- .3 Other locations as required by Testing and Balancing Trade, to permit testing, balancing and measurement of air quantities and static pressure in air handling systems.

.2 Locate probe inlets a sufficient distance from elbows or transition sections to ensure stable readings of non-turbulent air and install 75 mm from corners and at 150 mm centres across long side of duct.

3.8 **ACOUSTIC DUCT INSULATION**

- .1 Install internal acoustic insulation in specific sections of duct work and/or plenums as shown on Drawings as follows:
 - .1 Adhere insulation to duct work or plenums by bedding in strips of adhesive supplemented by impaling clips or weld pins spaced at 300 mm centres with self-locking washers.
 - .2 Apply adhesive at 50% coverage, in 150 mm strips.
 - .3 Cut off ends of welded impaling pins after application of self-locking washers.
 - .4 Seal butt joints of insulation with mastic sealant applied to edges of insulation.
 - .5 Coat joints and self-locking washers after installation with two coat application of mastic sealant, and with open mesh glass fabric embedded in mastic between first and second coat.
 - .6 In high velocity duct work install perforated or expanded metal inner liner over acoustic lining.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 REFERENCE STANDARDS

- .1 Comply with the latest edition of the standards referenced herein:
 - .1 Fans: designed and constructed in strict conformity with the AMCA Standards and bearing the "Certified Rating Seal".
 - .2 Applicable sections of CSA C22.2 No. 113 for fan construction and installation.
 - .3 Occupational Health and Safety Act, O.Reg 851.

1.3 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings as required by the Consultant.
 - .2 Submit manufacturer's certified shop drawings to the Consultant and include:
 - .1 Complete information on fan construction and performance
 - .2 Performance curves over full range from shut-off to free delivery
 - .3 Drive details
 - .4 Make, type and catalogue number of bearings
 - .5 State hour rating of bearings when specified.
- .2 Operation and Maintenance Data
 - .1 Submit printed operating instructions and maintenance data.
- .3 Maintenance Materials
 - .1 Provide and turn-over to Owner at time of Substantial Completion one V-belt set for each size used.
 - .1 Where more than one fan uses the same set size, provide only one set.

PART - 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- .1 Performance Ratings
 - .1 Type, size and capacity shown on Drawings for each specific application and conforming to requirements of manufacture, operation and performance as specified.
 - .2 Select fan size, operating rpm and rating point on stable head flow curve with smooth characteristics.

- .3 Operating at least 20% below first critical speed when operating at maximum speed for class of construction.
- .4 Dynamically and statically balance wheels of free standing or unitary fans to acceptable tolerances relative to size and speed.
- .2 Cleaning and Metal Protection
 - .1 Thoroughly clean interior and exterior surfaces of fans including screens, at factory with approved de-greasing agent.
 - .2 Apply a coating of red oxide or zinc chromate primer unless special protective coating is specified.
 - .1 Exception: fans constructed of galvanized steel or aluminum
- .3 Materials
 - .1 Fan casings: heavy gauge steel or spun aluminum construction, as specified by model number.
- .4 Bearings
 - .1 Service Life
 - .1 To L10 Life Standard in accordance with latest AFBMA Code.
 - .2 Unitary, axial and free standing fans: 200,000 (60,000) (80,000) (100,000) hour service
 - .3 Other fan bearings: 8,000 hour service
 - .2 Type:
 - .1 Grease lubricated ball or roller type fan bearings with ample thrust provision to prevent end play during normal life of bearings.
 - .2 Smaller than 36 mm diameter: cartridge type.
 - .3 36 mm dia. and larger: shaft adapter sleeve type bearings utilizing horizontally split pillow blocks and mechanical flinger type grease valves.
 - .4 Shafts smaller than 56 mm dia., interference fit bearings may be used in lieu of adapter sleeve type.
 - .3 Bearings in air stream:
 - .1 Well secured extended grease lubricating lines unless bearing is easily accessible through man-size access door.
 - .2 Pack bearings with low temperature grease in factory.
 - .4 Grease Fittings, for fans driven by motors 0.375 kW (1/2 HP) and larger
 - .1 Provide bearings with Zerk or Alemite grease fittings, with provision for automatic relief of lubricant pressure to outside of fan, away from wheel and visible from maintenance location.
 - .2 Use service fittings and relief fittings easily accessible from maintenance locations and at separate and opposite sides of bearing housing.
- .5 Motors and Drives
 - .1 Motor ratings:
 - .1 To Section 23 05 13.

- .2 Type, kW (HP) rating, motor speed and electrical characteristics shown on Drawings.
- .3 Capable of satisfactory operation over range of performance from shut-off to run-out at 110% of rated rpm at point of selection.
- .2 Drive and belt guards: to Section 23 05 01.

2.2

FAN TYPES

.1 Centrifugal Fans

.1 Fan wheels

- .1 Backward curved or backward inclined for fan wheels less than 686mm diameter.
- .2 Single or double thickness backward curved air foil blades for fan wheels 686 mm diameter and larger.

.2 Fan casing

- .1 Inlet mounting collar
- .2 Outlet flanged collar

.3 In-line Cabinet fans

- .1 Single wheel SWSI centrifugal fans with motor and V-belt drive or Direct Drive.
- .2 Removable panels for access to internal parts
- .3 Internally lined cabinet with 50 mm thick rigid acoustic insulation
- .4 Expanded metal mesh over insulation on floor
- .5 Motor pre-wired to external junction box
- .6 Mounting ring or brackets for vertical or horizontal suspension from overhead structure
- .7 Belt guard, motor and drive
- .8 Hanger brackets
- .9 Inlet and outlet cones
- .10 Quick-opening access door
- .11 External grease and relief fittings to each bearing

.4 Acceptable Manufacturers

- .1 Spun Aluminum Fans:
 - .1 Greenheck
 - .2 Jenn Air
 - .3 Penn
 - .4 Loren-Cook
 - .5 Twin City

PART - 3 EXECUTION

3.1 GENERAL

.1 Fan installation

- .1 Install fans complete with resilient mountings and restraining snubbers in accordance with Section 23 05 48.
- .2 Provide flexible connections on inlet and outlet ductwork: in accordance with Section 23 33 00.
- .3 Align shafts, belt drive and motor, adjust belt tension and check motor rotation before start-up.
- .4 Protect motors and fans during construction and rotate fans, by hand, every month between delivery and acceptance of building.

.2 Air Balancing

- .1 Adjust variable pitch fan/motor sheaves during balancing to achieve specified air quantities.
- .2 Provide sheaves and belts for final air balance.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 RELATED WORK

- .1 Door grilles: provided under General Trades scope of work.

PART - 2 PRODUCTS

2.1 DIFFUSERS, REGISTERS AND GRILLES

- .1 General
 - .1 Neck size, dimensions and capacity as shown on Drawings. Catalogue numbers of first named supplier are listed on Drawings to show required type and style.
 - .2 Acoustic and airflow performance is based on catalogued information of the indicated manufacturer and model as shown on drawings or schedules. Other named manufacturer products must match these implied performance criteria.
 - .3 Border and frame as required to suit wall and ceiling construction.
- .2 Square and Circular Pattern Diffusers
 - .1 Steel construction with baked white enamel finish, unless otherwise shown.
 - .2 True imperial or metric sizes.
 - .3 Radial opposed blade damper
- .3 Grilles
 - .1 Steel construction with baked white enamel finish, unless otherwise shown.
 - .2 Blade orientation parallel to the long dimension.
 - .3 Opposed blade damper in black finish.
- .4 Door Grilles
 - .1 Door grilles will be supplied and installed by General Trades.
- .5 Acceptable Manufacturers:
 - .1 E.H. Price
 - .2 MetalAire
 - .3 Nailor Industries Inc.
 - .4 Titus
 - .5 Tuttle and Bailey
 - .6 Krueger

PART - 3 EXECUTION

3.1 GENERAL

- .1 Supply diffusers and registers to deliver indicated air quantities shown with throw to reach intended space limits without increasing the sound level of room. Provide blank-off baffles where required and equalizing deflectors on diffusers and in other locations as shown or required.
- .2 Coordinate placing of diffusers, registers and grilles in ceilings with electrical and ceiling installation trades and exact location to final approval of Consultant.
- .3 For connection of air supply to coffered ceilings provide boots suitable for attachment to air slot on coffered ceilings as required and where shown on Drawings. Connect flexible supply air duct to neck of boot.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.
 - .2 Provide all required support and accessories for complete operating systems.
 - .3 Mechanical Subcontractor and his BMS Controls subtrade to provide all piping and connections, control valves and actuators, shut off valves, gauges, thermometers, damper actuators, sensors and wiring to BMS.

1.2 RELATED SECTIONS

- .1 Air Handling Unit internal components to comply with the following sections in addition to the requirements specified herein:
 - .1 Fans: to Section 23 34 00
 - .2 Filters: to Section 23 41 00
 - .3 Coils: to Section 23 82 16

1.3 QUALITY ASSURANCE

- .1 Certification
 - .1 Fans: to ARI Standard 430-66
 - .2 Coils: ARI Standard 410-72

PART - 2 PRODUCTS

2.1 GENERAL

- .1 Modular air handling units - tagged fcus have been pre-purchased in phase one of the construction. Units have been stored onsite.

PART - 3 EXECUTION

3.1 INSTALLATION

- .1 Install floor mounted air handling units on a flat surface leveled within 3mm
- .2 Provide condensate traps in accordance with manufacturers recommendations.
- .3 Install air handling units to allow proper service to all components.
- .4 Arrange units for floor mounting complete with vibration isolators and structural steel supports, or for suspension from overhead structure with spring hangers, as required or shown.
- .5 Provide flexible duct connections between the unit and ductwork.
- .6 For overhead installation suspend unit on hangers and in accordance with manufacturer's installation literature and with seismic restraints, as per general mechanical requirements.

- .7 Provide piping connections to coils such that individual coils can be isolated, drained and removed. Provide valved pressure gauge connections and thermometer wells on the entering and leaving piping.
- .8 Provide valved drain connections with hose end, cap and chain for all coils.
- .9 Pipe all drain pan connections the nearest floor drain with appropriately sized trap.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 CODES, PERMITS AND INSPECTIONS

- .1 Applicable Codes
 - .1 Ontario Electrical Safety Code
 - .2 Canadian Electrical Code with applicable regional amendments
 - .3 Ontario Building Code
 - .4 National Building Code
 - .5 Ontario Fire Code
 - .6 National Fire Code and Fire Commissioner Canada requirements
- .2 Comply with Ontario Electrical Safety Code, all local, provincial and federal laws, where applicable and with authorities having jurisdiction. Make any changes or alterations required by authorized inspector of authority having jurisdiction.
- .3 Equipment and material must be acceptable to Electrical Safety Authority.
- .4 Where materials are specified which require special inspection and approval, obtain such approval for the particular installation with the co-operation of the material supplier.
- .5 Obtain and pay for permits and inspections required for work performed.
- .6 Supply and install warning signs, nameplates and glass covered Single Line Diagrams as required by Electrical Safety Authority.
- .7 Submit required Documents and shop drawings to authorities having jurisdiction in order to obtain approval for the Work. Copies of Contract Drawings and Specifications may be used for this purpose.

1.3 REFERENCE STANDARDS

- .1 These Specifications supplement the referenced standards.
- .2 Where standards differ between authorities, the most rigid apply.
- .3 Where requirements of the specifications exceed referenced standards, the specifications apply.

1.4 COORDINATION

- .1 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences. Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.
- .2 Coordinate Work of this Division such that items will properly interface with Work of other Divisions.

- .3 Architectural Drawings, or in the absence of Architectural Drawings, Mechanical Drawings govern all locations.
 - .4 Coordinate work of this Division with Division 21 to ensure that damage does not occur to the fireproofing work of Division 21.
- 1.5 **SUBSTITUTIONS**
- .1 When only one manufacturer's catalogued trade name is specified, provide only that catalogued trade name, material or product.
 - .2 When more than one manufacturer's trade name is specified for a material or product, the choice is the bidders.
 - .3 No substitution is allowed upon award of contract.
- 1.6 **DIMENSIONS AND QUANTITIES**
- .1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to shop drawings and field measurement.
 - .2 Quantities or lengths indicated in Contract Documents are approximate only and shall not be held to gauge or limit the Work.
 - .3 Make necessary changes or additions to routing of conduit, cables, cable trays, and the like to accommodate structural, mechanical and architectural conditions. Where raceways are shown diagrammatically run them parallel to building column lines.
- 1.7 **EQUIPMENT LOCATIONS**
- .1 Devices, fixtures and outlets may be relocated, prior to installation, from the location shown on the Contract Drawings, to a maximum distance of 3 m, without adjustment to Contract price.
 - .2 Switch, control device and outlet locations are shown diagrammatically.
- 1.8 **WORKING DRAWINGS AND DOCUMENTS**
- .1 Where the word "HOLD" appears on Drawings and other Contract Documents, the Work is included in the Contract. Execute such Work only after verification of dimensions and materials and obtaining Consultant's written permission to proceed.
- 1.9 **INSTALLATION DRAWINGS**
- .1 Prepare installation drawings for equipment, based upon approved Vendor drawings, to check required Code clearances, raceway, busway and cable entries, sizing of housekeeping pads and structure openings. Submit installation drawings to Consultant for review.
- 1.10 **"AS BUILT" RECORD DRAWINGS**
- .1 Maintain a set of Contract Drawings on site and record all deviations from the Contract Documents. As a mandatory requirement, recording must be done on the same day deviation is made. Be responsible for full compliance with this requirement.
 - .2 Mark locations of feeder conduits, junction and terminal boxes and ducts or conduits run underground either below the building or outside the building.

- .3 Where conduit and wiring are underground or underfloor, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades.
- .4 Record deviations from branch circuit numbers shown on Drawings.
- .5 Prepare diagrams of interconnecting wiring between items of equipment including equipment supplied by Owner and under other Specification Sections.

1.11 **TEST REPORTS**

- .1 For each check and test performed prepare and submit a Test Report, signed by the Test engineer, and where witnessed, by the Consultant.
- .2 Include record of all tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test engineer, witnesses, also calibration record of all test instruments used together with manufacturers name, serial number and model number.
- .3 Include calibration record, percentage error and applicable correction factors.
- .4 Submit a Certified Test Report from each manufacturer, signed by the certifying inspector, confirming correct installation and operation of each product and part of Work. Include name of certifying inspector, date and times of inspection, ambient conditions.

1.12 **SHOP (VENDOR) DRAWINGS AND PARTS LISTS**

- .1 Submit for review, manufacturer's or vendor's drawings for all products being furnished except cable (up to 1000V), wire and conduit. Include rating, performance, specification sheets, descriptive literature, schematic and wiring diagrams, dimensional layouts and weights of components as well as complete assembly.
- .2 Drawings for equipment assemblies, such as switchgear and unit substations, must include the entire assembly on a single drawing having a minimum size of 420 mm x 594 mm.

PART - 2 PRODUCTS

2.1 **APPROVALS AND QUALITY**

- .1 Provide new materials bearing certification marks or labels acceptable under Ontario Electrical Safety Code.
- .2 Equipment must bear, on manufacturer's label, certification mark or label acceptable under Electrical Safety Authority.
- .3 Provide units of same manufacture where two or more units of same class or type of equipment are required.
- .4 Manufacturer's names are stated in this Specification to establish a definite basis for tender submission and to clearly describe the quality of product that is desired for the work.

2.2 **STANDARD SPECIFICATIONS**

- .1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all products provided comply with latest issue of applicable Standard Specifications issued by authorities having jurisdiction, but such Standard Specifications shall not be applied to decrease the quality of workmanship, products and services required by the Contract Documents.

2.3 EQUIPMENT COLOUR CODING

- .1 Exterior finish paint colour for switchgear, control panels, panelboards and devices on emergency and UPS systems:
 - .1 Emergency systems: red
 - .2 UPS systems: blue

2.4 PRODUCTS FURNISHED BY OWNER

- .1 Carefully examine the Vendor or Manufacturers' drawings and provide any incidental and miscellaneous materials, mounting hardware and supports required for complete systems.

2.5 INTERFERENCE/INTERFACE DRAWINGS

- .1 Contractor shall prepare a fully coordinated interference/interface drawing including ALL services and equipment which is intended to be supported from the structure above. The services to be coordinated include BUT are not limited to HVAC piping, domestic piping and drainage, FSP and sprinkler piping including sprinkler head locations, all HVAC ductwork, all equipment, all lighting, all electrical, communication, security, fire alarm, audio visual systems wiring, conduit, cable, race ways and all other essential vertically-horizontally mounted services. The said services point of origin and destination must be clearly identified,
- .2 The interference drawing shall:
 - .1 be a composite drawing showing all of the required services complete with elevation markers as required.
 - .2 Illustrate that the architectural dimensions can be achieved between the finished floor and the underside of the total sum services at the ceiling level. (Refer to the architectural drawings for exact clear dimensions required.)
 - .3 be issued in the form of a shop drawing for review by the Consultant.
 - .4 include all sections to satisfy the requirements of the submittal
- .3 The purchasing, fabrication and installation of all of the related services shall not commence until the above review process has been completed without any pending comments or requirements. Purchasing, fabricating and installing any of the related services prior to the above shop drawing review process shall be at the contractor's risk."

PART - 3 EXECUTION

3.1 MANUFACTURER'S ATTENDANCE

- .1 Provide manufacturer's representatives to initially start-up each part of the Work, as specified, to check, adjust, calibrate and balance as applicable all components including controls and field wiring. Provide these services for such period and for as many visits as necessary to achieve complete working order in the subject Work.

3.2 FIELD INSPECTION

- .1 Provide field engineer for inspection and certification of equipment during installation, testing and commissioning as required.

3.3 CORE DRILLING

- .1 Core Drilling Procedure
 - .1 Examine locations to be core drilled where:
 - .1 Diameter is greater than 25 mm
 - .2 Multiple drillings required and where the distance between centres is less than 10 times the diameter of the hole
 - .2 Examine by most suitable method including:
 - .1 X-ray
 - .2 Ferro scan
 - .3 Cable detection
 - .3 Examine from both sides of the structure to be drilled.
 - .4 Examine proposed core drilling locations to determine:
 - .1 Possible interference with
 - .1 Services
 - .2 Structural components
 - .2 Possible presence of asbestos tile or other asbestos based material. Report any occurrence or suspected occurrence to the Consultant immediately.
 - .5 Select locations as suitable for core drilling and label them:
 - .1 Uniquely number each drilling location and core so that markings will be legible after drilling
 - .2 Mark each core with a north pointing arrow where drilling a slab or upward pointing arrow where drilling a wall
 - .6 Without interfering with or damaging any services or structural elements, drill pilot holes sufficient to verify location of potential obstructions or for alignment purposes.
 - .7 Use impact drill when drilling holes of 25 mm diameter or less. For holes of greater diameter use core drill.
 - .8 Prepare report showing intended core drill locations including printouts, X-ray images. Submit the report for approval prior to drilling to Consultant.
 - .9 Proceed with core drilling only after approval has been received from Consultant.
 - .10 Confine drilling operation to time-of-day as stipulated by Consultant.
 - .11 Position suitable warning notices of a type acceptable to Consultant and exercise caution to ensure safety and protection of personnel and property during drilling especially from effects of water, dust damage, or falling objects below the slab or behind the wall being drilled.
 - .12 Stop drilling immediately, and report to Consultant, if contact is made with foreign objects such as reinforcing steel (rebar), electrical conduit, water pipes, drainage pipes.
 - .13 Cover open holes with secured covers to guard against fall through of objects.

- .14 Provide necessary firestopping, temporary or otherwise, sufficient to firestop holes that would be otherwise open during hours that the location is unattended. Coordinate placement of firestopping with Consultant.
- .15 Store all cores or core fragments on site and make them available for inspection by Consultant. Dispose of the cores or core fragments after permission is received from Consultant.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
- .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 RELATED SECTIONS

- .1 Section 26 05 01: Basic electrical requirements.
- .2 Section 26 05 54: Electrical identification.

1.3 REFERENCES

- .1 Conform to latest issues, amendments and supplements of following standards:
- | | | |
|-----|------------------------|---|
| .1 | CISC/CPMA 2.75 | Canadian Institute of Steel Construction/
Canadian Paint Manufacturers Association, A
Quick Drying Primer For Use on Structural Steel |
| .2 | CAN/CGSB-1.40-M | Primer, Structural Steel, Oil Alkyd Type |
| .3 | CAN3-C21.1-M | Control Cable - 600V |
| .4 | CAN3-C21.2-M | Control Cable for Low Energy Circuits 150V and
300V |
| .5 | CAN/CSA C22.2 No. 18 | Outlet Boxes, Conduit Boxes, and Fittings |
| .6 | CAN/C22.2 No. 26 | Wireways, Auxiliary Gutters and Associated
Fittings |
| .7 | CSA C22.2 No. 30-M | Explosion-Proof Enclosures for Use in Class I
Hazardous Locations |
| .8 | CSA C22.2 No. 38-M | Thermoset Insulated Wires and Cables |
| .9 | CSA C22.2 No. 40-M | Cutout, Junction and Pull Boxes |
| .10 | CSA C22.2 No. 42-M | General Use Receptacles, Attachment Plugs and
Similar Wiring Devices |
| .11 | CSA C22.2 No. 45-M | Rigid Metal Conduit |
| .12 | CSA C22.2 No. 49 | Flexible Cords and Cables |
| .13 | CAN/CSA C22.2 No. 51-M | Armoured Cables |
| .14 | CSA C22.2 No. 52-M | Service-Entrance Cables |
| .15 | CSA C22.2 No. 56 | Flexible Metal Conduit and Liquid-Tight Flexible
Metal Conduit |
| .16 | CSA C22.2 No. 62 | Surface Raceway Systems |
| .17 | CSA C22.2 No. 65 | Wire Connectors |
| .18 | CSA C22.2 No. 75-M | Thermoplastic Insulated Wires and Cables |
| .19 | CSA C22.2 No. 76-M | Splitters |

.20	CSA C22.2 No. 79	Cellular Metal and Cellular Concrete Floor Raceways and Fittings
.21	CSA C22.2 No. 80	Underfloor Raceways and Fittings
.22	CSA C22.2 No. 83-M	Electrical Metallic Tubing
.23	CAN/CSA-C22.2 No. 85-M	Rigid PVC Boxes and Fittings
.24	CAN/CSA C22.2 No. 94-M	Special Purpose Enclosures
.25	CSA C22.2 No. 123-M	Aluminum Sheathed Cables
.26	CSA C22.2 No. 124-M	Mineral-Insulated Cables
.27	CSA C22.2 No. 126-M	Cable Tray Systems
.28	CSA C22.2 No. 127	Equipment Wires
.29	CAN/CSA-C22.2 No. 131-M	Type Teck 90 Cable
.30	CSA C22.2 No. 138-M	Heat Tracing Cable and Cable Sets for Use in Hazardous Locations
.31	CSA C22.2 No. 159-M	Attachment Plugs, Receptacles and Similar Wiring Devices for Use in Hazardous Locations: Class I, Groups A, B, C, and D; Class II, Group G, in Coal or Coke Dust, and in Gaseous Mines
.32	CSA C22.2 No. 174-M	Cable and Cable Glands for Use in Hazardous Locations
.33	CSA C22.2 No. 182.1	Industrial Type, Special Use Attachment Plugs, Receptacles, and Connectors
.34	CSA C22.2 No. 182.2-M	Industrial Locking Type, Special Use Attachment Plugs, Receptacles, and Connectors
.35	CSA C22.2 No. 182.3-M	Special Use Attachment Plugs, Receptacles, and Connectors
.36	CSA C22.2 No. 208-M	Fire Alarm and Signal Cable
.37	CSA C22.2 No. 211.2-M	Rigid PVC (Unplasticized) Conduit
.38	CSA C22.2 No. 211.3	Rigid Fiberglass Reinforced Epoxy (RE) Conduit and Associated Fittings
.39	CSA C22.2 No. 214-M	Communications Cables
.40	CSA C22.2 No. 222-M	Type FCC Under-Carpet Wiring System
.41	CSA C22.2 No. 227.1	Electrical Nonmetallic Tubing
.42	CSA C22.2 No. 227.2	Flexible Liquid-Tight Nonmetallic Conduit
.43	CSA C22.2 No. 227.3-M	Flexible Nonmetallic Tubing
.44	CSA C22.2 No. 230-M	Tray Cables
.45	CSA C22.2 No. 232-M	Optical Fiber Cables
.46	SSPC	Steel Structures Painting Council "Steel Structures Painting Manual, Vol. 2"

1.4 **SUBMITTALS**

- .1 Consultant reserves the right to require Contractor to submit samples of any materials to be used in this project.

PART - 2 PRODUCTS

2.1 **WIRE - LOW VOLTAGE UP TO 1000V SERVICE**

- .1 Conductors
 - .1 ASTM Class B, soft drawn, electrolytic copper
 - .2 Stranded
- .2 Insulation
 - .1 CSA type RW90 XLPE (-40°C)
 - .1 Heat and moisture resistant
 - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
 - .3 600V rated
 - .4 For maximum 90°C conductor temperature
 - .5 For installation at minimum -40°C temperature
 - .6 To CSA C22.2 No. 38
 - .2 CSA type RWU90 XLPE (-40°C):
 - .1 Heat and moisture resistant
 - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
 - .3 1000V rated
 - .4 For maximum 90°C conductor temperature
 - .5 For installation at minimum -40°C
 - .6 To CSA C22.2 No. 38
 - .3 CSA type T90 NYLON (-10°C):
 - .1 Heat resistant
 - .2 Flame retardant
 - .3 Thermoplastic PVC material with extruded nylon cover
 - .4 600V rated
 - .5 For maximum 90°C conductor temperature dry and 75°C in wet locations
 - .6 For installation at minimum -10°C
 - .7 To CSA C22.2 No. 75-M
 - .4 CSA type TEW:
 - .1 Heat resistant

- .2 600V rated
- .3 For maximum 105°C conductor temperature
- .4 To CSA C22.2 No. 127
- .5 CSA type SEW-2
 - .1 Heat resistant
 - .2 600V rated
 - .3 For maximum 200°C conductor temperature
 - .4 To CSA C22.2 No. 127
- .3 Acceptable Manufacturers
 - .1 Alcan Cable
 - .2 Alcatel Canada Wire
 - .3 Pirelli Cables
- 2.2 **CABLE - LOW VOLTAGE UP TO 1000V SERVICE**
 - .1 CSA Type AC90 XLPE (-40°C)
 - .1 Conductors
 - .1 ASTM Class B, soft drawn, electrolytic copper
 - .2 Solid for sizes #10 AWG and smaller
 - .3 Stranded for sizes #8 AWG and larger
 - .2 Insulation
 - .1 Heat and moisture resistant
 - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
 - .3 600V rated for sizes #10 AWG and smaller
 - .4 1000V rated for sizes #8 AWG and larger
 - .5 For maximum 90°C conductor temperature
 - .6 For installation at minimum -40°C temperature
 - .7 To CSA C22.2 No. 38
 - .3 Construction
 - .1 2, 3 or 4 insulated conductors
 - .2 Bare ground conductor
 - .3 Overall interlocking aluminum armour
 - .4 To CSA C22.2 No. 51
 - .4 Acceptable Manufacturers
 - .1 Alcan Cable
 - .2 Alcatel Canada Wire
 - .3 Pirelli Cables

- .2 CSA Type TECK90 (-40°C)
 - .1 Conductors
 - .1 ASTM Class B, soft drawn, electrolytic copper
 - .2 Stranded
 - .2 Insulation
 - .1 Heat and moisture resistant
 - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
 - .3 600V or 1000V rated
 - .4 For maximum 90°C conductor temperature
 - .5 For installation at minimum -40°C temperature
 - .6 CSA type RW90 XLPE
 - .7 To CSA C22.2 No. 38
 - .3 Construction
 - .1 1 or more insulated conductors
 - .2 Bare, stranded, copper ground conductor for multi-conductor cables
 - .3 Bare, solid, served copper ground conductors for single conductor cables
 - .4 Fillers with binder tape to produce a circular cross-section for multi-conductor cables
 - .5 Power cables
 - .1 1, 2, 3 or 4 conductors
 - .2 Conductors 1000V rated
 - .6 Control cables
 - .1 2 or more conductors
 - .2 Conductors 600V rated
 - .7 Composite cables
 - .1 3 power conductors
 - .2 3 #14 AWG control conductors
 - .3 Conductors 600V rated
 - .8 Extruded PVC inner jacket over conductor assembly
 - .9 Interlocking aluminum armour over inner jacket
 - .10 Extruded PVC overall jacket over armour
 - .1 FT4 flame test rated
 - .2 Colour black unless otherwise indicated
 - .11 Cable assembly for installation at minimum -40°C temperature
 - .12 To CSA C22.2 No. 131 and CSA C22.2 No. 174

- .4 Acceptable Manufacturers
 - .1 Alcan Cable
 - .2 Alcatel Canada Wire
 - .3 BICC Phillips
 - .4 Pirelli Cables
- .3 CSA Type RA90 XLPE (-40°C)
 - .1 Conductors
 - .1 ASTM Class B, soft drawn, electrolytic copper
 - OR
 - .2 CSA type ACM aluminum alloy
 - .3 Stranded
 - .2 Insulation
 - .1 Heat and moisture resistant
 - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
 - .3 600V rated
 - .4 For maximum 90°C conductor temperature
 - .5 For installation at minimum -40°C temperature
 - .6 CSA type RW90 XLPE
 - .7 To CSA C22.2 No. 38
 - .3 Construction
 - .1 Single conductor
 - .2 Continuous, corrugated aluminum sheath of minimum cross-sectional area to comply with Ontario Electrical Safety Code Table 16
 - .3 Extruded PVC overall jacket over armour
 - .1 FT4 flame test rated
 - .2 Colour black unless otherwise indicated
 - .4 Cable assembly for installation at minimum -40°C temperature
 - .5 To CSA C22.2 No. 123 and CSA C22.2 No. 174
 - .4 Acceptable Manufacturers
 - .1 Alcan Cable
 - .2 Alcatel Canada Wire
 - .3 BICC Phillips
- .4 CSA Type MI
 - .1 Conductors
 - .1 ASTM Class B, soft drawn, electrolytic copper

- .2 Solid
- .2 Insulation
 - .1 Powdered magnesium oxide
 - .2 600V rated
- .3 Construction
 - .1 Solid conductor
 - .2 Insulation around the conductor compressed to form a solid, homogeneous mass between the conductor and the metal sheath throughout the entire length of cable
 - .3 Soft annealed seamless copper sheath over insulation
- .4 Acceptable Manufacturer
 - .1 Pyrotenax

2.3 **MODULAR WIRING (LIGHTING SYSTEMS)**

- .1 Distribution Boxes
 - .1 Steel, EEMAC 1 enclosure, minimum size 300 mm x 300 mm x 100 mm
 - .2 Modular connectors, 5 wire, female
 - .3 Terminal block for incoming wiring
 - .4 Stranded copper wiring between terminal block and modular connectors
- .2 Extension/Tap Cables
 - .1 Armoured type cable, #10 or #12 AWG, copper conductors rated 600V, 90°C insulation
 - .2 Modular connectors, 5 wire, one male at one end and twin female at other end or splitters to maintain circuit continuity on removal of luminaire drop cable
- .3 Luminaire Drop Cables
 - .1 Service cord, type SEO or armoured cable, 3 wire, stranded copper conductors rated 600V, 105°C insulation, colour phase identification on jacket (phase A, red; phase B, black; phase C, blue)
 - .2 Modular connector, male
 - .3 Prewired to luminaires
- .4 Modular Connectors
 - .1 Rated 347V, 20A
 - .2 Rated to connect or disconnect an individual luminaire under load
- .5 Acceptable Manufacturers
 - .1 Flex Systems (Flex) 3+
 - .2 Lithonia Reloc
 - .3 Holophane Holoflex
 - .4 Cooper MWS

2.4 **CABLE CONNECTORS**

- .1 Connectors for Type AC90 Cable
 - .1 Steel
 - .2 Insulated throat
 - .3 Acceptable manufacturers
 - .1 Efcor 1000B series
 - .2 Elliott 65200 series
 - .3 Thomas & Betts 3110 series
- .2 Connectors for Type TECK90 Cable
 - .1 Copper free aluminum body
 - .2 Steel or copper free aluminum fittings and locknut
 - .3 Certified for use in hazardous locations Classes I, II, and III
 - .4 Class I hazardous location sealing fitting
 - .5 Acceptable manufacturers
 - .1 Thomas & Betts "STE" series
 - .2 Crouse-Hinds type TMC
 - .3 Commander/Iberville type TEK
- .3 Connectors for Type RA90 Cable
 - .1 Copper free aluminum body
 - .2 Steel or copper free aluminum fittings
 - .3 Acceptable manufacturers
 - .1 Alcatel Canada Wire
 - .2 Crouse-Hinds, type TMC
- .4 Connectors for Type TC, Tray Cable
 - .1 Copper free aluminum body
 - .2 Steel or copper free aluminum fittings and locknut
 - .3 Acceptable manufacturers
 - .1 Thomas & Betts, Tray-Star, HLT series
 - .2 Crouse-Hinds, type TMC

2.5 **WIRE AND CABLE CONNECTORS**

- .1 Copper compression type wire and cable terminations for #8 AWG and larger conductors, colour keyed, sized to suit. Long barrel NEMA 2 hole lugs for sizes #1/0 AWG and larger.
 - .1 Acceptable Manufacturers
 - .1 Thomas & Betts series 54000
 - .2 Ideal Powr-Connect
 - .3 Burndy Hylug

- .2 Twist type splicing connectors, copper, sized to suit, with nylon or plastic shroud for tee connections in #10 AWG and smaller conductors.
 - .1 Acceptable Manufacturers
 - .1 Thomas & Betts spring type
 - .2 Ideal Twister
 - .3 Marr Marrette
 - .3 Conductor compression splice for #10 AWG or smaller.
 - .1 Acceptable Manufacturers
 - .1 Thomas & Betts STA-Kon series
 - .2 Ideal Splices
 - .3 Burndy
- 2.6 **HEAT SHRINKABLE TUBING INSULATION, HEAVY WALL**
 - .1 Acceptable Manufacturers
 - .1 Thomas & Betts, Shrink-Kon series
 - .2 Ideal Thermo-Shrink, TS-46
 - .3 Raychem tubing WCSM
 - .4 3M cable sleeve ITCSN
- 2.7 **MOTOR LEAD CONNECTION KITS, 600 VOLT**
 - .1 Connection kits for low voltage motors.
 - .2 Acceptable Manufacturers
 - .1 3M, motor lead splice kit, pigtail, 5300 series
 - .2 Raychem, motor connection kit, MCK, type V
- 2.8 **CONDUIT AND FITTINGS**
 - .1 Rigid Steel Conduit
 - .1 To CSA C22.2 No. 45-M
 - .2 Rigid thickwall galvanized steel threaded conduit
 - .2 Coated Steel Conduit
 - .1 Corrosive resistant coated rigid thickwall steel threaded conduit, CSA approved.
 - .2 Acceptable Manufacturers
 - .1 Rob Roy Plastibond PVC coated
 - .2 Columbex Green Guard II epoxy polyester coated
 - .3 Rigid PVC Conduit
 - .1 To CSA C22.2 No. 211.2-M
 - .2 Rigid PVC conduit

- .4 Flexible Steel Conduit
 - .1 To CSA 22.2 No. 56
 - .2 Liquid-tight flexible steel conduit with PVC cover
- .5 Non-Metallic Flexible Conduit
 - .1 Non-metallic extra flexible PVC conduit
 - .2 Acceptable Manufacturers
 - .1 Carlon, Carflex X-Flex
 - .2 Hubbell, Polytuff Black
- .6 Rigid Steel Conduit Fittings
 - .1 To CAN/CSA C22.2 No. 18
 - .2 Galvanized or polymer coated cast steel fittings
 - .3 Expansion fittings, watertight with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions
 - .4 Sealing condulets for hazardous areas
 - .5 Corrosive resistant coated cast steel fittings for corrosive resistant conduit
- .7 Rigid PVC Conduit Fittings
 - .1 To CSA C22.2 No. 85-M
 - .2 Rigid PVC fittings of same manufacture as rigid PVC conduit
- .8 Liquid Tight Flexible Steel Conduit Fittings
 - .1 Watertight connectors with nylon insulated throat
 - .1 Acceptable Manufacturers:
 - .1 T & B Series 5331 with Sealing O-ring Series 5262
 - .2 Commander/Iberville Series 6300-IT with nitrile O-ring

2.9 **EMT AND FITTINGS**

- .1 EMT
 - .1 To CSA C22.2 No. 83-M
 - .2 EMT galvanized cold rolled steel tubing
- .2 EMT Fittings
 - .1 Compression type, steel
 - .1 Gland compression connectors with insulated throats
 - .2 Compression couplings
 - .3 Acceptable manufacturers:
 - .1 T & B Series 5123 & 5120
 - .2 O-Z/Gedney type ZTC series
 - .3 Commander/Iberville Series 5600-IT and 5700

- .2 Set screw type, steel, concrete-tight
 - .1 Connectors with insulated throats
 - .2 Couplings
 - .3 Acceptable manufacturers
 - .1 Commander/Iberville Series 5400 and 5500

2.10 **CABLE TRAY**

- .1 Cable Trays and Fittings
 - .1 To EEMAC F5-1
 - .2 To CAN/CSA C22.2 No. 126-M
- .2 Ladder Type
 - .1 Class C1
 - .2 Steel, hot dip galvanized after fabrication
 - .3 Side height, 100 mm (150 mm)
 - .4 Rung spacing, 300 mm
- .3 Ventilated Type
 - .1 Class C1
 - .2 Steel, hot dip galvanized after fabrication
 - .3 Side height, 100 mm
- .4 Solid Type
 - .1 Class C1
 - .2 Steel, hot dip galvanized after fabrication
 - .3 Side height, 100 mm
- .5 Centre Rail Type
 - .1 Class C1
 - .2 Steel
 - .3 Rung spacing 225 mm
 - .4 Loading depth 100 mm
 - .5 Rung width 25 mm minimum
- .6 Acceptable manufacturers for ladder, ventilated and solid types:
 - .1 B-Line
 - .2 Canadian Electrical Raceways
 - .3 Canstrut
 - .4 Electrotray
 - .5 Pilgrim
 - .6 Pursley

- .7 Unistrut
- .7 Acceptable manufacturers for centre rail type:
 - .1 Wiremold, Spec Mate CA series
 - .2 B-Line, Cent-R-Rail
- 2.11 **WIREWAY**
 - .1 To CSA C22.1 No. 94-M.
 - .2 Steel with hinged cover to give uninterrupted access.
 - .3 Elbows, tees, couplings and hanger fittings manufactured as accessories for wireway supplied.
 - .4 Acceptable Manufacturers:
 - .1 Amalgamated Electric
 - .2 Canadian Electrical Raceways
 - .3 Schneider Square D
 - .4 Pilgrim
 - .5 Pursley
- 2.12 **SURFACE RACEWAY**
 - .1 Surface metal raceway, snap-in divider to form 2 compartments for power and voice/data, with removable cover.
 - .2 Elbows, couplings, end caps, device brackets and faceplates for power, data and voice, and fittings manufactured as accessories for wireway supplied. 120V power receptacles and mounting only for voice/data.
 - .3 Acceptable manufacturer:
 - .1 Wiremold with following components:
 - .1 4000 series, ivory colour
 - .2 Device mounting plate, V4049-G and faceplate 5507-G colour grey
 - .3 Duplex receptacles, 120V, 15A, Leviton Decora plus, colour grey 16262-GY
 - .4 Duplex receptacle, 120V, 20A, P & S Sierraplex, colour grey, 26342-GRY
- 2.13 **FASTENINGS, SUPPORTS AND SLEEVES**
 - .1 Fastenings
 - .1 Galvanized steel straps, beam clamps and threaded rods
 - .2 Sleeves
 - .1 Schedule 40 steel pipe, minimum I.D. 13 mm larger than O.D. of conduit or cable passing through.
 - .3 Strut
 - .1 Continuous slotted channel

- .2 12 gauge pre-galvanized steel
- .3 41.2 mm x 41.2 mm minimum
- .4 Acceptable manufacturers:
 - .1 B-Line
 - .2 Pilgrim
 - .3 Pursley
 - .4 Unistrut

2.14 **SPLITTER BOXES**

- .1 Code gauge sheet steel enclosure EEMAC Type 1 welded corners and formed hinged cover suitable for locking in closed position.
- .2 Cast steel enclosure EEMAC 9 with gasketed bolt on cover for hazardous locations.
- .3 Copper main and branch lugs to match required size and number of incoming and outgoing conductors.
- .4 At least 3 spare terminals on each set of lugs in splitters less than 400 A.

2.15 **JUNCTION BOXES**

- .1 Galvanized steel EEMAC Type 1 size as required by code for number and size of conduits, conductors and devices, complete with covers, corrosion resistant screws, terminal blocks and mounting rails.
- .2 Screw-on sheet steel covers to match enclosure for surface mounting boxes.
- .3 Covers with 25 mm minimum extension around for flush-mounted junction boxes.
- .4 Galvanized steel barriers as required.

2.16 **TERMINAL BLOCKS - SURGE PROTECTION**

- .1 Terminal blocks, rail mounted, with surge voltage protection, rated for circuit voltage.
- .2 Acceptable Manufacturers
 - .1 Phoenix Contact Termitrab SLKK5.

2.17 **PULL BOXES**

- .1 Galvanized sheet steel welded construction, EEMAC Type 1.
- .2 Screw-on galvanized sheet steel covers for surface mounting boxes.
- .3 Covers with 25 mm minimum extension around, for flush mounted pull boxes.
- .4 Galvanized steel barriers as required.

2.18 **CONDUIT BOXES - GENERAL**

- .1 Boxes for EMT
 - .1 Galvanized pressed steel

- .2 Boxes for Rigid Steel Conduit
 - .1 Galvanized cast iron alloy FS boxes with mounting feet for surface mounted switches and receptacles
 - .2 Gasketed cover plate for exterior location
 - .3 For corrosive resistant coated conduit: cast boxes with same finish as conduit
- .3 Boxes for Rigid PVC Conduit
 - .1 PVC boxes
- 2.19 **OUTLET BOXES - SHEET STEEL**
 - .1 Pressed steel single and multi-gang flush device boxes, minimum size 100 mm x 50 mm x 38 mm. 100 mm square outlet boxes where more than 1 conduit enters 1 side, with extension rings as required.
 - .2 100 mm square or octagonal outlet boxes.
 - .3 119 mm square outlet boxes with extension and plaster rings as necessary for flush mounting devices in gypsum board, plaster or panelled walls.
- 2.20 **MASONRY BOXES**
 - .1 Pressed steel masonry single and multi-gang boxes for devices flush mounted in exposed masonry walls with extension and plaster rings as required.
- 2.21 **CONCRETE BOXES**
 - .1 Pressed steel concrete type boxes for flush mount in concrete with extension and plaster rings as required.
- 2.22 **OUTLET BOXES - FITTINGS**
 - .1 Bushings and connectors with nylon insulated throats.
 - .2 Knock-out fillers to prevent entry of foreign materials.
 - .3 Double locknuts and insulated bushings for sheet steel metal boxes.
- 2.23 **WIRING DEVICES - SWITCHES**
 - .1 Specification grade, general purpose AC switches, manual toggle operated, ivory and brown colour, 15A, 20A, 120-277V, 347V, single pole, double pole, three-way, four-way switches as required.
 - .2 Acceptable manufacturers:
 - .1 Hubbell - HBL1201 Series: HBL1221 Series: HBL18201 Series: HBL 18221 Series
 - .2 P & S - 15AC Series: 20AC Series: 370000 Series
 - .3 Arrow Hart - 1891 Series: 1991 Series: 18201 Series: 18221 Series
 - .3 Specification grade, general purpose AC switches, manual rocker operated, ivory colour, 15A, 20A, 120-277V, 347V, single pole, double pole, 3 way, 4 way switches as required.
 - .4 Acceptable Manufacturers
 - .1 Bryant, 120-277V, Fashion Series 9000

- .2 Hubbell, 120-277V, Style Line 2100 Series
- .3 Leviton, 120-277V and 347V, Decora Plus 5600 Series
- .4 Pass & Seymour, 120-277V and 347V, Sierraplex Decorator, 2600 and 2600000 Series

2.24 WIRING DEVICES - DIMMER SWITCHES

- .1 Dimmer switches: solid state, full range with slider type handle on-off switch, rated to suit circuit load, 1000 watts minimum, 120 volts.
- .2 Acceptable Manufacturers:
 - .1 P & S
 - .2 Lutron

2.25 WIRING DEVICES - RECEPTACLES FOR GENERAL SERVICE

- .1 Receptacles: specification grade suitable for back and side wiring, complete with grounding terminal, colour as required for type of area for straight blade devices and black colour for twistlock devices.
- .2 Receptacles of one manufacturer.
- .3 Acceptable Manufacturers:
 - .1 15A, 125V, (5-15R) Single Straight Blade
 - .1 Arrow Hart 5261
 - .2 Leviton 5261
 - .3 Hubbell 5261
 - .4 Pass & Seymour 5261
 - .2 15A, 125V, (5-15R) Duplex Straight Blade
 - .1 Arrow Hart 5262
 - .2 Leviton 5262
 - .3 Hubbell 5262
 - .4 Pass & Seymour 5262
 - .3 20A, 125V, (5-20R) Single Straight Blade
 - .1 Arrow Hart 5361
 - .2 Leviton 5361
 - .3 Hubbell 6331
 - .4 Pass & Seymour 5361
 - .4 20A, 125V, (5-20R) Duplex Straight Blade
 - .1 Arrow Hart 5392
 - .2 Leviton 5362
 - .3 Hubbell 5392
 - .4 Pass & Seymour 5362

- .5 15A, 125V, (5-15R) Duplex GFCI, Straight Blade
 - .1 Arrow Hart GF5242AH
 - .2 Leviton 6599-W
 - .3 Hubbell GF-5252
 - .4 Pass & Seymour 1591
- .6 15A, 125V, (5-15R) Duplex Isolated Ground Straight Blade
 - .1 Arrow Hart IG5262AH
 - .2 Leviton 5262-IG
 - .3 Hubbell IG-5262
 - .4 Pass & Seymour IG6200
- .7 20A, 125V, (L5-20R) Single locking, 2 pole, 3 wire grounding
 - .1 Arrow Hart 6200
 - .2 Leviton 2310
 - .3 Hubbell 2310ACN
 - .4 Pass & Seymour L520-RCN
- .8 20A, 250V, (L6-20R) Single locking, 2 pole, 3 wire, grounding
 - .1 Arrow Hart 6210
 - .2 Leviton 2320
 - .3 Hubbell 2320ACN
 - .4 Pass & Seymour L620-RCN
- .9 30A, 250V, (L6-30R) Single locking, 2 pole, 3 wire, grounding
 - .1 Arrow Hart 6340
 - .2 Leviton 70630-FR
 - .3 Hubbell 2620CAN
 - .4 Pass & Seymour L630RCN
- .10 30A, 250V, (L15-30R) Single locking, 3 pole, 4 wire, phase, grounding
 - .1 Arrow Hart 6520
 - .2 Leviton 2720
 - .3 Hubbell 2720ACN
 - .4 Pass & Seymour L1530-RCN
- .11 20A, 277V, (L7-20R) Single locking, 2 pole, 3 wire, grounding
 - .1 Arrow Hart 6220
 - .2 Leviton 2331
 - .3 Hubbell 2330ACN
 - .4 Pass & Seymour L720R

- .12 20A, 347V (L24-20R) Single locking, 2 pole, 3 wire grounding
 - .1 Leviton 3721
 - .2 Pass & Seymour L3720-RCN
- .13 15A, 125V (5-15R) Quad straight blade, 2 pole, 3 wire grounding
 - .1 Bryant 1254
 - .2 Hubbell 415 series
 - .3 Pass & Seymour 1254
- .14 15A, 347V, (24-15R) Quad straight blade, 2 pole, 3 wire grounding
 - .1 Bryant 3474W
 - .2 Hubbell 415347WC
 - .3 Pass & Seymour 3474W
- .15 15A, 125V, (5-15R) Duplex straight blade
 - .1 Arrow Hart 26262
 - .2 Leviton Decora Plus
 - .3 Hubbell 2152 series
 - .4 Pass & Seymour 885
- .16 15A, 125V (5-15R) Duplex straight blade, 2 pole, 3 wire grounding, surge suppression indicator light, blue colour
 - .1 Arrow Hart 5250
 - .2 Hubbell 5260
- .17 15A, 125V (5-15R) Duplex straight blade, 2 pole, 3 wire grounding, isolated ground surge suppression indicator light, blue (ivory) colour
 - .1 Arrow Hart IG5250
 - .2 Hubbell IG5262,

2.26 **WIRING DEVICES - COVER PLATES**

- .1 Stainless steel Type 302 alloy, vertically brushed, 0.8 mm thick cover plates.
- .2 Cast covers for cast boxes with gaskets.
- .3 Cover plates of same manufacture as devices.

2.27 **HEAT TRACING CABLE**

- .1 120 volt copper heat tracing cables for installation on exterior of pipes complete with line voltage thermostat with remote sensor and capillary.
- .2 Acceptable Manufacturers:
 - .1 Thermon
 - .2 Raychem
 - .3 Pyrotenax

2.28 PLYWOOD BACKBOARDS

- .1 Plywood backboards, good one side, 4' x 8' x 3/4" unless indicated otherwise. Treat with primer and two coats of fire retardant paint.
- .2 Mount plywood on vertical strapping, on 40 mm centres to provide 10 mm clearance between wall and rear of plywood. Treat strapping similar to plywood.

2.29 FINISH

- .1 Equipment enclosure finish: baked grey enamel, ANSI 49 or ANSI 61.

PART - 3 EXECUTION

3.1 WIRE AND CABLE

- .1 Install wiring in raceways unless noted otherwise.
- .2 Minimum wire sizes:
 - .1 Power and lighting No. 12 AWG
 - .2 Control No. 14 AWG
 - .3 Fire alarm No. 18 AWG

- .3 Wire and cable application and type:

Application	Type
Lighting branch circuit where connection to luminaire is AC90 cable	T90 nylon
Receptacle branch circuit	T90 nylon
Ceiling boxes to luminaires in suspended ceiling	T90 nylon or AC90 cable
Wiring under raised floor used as plenum	AC90 cable or wire in flexible metal conduit
Wiring inside high temperature equipment	TEW or SEW-2
Branch circuits other than those covered above	RW90
Equipment feeders, circuits	RW90
Underground and under slab raceways, duct banks, direct burial	RWU90

- .4 Type AC90 cable length limitations:
 - .1 Ceiling box to luminaire:
 - .1 1.2 m maximum in non-accessible ceilings;
 - .2 1.8 min accessible ceilings
 - .2 Junction box to outlet:
 - .1 3.6 m maximum

- .5 Load current limitations:
 - .1 Conductors rated for more than 90°C:
 - .1 90°C code ampacity rating
 - .2 Motor connection:
 - .1 75°C code ampacity rating
- .6 EMF-Free Power Cables
 - .1 Install the EMF-free power cable system in complete accordance with the manufacturer's written instructions.
 - .2 Provide a manufacturer's representative on site during installation of the system.
 - .3 At completion of the work, provide a letter from the manufacturer indicating that the system was installed to the manufacturer's satisfaction and that it is ready for use.
 - .4 Provide manufacturer's commissioning report to include the manufacturer's standard readings and specifically the following readings taken at 3 locations, determined by the Consultant; 1 m from the feeder and distance from the feeder where the EMF is 0.5 micro Teslas.
 - .1 Background ac and steady state (dc) EMF readings (feeder de-energized)
 - .2 EMF readings at full load, balanced $\pm 5\%$
 - .3 EMF readings near full load with 20% $\pm 5\%$ unbalance
 - .5 Acceptance Criterion
 - .1 The installation will be deemed not acceptable if the ac EMF is in excess of 0.5 micro Teslas above the background EMF at any point along the feeder not within 2 m of either end for all load conditions
- 3.2 **MODULAR WIRING**
 - .1 Install and connect modular wiring.
- 3.3 **CONNECTORS**
 - .1 Install compression terminations and splices in accordance with manufacturer's written instructions.
 - .2 Make splices in junction boxes.
 - .3 Make connections in lighting circuits with twist type splicing connectors.
 - .4 Terminate and splice conductors No. 8 and larger at terminal blocks in junction boxes.
 - .5 Seal terminations and splices exposed to moisture, corrosive conditions or mechanical abrasions with heavy wall heat shrinkable insulation.
 - .6 Install fixture type connectors and tighten. Replace insulating cap.
- 3.4 **MOTOR LEAD CONNECTION KITS, 600 VOLT**
 - .1 Install motor lead connection kits for low voltage motors.
- 3.5 **CONDUIT AND EMT - GENERAL**
 - .1 Run parallel or perpendicular to building lines.

- .2 Group raceways wherever possible. Support on channels.
- .3 Install expansion joints as required.
- .4 Run raceways in web portion of structural steel columns and beams.
- .5 Do not drill structural members to pass through.
- .6 Locate raceways behind infrared or unit heaters with 1500 mm clearance.
- .7 Locate raceways not less than 125 mm clear where parallel to steam or hot water lines with a minimum of 75 mm at crossovers.
- .8 Do not install horizontal runs in masonry walls.
- .9 Use metallic raceway where temperatures exceed 75°C or where enclosed in thermal insulation.
- .10 EMT and non-metallic conduits to contain insulated green ground wire.
- .11 Install 6 mm diameter nylon pull cord in empty raceways.

3.6 **CONDUIT AND FITTINGS**

- .1 Minimum conduit sizes:
 - .1 Surface installation: 21 trade size conduit
 - .2 Embedded in concrete: (27) trade size conduit
 - .3 Directly buried: 53 trade size conduit

.2 Conduit application and type:

Application	Type
Corrosive areas	rigid steel corrosion resistant coated
Hazardous areas	rigid steel
Outdoor areas	rigid steel
Embedded in concrete, other than grade slab	PVC
In or below grade slab	PVC
Exposed in unfinished areas up to 3 m above finished floor. Use EMT above 3m	rigid steel
Connection to motors and equipment subject to vibration	liquid tight flexible steel conduit
Final connection to dry type transformer	flexible steel conduit
Whip connection to modular furniture	non-metallic extra flexible PVC

- .3 Use field threads on rigid conduit of sufficient length to draw conduits up tight.
- .4 Do not bend coated steel conduit. Use elbows for deflections.
- .5 Do not install conduit in or under slab.
- .6 Use factory "ells" where 90° bends are required for 27 trade size and larger conduits.

- .7 Bend conduit offsets cold. Do not install crushed or deformed conduits and avoid trapped runs in damp or wet locations. Prevent the entrance of water and lodging of concrete, plaster, dirt, or trash in conduit, boxes, fittings, and equipment during course of construction.
- .8 Where conduit joints occur in damp or wet locations, make joints watertight by applying an approved compound on the entire thread area before assembling. Draw up all conduit joints as tightly as possible.
- .9 Cap exposed empty conduits which do not terminate in outlets, panels, cabinets, etc., with standard galvanized plumber's pipe caps.
- .10 Plug empty conduits which terminate flush with floors or walls with flush coupling and brass plug.
- .11 Install conduit sleeves for all exposed conduits and cables passing through walls, ceilings, or floors, and fill void between sleeve and conduit with caulking. If fire-rated caulking is required by code, use same class as walls, ceilings or floors.
- .12 Terminate conduit stubbed up through concrete floor for connection to free standing equipment with a coupling flush with finish floor, and extend rigid conduit to equipment, except where required, use flexible conduit from a point 150 mm above floor.
- .13 Install double locknuts and bushings on all rigid conduit terminations into threadless openings. Increase length of conduit threads at terminations sufficiently to permit bushing to be fully seated against end of conduit.
- .14 Mechanically bend steel conduit.
- .15 Install sealing condulets in conduits at hazardous area boundaries.
- .16 Conduits in Poured Concrete
 - .1 Locate to suit reinforcing steel. Secure firmly to prevent movement during pour.
 - .2 Clear each conduit with mandrel and brush before concrete sets.
 - .3 Protect conduits from damage where they stub out of concrete.
 - .4 Install sleeves where conduits pass through slab or wall.
 - .5 Provide oversized sleeve before membrane is installed where conduits pass through waterproof membrane. Use cold mastic between sleeve and conduit.
 - .6 Encase conduits completely in concrete; provide 50 mm minimum concrete cover.
 - .7 Replace with exposed conduit, any conduit run found to be obstructed after concrete sets.

3.7 **EMT AND FITTINGS**

- .1 Minimum EMT size: 21 trade size conduit.
- .2 EMT Application
 - .1 Exposed in unfinished areas, above truss level and for drops in column web to 3 m above finished floor. Use rigid steel conduit below 3 m.
 - .2 In block walls and stud partitions.

3.8 **CABLE TRAY**

- .1 Install cable tray systems.
- .2 Provide barriers where required by Code.
- .3 Support cable trays from structural members. Support cable tray on both sides or on cantilever brackets to provide continuous open access to one side of the tray as required. Coordinate support locations and weight per support with building structure. Provide any additional support fastenings required.
- .4 Provide the following minimum clearances:
 - .1 300 mm vertical between top of tray and equipment or structure above.
 - .2 300 mm vertical between trays.
 - .3 600 mm horizontal on access side of tray.
- .5 Ensure that sharp burrs or projections are removed to prevent damage to cables and injury to personnel.
- .6 Install cables individually.
- .7 Lay cables into cable tray. Use rollers where necessary, to pull cables.
- .8 For maintained spacing, secure cables in cable tray at 3 m centers for horizontal runs with black coloured tie wraps and at 1500 mm centres for vertical runs with aluminum clamps supplied by tray manufacturer.
- .9 Maintain power cables greater than one diameter minimum spacing unless shown otherwise.
- .10 Firestop Fire Barriers (refer to Section 26 05 01).
 - .1 Frame openings in walls, and floors for width and depth required for cable tray to run through with 50 mm clear all around.

3.9 **WIREWAYS**

- .1 Install per manufacturer's recommendations.
- .2 Keep number of elbows, offsets and connections to a minimum.
- .3 Install barriers where required by Code.
- .4 Install gutters to full length of equipment.

3.10 **SURFACE RACEWAYS**

- .1 Install per manufacturer's recommendations.

3.11 **CELLULAR FLOOR SYSTEM**

- .1 Install trenchduct, preset inserts and activation kits including activation power and data receptacles and telephone jack outlets.
- .2 Tack weld trenchduct to non-cellular decking, and tack weld trenchduct void closures.
- .3 Seal voids at preset inserts, cellular raceway butt joints and void closures with sealing compound.

3.12 **FASTENINGS AND SUPPORTS**

- .1 Provide supports and fastenings for the Work of this Division. Do not use supports or equipment provided by other Trades.
- .2 Equipment fastenings and supports shall conform to manufacturers recommendations.
- .3 Do not attach to, or suspend any electrical product or service from the roof deck, mechanical ductwork or piping.
- .4 Do not use wire lashing or perforated strap to support or secure raceways or cable.
- .5 Support rods for any suspended item must not be attached to or extended through steel pan type roofs or through concrete slab roofs.
- .6 For surface mounting of two or more raceways or cables use channels.
- .7 Where there is no wall support for raceways and cables dropped vertically to equipment, provide channel properly secured to floor and structure.
- .8 Hang supports from structural members. Where location does not permit direct support from structure provide necessary brackets, frames, channels secured to structural members.
- .9 Fasten exposed conduit and cables to building construction or support systems using straps. Use beam clamps on exposed steelwork.
- .10 Masonry, tile and plaster surfaces: use lead anchors.
- .11 Poured concrete: use expandable inserts. Low velocity powder activated fastenings may be used only in poured concrete.
- .12 Steel structures: use clips, spring loaded bolts, cable clamps, designed as accessories to basic channel members.
- .13 Do not use powder activated fasteners in, tile, precast concrete or steel structure.
- .14 Do not install conduits or cables on the bottom chord of joists or trusses.
- .15 Use beam clamps of the 2-bolt design and of such type that the rod load is transmitted only concentrically to the beam web centreline. The use of "C" and "I" beam side clamps will not be allowed.
- .16 Where the roof or floor framing consists of open web or long span steel joists and/or trusses, ensure that hangers are located at or within 150 mm of the joist or truss top or bottom chord panel points, otherwise provide additional structural steel as required where hanger spacing does not coincide with joist or truss spacing. Design suspension assembly such that the hanger load is transmitted only concentrically to the supporting joist or truss. The use of "C" and "I" beam clamps, brackets, etc., will not be allowed.
- .17 Locate secondary structural steel members between joists or trusses at or within 150 mm of top or bottom chord panel points. Where the secondary structural steel member cannot be located at or near a joist or truss panel point, provide additional diagonal structural steel web member/members designed for the applicable load to the nearest panel point in the opposite chord member. Diagonal hangers which will induce lateral stresses in the chord members of the joist will not be permitted. Submit shop drawings of the suspension assembly indicating the location of suspension or support points, the maximum load at each suspension point, location and size of hangers, brackets and intermediate framing members when required, and also details of connection to building structure.

3.13 SPLITTER BOXES

- .1 Install splitters as indicated and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement.

3.14 JUNCTION BOXES

- .1 Install junction boxes in inconspicuous but accessible locations. Secure to structure.
- .2 Install terminal blocks on mounting rails, for termination of each wire and cable regardless of size.
- .3 Only one voltage source is permitted in a junction box.
- .4 Install barriers to separate different auxiliary systems.

3.15 TERMINAL BLOCKS - SURGE SUPPRESSION

- .1 Install surge suppression terminal blocks.

3.16 PULL BOXES

- .1 Install pull boxes in inconspicuous but accessible locations. Secure to structure.
- .2 Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.
- .3 Only one voltage source is permitted in a pull box.
- .4 Install barriers to separate different auxiliary systems.

3.17 OUTLET AND CONDUIT BOXES

- .1 Install conduit outlet boxes for conduit up to 32 mm and pull boxes for larger conduits.
- .2 Support boxes independently of connecting conduits.
- .3 Seal boxes during construction to prevent entry of debris, dust and dirt.
- .4 For flush installations mount plaster rings to box, flush with wall surface to permit wall finish to come within 6 mm of opening.
- .5 Provide correct size of openings in boxes for conduit, armoured cable connections. Reducing washers will not be acceptable.
- .6 Install switches and other controls close to door lock or latch jambs and other openings, maintaining a minimum of 100 mm from trims of doors (except where installed in door frames of metal partitions) check door swings.
- .7 Install 100 mm square or octagonal outlet boxes for lighting fixture outlets.

3.18 MASONRY BOXES

- .1 In block walls use deep boxes to provide clear space around knockout for AC90 cable entry.

3.19 WIRING DEVICES - SWITCHES

- .1 Install single throw switches with handle in UP position when switch is closed.
- .2 Install switches in gang type outlet box when more than one switch is required in a location.

.3 Mount toggle switches at height indicated.

.4 Install switch colours as follows:

Area	Colour
Gypsum board, plaster or panelled	ivory
Office	ivory
Factory, service	brown

.5 Install Decora style devices in all finished spaces.

3.20 **WIRING DEVICES - DIMMER SWITCHES**

.1 Install each dimmer switch in outlet box at locations indicated.

.2 Mount dimmer switches at height indicated.

3.21 **WIRING DEVICES - RECEPTACLES**

.1 Install receptacles vertically, use gang type outlet box where more than one receptacle is required in a location.

.2 Where split receptacle has a portion switched, mount vertically and switch upper portion.

.3 Coordinate with architectural and interior design drawings for final positioning and mounting heights of power and voice/data receptacles. Where there is disagreement between electrical and architectural drawings, take the architectural drawings as correct.

.4 Maintain clearances between receptacle outlet boxes and millwork as stipulated on the drawings.

.5 Align and evenly space outlet boxes that are mounted as a group.

.6 Install receptacle colours as follows:

Area	Colour
Gypsum board, plaster or panelled	ivory
Office	ivory
Factory, service, exterior	brown

.7 Install Decora style devices in all finished spaces.

3.22 **WIRING DEVICES - COVER PLATES**

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates designed for flush outlet boxes on surface-mounted boxes.

.4 Provide plaster ring where necessary.

- .5 Install cover plates as follows:

Area	Cover Plate Type
Gypsum board, plaster or paneled	stainless steel
Factory, service	galvanized steel
Exterior	cast cover

3.23 **WELDING RECEPTACLES**

- .1 Install welding receptacles.
.2 Ensure that phase rotation is similar for all receptacles.

3.24 **CONTROL DEVICES**

- .1 Install as indicated.

3.25 **HEAT TRACING CABLES**

- .1 Install heat tracing cables where indicated. Measure pipes at site for exact length and verify sizes.
.2 Secure cable and remote sensor to pipe in accordance with cable manufacturer's recommendation keeping bulb clear of heating cable.
.3 Install heating cable as per manufacturer's recommendations.
.4 Wire to thermostat and heater cable in conduit. Provide watertight coupling at heater cable.
.5 Coordinate with mechanical and sprinkler pipe trades. For exterior applied cable do not energize until insulation has been applied over cable.
.6 Where installed inside pipes provide watertight gland for installation by pipe fitters.
.7 Megger test insulation resistance before installation, before addition of thermal insulation and after addition of thermal insulation in accordance with manufacturer's recommendations.
.8 Install and commission heat tracing system under supervision of manufacturer's representative.

3.26 **PLYWOOD BACKBOARDS**

- .1 Install plywood backboards.

3.27 **FIELD FABRICATED METAL WORK**

- .1 Clean and prime paint field fabricated metal work.
.2 After fabrication deburr, scrape, grind smooth, wire brush with power brush and degrease metal work.
.3 Prime paint steel with 1 coat of CISC/CPMA 2.75 oil alkyd primer.
.4 Prime paint aluminum as follows: wash with detergent solution and wipe down with SSPC-SP1 solvent. Apply Glidden #Y-5229 primer to 1.5 mils DFT.

- .5 For brass and bronze alloy materials, prepare as for aluminum but apply 1 coat of CAN/CGSB-1.40-M zinc chromate primer.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.
 - .2 Refer to Section 00 21 03 – General Scope of Work and Section 02 41 11 – Demolition and Preparatory Work.

1.2 GENERAL

- .1 Modifications, demolition and installation of services within this building require utmost care due to vital operation of systems involved. Removal and installation of systems require constant communication with Consultant.

1.3 CO-ORDINATION BETWEEN NEW AND EXISTING INSTALLATIONS

- .1 Provide interfacing components between new and existing systems as necessary for proper performance and operation.

1.4 EXISTING SERVICES

- .1 Ensure existing services remain undisturbed and energized except where indicated to be disconnected.
- .2 Disconnect and remove abandoned wiring materials and devices.
- .3 Cut raceways flush where embedded in structure.
- .4 Retain abandoned embedded outlet boxes and close with pressed steel coverplates.
- .5 Make safe all circuit wiring left for future use.

1.5 INTERRUPTION OF SERVICES

- .1 Obtain Owner's written approval before interrupting any service. Long outages are not acceptable.
- .2 Provide temporary services to maintain continuity in the event that services must be interrupted.

1.6 PREMIUM TIME

- .1 Include cost of premium time in tender price for work during nights, weekends or other time outside normal working hours necessary to do the work and maintain electrical services in operation.

PART - 2 PRODUCTS

2.1 USE OF EXISTING MATERIAL AND EQUIPMENT

- .1 Unless noted otherwise, provide additional equipment of same type and manufacture to supplement existing equipment.
- .2 Reused Luminaires: Furnish new lamps.

PART - 3 EXECUTION

3.1 EXISTING MATERIAL AND EQUIPMENT

- .1 Equipment to be reused or relocated: test for proper operation and repair as necessary.
- .2 Repair or replace existing equipment which is damaged in process of relocation.
- .3 Reused Luminaires: Install lamps, clean fixtures and touch up damaged finish.
- .4 Relocate existing junction, pull or terminal boxes which become inaccessible due to new mechanical ductwork or equipment.

3.2 DEMOLITION

- .1 Demolish existing work, where indicated, and remove from site.
- .2 Execute all demolition work so as to create minimum vibration or dust within and outside the building. Obtain Owner's approval of methods before proceeding.

3.3 WORK IN EXISTING TENANT FACILITIES

- .1 Coordinate work in tenant facilities with tenant. Ensure that no interruptions and/or interferences occur with tenant's normal operation.
- .2 Be responsible for any damage created in existing tenant facilities when installing equipment and materials.

3.4 PENETRATIONS IN EXISTING STRUCTURE

- .1 Perform cutting, patching and repairing. Before proceeding obtain Owner's approval.
- .2 Where necessary to penetrate existing floors, walls, ceiling, roof or structural members provide sleeve and follow Consultant's instructions.
- .3 Restore surfaces to same finish and condition as existed prior to penetration.
- .4 Core Drilling Procedure
 - .1 Examine locations to be core drilled where:
 - .1 Diameter is greater than 25 mm
 - .2 Multiple drillings required and where the distance between centres is less than 10 times the diameter of the hole
 - .2 Examine by most suitable method including:
 - .1 X-ray
 - .2 Ferro scan
 - .3 Cable detection
 - .3 Examine from both sides of the structure to be drilled.
 - .4 Examine proposed core drilling locations to determine:
 - .1 Possible interference with
 - .1 Services
 - .2 Structural components
 - .2 Possible presence of asbestos tile or other asbestos based material.

Report any occurrence or suspected occurrence to the Consultant immediately.

- .5 Select locations as suitable for core drilling and label them:
 - .1 Uniquely number each drilling location and core so that markings will be legible after drilling
 - .2 Mark each core with a north pointing arrow where drilling a slab or upward pointing arrow where drilling a wall
- .6 Without interfering with or damaging any services or structural elements, drill pilot holes sufficient to verify location of potential obstructions or for alignment purposes.
- .7 Use impact drill when drilling holes of 25 mm diameter or less. For holes of greater diameter use core drill.
- .8 Prepare report showing intended core drill locations including printouts, X-ray images. Submit the report for approval prior to drilling to Consultant.
- .9 Proceed with core drilling only after approval has been received from Consultant.
- .10 Confine drilling operation to time-of-day as stipulated by Consultant.
- .11 Position suitable warning notices of a type acceptable to Consultant and exercise caution to ensure safety and protection of personnel and property during drilling especially from effects of water, dust damage, or falling objects below the slab or behind the wall being drilled.
- .12 Stop drilling immediately, and report to Consultant, if contact is made with foreign objects such as reinforcing steel (rebar), electrical conduit, water pipes, drainage pipes.
- .13 Cover open holes with secured covers to guard against fall through of objects.
- .14 Provide necessary firestopping, temporary or otherwise, sufficient to firestop holes that would be otherwise open during hours that the location is unattended. Coordinate placement of firestopping with Consultant.
- .15 Store all cores or core fragments on site and make them available for inspection by Consultant. Dispose of the cores or core fragments after permission is received from Consultant.

3.5 **SALVAGE MATERIALS**

- .1 Remove from site materials in renovated areas that are not to remain or be reused, unless noted as remaining property of Owner.

3.6 **WORK IN EXISTING AREAS**

- .1 Schedule work in existing areas to the approval and convenience of the Consultant and Owner.
- .2 Carry out the work with a minimum of noise, dust and disturbance. Provide and use covers and screens to protect existing facilities and to prevent dust, moisture or dirt from extending past the immediate working areas.
- .3 Do not allow materials, dirt or debris to accumulate in these areas at any time. When the work is complete, leave the areas broom clean.
- .4 Provide tools and cleanup equipment. Obtain the Owner's permission for the use of electrical, plumbing or drainage outlets.

- .5 Relocate or adjust existing equipment and wiring as required to permit the installation of new work in existing areas.
- .6 When deleting or making safe existing electrical work, ensure that it includes all wiring back to the associated panel board.
- .7 Ensure that all existing equipment which is to be reused and/or relocated, is thoroughly inspected and refurbished to ensure correct operation and Ontario Electrical Safety Authority's approval when put back into service.

3.7 **POWER INTERRUPTIONS AND CHANGEOVERS**

- .1 Make arrangements to carry out all power interruptions and changeovers required to connect services to new or existing switchboards, panels and equipment.
- .2 Make the interruptions at times suitable to the Owner. Notify the Consultant in advance so that he may attend.
- .3 The prearranged power interruptions may be delayed or postponed by the Consultant or the Owner, if an emergency or unforeseen condition arises.
- .4 Submit a complete schedule of power interruptions and changeovers with approximate dates required, durations and times of day for approval before proceeding with the Work.
- .5 Keep power interruptions to an absolute minimum. Carry out all preparatory work, measurements, prefabrication and wiring up to the final connections without interruption to the existing services.

3.8 **CONTINUITY OF ELECTRICAL SERVICES DURING DEMOLITION AND CONSTRUCTION**

- .1 Refer to the Architectural, Structural, Mechanical and Electrical Drawings and Specifications, for the extent and staging of the work as it relates to demolition, construction and asbestos removal.
- .2 Disconnect, remove and dispose of redundant feeders and branch circuits to lighting, receptacles and equipment, including conduit, wiring and associated supports, fittings and devices.
- .3 Disconnect, remove and dispose of existing electrical and auxiliary equipment, including panels, switching equipment, receptacles, lighting, wiring devices, alarms, cover plates and enclosures in the demolition area, except as noted or specified.
- .4 Keep auxiliary electrical services such as security, audio visual, fire alarm and communications systems fully operational in the remaining parts of the building outside the demolition area. Seal openings in boxes, floors, raceways and walls, which result from the removal of equipment. Properly terminate and insulate cables and wires to restore the system to a safe, sound operating condition to the Consultant's satisfaction.
- .5 Where wiring of power or auxiliary systems for other areas passes through the demolition area, provide all necessary bypass wiring to maintain the systems in operation for other parts of the building.
- .6 Securely support raceways of electrical systems to be maintained in or passing through the demolition area, independently of the ceiling and mechanical systems, prior to removal of the ceiling.

- .7 Protect existing wiring and equipment serving the existing and new areas from damage due to mechanical injury, moisture or asbestos.
- .8 Coordinate the sequence of relocation of existing equipment and wiring with other trades and conform to the requirements and conditions outlined in the Specifications.
- .9 Existing fixtures and wiring designated to be removed and not to be reused may be used for temporary lighting within the work envelope and shall be removed as soon as their use becomes unnecessary.
- .10 Identify as "spare" in the panels any power and lighting circuits from which wiring is disconnected.
- .11 Provide a set of record drawings indicating dimensioned locations of conduit runs for those electrical and auxiliary systems which must be maintained operational for other parts of the building.

3.9 **DISPOSAL OF REDUNDANT ELECTRICAL EQUIPMENT**

- .1 Carefully remove from the site and dispose of all existing electrical equipment and material not required in the final installation, in accordance with other sections of this Specification.
- .2 Carefully remove and pack electrical equipment and devices containing PCB's in accordance with government regulations. Store in a location as directed by the Owner.

3.10 **HERITAGE AREAS WORK**

- .1 Consultant must be contacted, without delay, if the Demolition of Existing Mechanical and Electrical Equipment and their Scope of Work or the Installation of New Mechanical and Electrical Equipment and their Scope of Work will involve Removal, Damage or Modification to any of the existing heritage fabric. All Work in the immediate areas is to cease pending further instruction by Consultant.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 APPROVALS

- .1 Identification subject to prior approval of Consultant.

PART - 2 PRODUCTS

2.1 WIRE AND CABLE MARKERS

- .1 Wire and Cable Diameter Less Than 13 mm
 - .1 Acceptable manufacturer
 - .1 Wieland Z type
 - .2 Cable Diameter 13 mm and Larger
 - .1 Acceptable manufacturer
 - .1 Wieland K type
 - .3 Non-Circular Wire
 - .1 Acceptable manufacturer
 - .1 Raychem Shrinkmark sleeves

2.2 CONDUIT AND ELECTRICAL METALLIC TUBING MARKERS

- .1 Stick-On Marker
 - .1 Raceway Size Minimum Character Height
 - .1 ¾" - 1¼" 15 mm
 - .2 1½" - 2" 19 mm
 - .3 over 2" 32 mm
 - .2 Acceptable Manufacturers
 - .1 Brady, vinyl cloth, black on orange, type B-500
 - .2 Panduit, vinyl cloth, black on yellow, type PCL
 - .3 Wieland, mylar, black on yellow, type NL

2.3 CABLE TRAY MARKERS

- .1 Stick-On Marker
 - .1 Acceptable Manufacturers
 - .1 Brady, vinyl cloth, black on orange, 48 mm character height, type B-500
 - .2 Safety Supply Canada, conduit and voltage markers, style A, 48 mm

character height

- .3 Panduit, vinyl indoor/outdoor, black on yellow, 50 mm character height, type PVL
- .4 Wieland, black on yellow, 50 mm character height, Electrocode NL

2.4 WARNING SIGNS

- .1 Outdoor - metal, porcelain enamel finish. Indoor - rigid vinyl.
- .2 Typical Identification: "Danger - High Voltage".
- .3 Acceptable Manufacturers
 - .1 Outdoor: Safety Supply Canada
 - .2 Indoor: Safety Supply Canada, Panduit

2.5 MARKER TAPE, SERVICE AND PHASE IDENTIFICATION

- .1 Acceptable Manufacturer
 - .1 3M, Scotch Code Tape, type STD with SDR colour refills or 3M Scotch 35 colour tape.

PART - 3 EXECUTION

3.1 SYSTEMS IDENTIFICATION

- .1 Refer to drawings for correct equipment identification.
- .2 Identify outlet boxes for various systems with distinctive paint colour. Apply a small area of paint to inside of outlet, junction and pull boxes and panels. In suspended ceiling areas, apply paint to inside and outside of junction boxes. System colours:

System	Normal	Emergency	UPS
120/208 volt	black	black/red	black/blue
347/600 volt	orange	orange/red	orange/blue
Fire alarm	red		
Intercom	brown		
Low voltage control	black		
PA and sound	light green		

3.2 WIRE AND CABLE IDENTIFICATION

- .1 Identify power, control, lighting and receptacle wires with continuous colouring as follows:
 - .1 Phase A red
 - .2 Phase B black
 - .3 Phase C blue
 - .4 Neutral white
 - .5 Ground green
 - .6 Isolating ground green and yellow

- .7 Control red
- .8 Interlock yellow
- .9 D.C. blue

- .2 For larger wire sizes available only in black, install coloured wire marker tape in accordance with above coding.

- .3 Cables Bearing Identification Numbers on the Drawings
 - .1 Install identification markers at each end of cable run.

- .4 Control/Indication Conductors
 - .1 Install conductor identification markers at switchgear, motor control centres and motor starter terminal blocks and at remote devices.
 - .2 Identification in accordance with the Drawings and reviewed shop drawings.

- .5 Lighting and Receptacle Branch Circuits
 - .1 Install conductor identification markers at panel, outlet box connections to lighting fixtures and device outlet boxes.
 - .2 Typical identification if fixture or device is connected to panel A, circuit 5: A-5.

- .6 Low Voltage Lighting Control
 - .1 Install conductor identification marker at relay phase conductors. Typical identification if connected to panel A, circuit 5: A-5.
 - .2 Install conductor identification marker on conductors between control locations and relay panels. Identify in accordance with reviewed shop drawings.

- .7 Data, Voice and Fibre Optic Cables
 - .1 Label horizontally distributed cabling at the following locations:
 - .1 Both ends of cable run
 - .2 Entrance and exit of cable pathway (i.e. cable trays, zone conduits, etc.)
 - .2 Label riser/backbone distribution cables at the following locations:
 - .1 Both ends of cable run
 - .2 Entrance and exit of cable pathway (ie. cable trays, zone conduits, etc.)
 - .3 1.5 m above finished floor in communication closets and equipment rooms
 - .4 At entrance and exit of a sleeve or slot in communication closets and equipment rooms
 - .3 Use the following colour codes for labels:

Function	Colour
Auxiliary and miscellaneous circuits	Yellow
Common equipment	Purple
Customer side of network interface	Green
First level backbone	White
Horizontal cabling to workstations	Blue

Interbuilding backbone	Brown
Key telephone systems	Red
Network side of network interface	Orange
Second level backbone	Gray

Note: Common equipment refers to PBX equipment, host computer, LANs and multiplexer. Miscellaneous refers to maintenance alarms, security, paging systems, and other system and circuits not an integral part of common equipment. Colour codes to ANSI/TIA/EIA-606.

- .8 Fire Alarm and Miscellaneous Systems
 - .1 Install identification on conductors at panels, remote devices and system connections. Identify in accordance with reviewed shop drawings.
 - .2 Install maglock/fire alarm pull station identification adjacent to each door equipped with a maglock.

3.3 **CONDUIT AND ELECTRICAL METALLIC TUBING (EMT) IDENTIFICATION**

- .1 Where Drawings indicate conduit and EMT identification numbers/letters, install identification markers at each end of run and at pull box locations.

3.4 **MOTOR STARTER, CONTACTOR AND DISCONNECT SWITCH IDENTIFICATION**

- .1 Install identification plates using self-tapping screws.

3.5 **IDENTIFICATION AFTER FINISH PAINTING**

- .1 Behind access doors at shaft plenums: identify busways, feeder cables and feeder conduits.

3.6 **EQUIPMENT WARNING SIGNS**

- .1 Install "Danger - High Voltage" signs.
- .2 When equipment is supplied from more than one source install red warning signs to this effect.

3.7 **PATCH PANEL AND FACEPLATE IDENTIFICATION**

- .1 Identify each jack at each wall or furniture outlet with a label supplied by the faceplate manufacturer. Each jack identification designation to match the respective cable identification designation.
- .2 Identify each jack at each patch panel jack with labels, front and back, supplied by the patch panel manufacturer. Each jack identification designation to match the respective cable identification designation.
- .3 In addition to an alphanumeric label use manufacturer's matching colour coded icons, which conform to ANSI/TIA/EIA-606, to identify individual jacks on faceplate and patch panels.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 TESTING AND INSPECTION

- .1 Cooperate and assist Testing and Inspection Company in executing their work.
- .2 Provide personnel as required to remedy defects and make adjustments as requested by Testing and Inspection Company.
- .3 Arrange for site attendance by representatives of product manufacturer companies as requested by Testing and Inspection Company.

1.3 RELATED SECTIONS

- .1 Related work includes but is not limited to the following sections:
 - .1 Section 26 05 01: Basic electrical requirements.
 - .2 Section 26 08 02: Field testing and commissioning.

1.4 REFERENCES

- .1 Conform to latest issues, amendments and supplements of following standards:
 - .1 ASTM American Society for Testing and Materials
 - .2 CSA C22.2 No. 41-81 Grounding and Bonding Equipment
 - .3 CAN/CSA-C22.3 No. 1-M Overhead Systems
 - .4 CSA C22.3 No. 2 General Grounding Requirements and Grounding Requirements for Electrical Supply Stations
 - .5 NETA International Electrical Testing Association Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems, 1987
 - .6 CEA Commissioning Guide for Electrical Apparatus
 - .7 ICEA Insulated Power Cable Engineer's Association
 - .8 IEEE Institute of Electrical and Electronic Engineers Guide for Making High Voltage Tests on Power Cable Systems the Field Std. 400

1.5 PROJECT SITE CONDITIONS

- .1 Prior to testing, concrete and masonry work in vicinity of equipment and enclosures, walls, doors, gates and fences shall be completely installed, loose dirt and debris removed, and area cleaned. Interior areas shall be broom cleaned and washed down to remove dust.

1.6 SAFETY

- .1 Conform to Federal, Provincial and Municipal safety requirements.

- .2 Provide adequate protection for persons performing, assisting, or witnessing tests.
- .3 Guard test areas from persons not involved in test procedures.

1.7 **QUALITY ASSURANCE**

- .1 The Testing and Inspection to be performed on the following:
 - .1 Power transformers
 - .2 Motors
 - .3 Low voltage cables
 - .4 Panelboards
 - .5 Thermographic scanning

PART - 2 PRODUCTS

2.1 **MATERIALS**

- .1 Furnish materials, instruments, and equipment required to execute specified pre-test inspection, testing and cleaning.
- .2 Furnish megger test instruments as follows:

System Voltage	Megger Voltage
.1 less than 208V	500V
.2 277V to 1000V	1000V
.3 over 1000V	5000V, motor driven

PART - 3 EXECUTION

3.1 **GENERAL**

- .1 Remove dust, debris, surplus material and tools from equipment.
- .2 Check and tighten bus connections and terminations with a calibrated torque wrench. Refer to manufacturer's instruction for proper foot pound levels. Mark with adhesive tape or label when satisfactory.
- .3 Notify Testing and Inspection Company when each equipment installation is completed, cleaned, safe and ready for testing.
- .4 Insulation resistance values:

System Voltage	Megger Voltage	Minimum Acceptable Resistance in Megohms
less than 208V	500V	25
277 to 1000V	1000V	100

3.2 **LOW VOLTAGE CABLES (LESS THAN 1000V)**

- .1 Install low voltage feeder cables to switchgear, panelboards, MCC's and distribution transformers but do not terminate to equipment.

- .2 Take precautions necessary to ensure that installed cable runs which have not been terminated to their respective equipment and exposed terminals of equipment are protected from any damage.
- .3 Visually inspect and megger cables to ensure they are ready for testing by Testing and Inspection Company.
- .4 Terminate cable runs to equipment when instructed to do so by Consultant.

3.3 **FIBRE-OPTIC CABLES**

- .1 Inspect cables for physical damage and proper connection.
- .2 Inspect splices and connectors for physical damage and proper connection.

3.4 **FUSIBLE AND NON FUSIBLE DISCONNECT SWITCHES**

- .1 Clean equipment.
- .2 Inspect for physical and mechanical condition.
- .3 Verify that fuse sizes and types correspond to drawings.

3.5 **AC INVERTER SYSTEM**

- .1 Clean equipment.
- .2 Check, calibrate and adjust inverter system under supervision of inverter and battery manufacturer's representatives.

3.6 **MOTORS**

- .1 Inspect for physical damage.
- .2 Inspect for proper anchorage, mounting, grounding, connection, and lubrication.
- .3 Inspect for unusual mechanical or electrical noise or signs of overheating during initial test run.

3.7 **FIRE DETECTION AND ALARM SYSTEM**

- .1 Engage manufacturer's qualified representative to make an inspection of fire alarm system. Inspection shall verify the following:
 - .1 The installation is that designated by the Consultant's specifications
 - .2 The installation complies with standard CAN/ULC-S537-M
 - .3 The equipment has been installed in accordance with manufacturer's recommendations, and that all signalling devices of whatever manufacture have been operated or tested to verify their operation
 - .4 That supervisory wiring of those items of equipment connected to a supervised circuit is operating and that governmental regulations, if any, concerning such supervisory wiring, have been met
- .2 On completion of inspection and when all of above conditions have been complied with, manufacturer shall issue to Consultant:
 - .1 A copy of inspection report showing location of each device and certifying test results of each device

- .2 A certificate of verification confirming that inspection has been completed and showing conditions upon which such inspection and certification have been rendered

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 General

- .1 Provide labour, products, equipment and services necessary to complete the work of this Section, including but not limited to the following:
 - .1 Short circuit analysis and equipment evaluation study.
 - .2 Protective device coordination study.
 - .3 Arc Flash Hazard Analysis
 - .4 Third party inspection, testing and commissioning each equipment, electrical system and installation as specified herein.
 - .5 Demonstration testing services for specified low voltage electrical and auxiliary systems.
- .2 Section includes labour, equipment and services to complete the following:
 - .1 Material, equipment, labour and technical supervision to perform work as specified herein.
 - .2 Determine and conclude, equipment and systems specified herein, are operational, within industrial and manufacturer's tolerance, installed in accordance with design specifications and manufacturer's requirements, comply with design specifications and Electrical Safety Authority (ESA). Certify that equipment and systems are suitable for energization.
 - .3 Obtain and utilize for inspection, testing and commissioning the following references.
 - .1 International Electrical Testing Association; Acceptance, Testing Specifications for Electrical Power Distribution Equipment and Systems, NETA ATS-1995
 - .2 Project Design Specifications
 - .3 Project Design Drawings
 - .4 Short Circuit Analysis and Protective Device Coordination Study Report
 - .5 Approved manufacturer's shop drawings
 - .4 Obtain and utilize information required for Short Circuit Analysis/Equipment Evaluation Study and Protective Device Coordination Study from:
 - .1 Project Design Specifications and Drawings
 - .2 Approved Manufacturer's Shop Drawings
 - .3 Project Site Visits
 - .4 Local Utility Authority
 - .5 Coordinate with installation Contractors, inspection, testing and commissioning schedules for equipment and electrical system. Work must be coordinate to expedite project scheduling and must not interfere with progress of installation work.

- .6 Maintain a written record of each inspection, test and commissioning and provide a certified final project testing and commissioning report.
- .7 Maintain a written record of each deficiency and provide a certified final project deficiency report.
- .8 Inform Owner, installation contractor and equipment manufacturer immediately when equipment, electrical system or installation;
 - .1 Found defective on the basis of acceptance test
 - .2 Not in compliance with design specifications, design drawings and approved manufacturer's shop drawings
 - .3 Not in compliance with Electrical Safety Authority (ESA)
 - .4 Found in adverse conditions
 - .5 Requires adjustments
- .9 Provide portable generators to supply a suitable and stable source of electrical power required for the inspection, testing and commissioning of equipment and system as herein specified.
- .10 Remove and re-terminate cables, bus duct, bus bars, and wire terminations required to isolate equipment or electrical system under test.
- .11 Retest equipment after deficiencies have been rectified.
- .12 Maintain a written record of each corrected deficiency and provide a certified final project corrected deficiency report.

1.2 REFERENCES

- .1 ANSI/IEEE Std 241-1983: IEEE Recommended Practice for Electrical Power Systems in Commercial Building
- .2 ANSI/IEEE Std 141-1986: IEEE Recommended Practice for Electric Power Distribution for Industrial Plants
- .3 IEEE Std 242-1986: IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
- .4 CSA C22.3 No. 0.3-M85 : Test Methods for Electrical Wires and Cables
- .5 CSA C22.2 No. 0.4-M82: Bonding and Grounding Equipment (protective grounding)
- .6 CSA C22.2 No. 41-81: Grounding and Bonding Equipment
- .7 CSA C22.3 No. 2-75: General Grounding Requirements and Grounding Requirements for Electrical Supply Stations
- .8 NETA ATS-1995: International Electrical Testing Association Acceptance Testing Specifications for Electrical Power Distribution Equipment and System, 1995
- .9 IEEE 400-1980: Institute of Electrical and Electronic Engineers Guide for Making High Voltage Tests on Power Cable Systems the Field Std. 400-1980
- .10 IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.
- .11 NFPA 70E – Standard for Electrical Safety in the Workplace.

1.3 **SAFETY**

- .1 Conform with Federal, Provincial and Municipal safety requirements.
- .2 Provide adequate protection for persons performing, assisting, or witnessing tests.
- .3 Guard test areas from persons not involved in test procedures.

1.4 **QUALITY ASSURANCE**

- .1 This Specification is intended to supplement the International Electrical Testing Association NETA ATS. Requirements of the NETA ATS apply unless superseded or modified by the specification.
- .2 Perform inspection, testing and commissioning during warranty period of equipment and electrical installation.
- .3 Short Circuit Analysis/Equipment Evaluation Study and Protective Device Coordination Study performed, reviewed and stamped by a Professional Engineer currently licensed and registered with the Professional Engineers of Ontario.
- .4 Certified Inspection, Testing and Commissioning Report, reviewed and stamped by a Professional Engineer currently licensed and registered with the Professional Engineers of Ontario.
- .5 Utilize only full-time technicians who are regularly employed by the firm for inspection, testing and commissioning services. Electrically unskilled employees are not permitted to perform testing or assistance of any kind.
- .6 Instruments used to evaluate electrical performance to comply in accordance with "Test Instrument Calibration" section as herein specified.

1.5 **TEST INSTRUMENT CALIBRATION**

- .1 Instruments calibrated in accordance with the following frequency schedule:
 - .1 Field Instruments: Analog - 6 months maximum
 - .2 Digital: 12 month maximum
 - .3 Laboratory Instruments: 12 months
 - .4 Leased specialty equipment: 12 months
- .2 Provide and have in place a calibration program which documents test instrumentation are maintained within rated accuracy.
- .3 Accuracy of test instrumentation directly traceable to the National Bureau of Standards.
- .4 Dated calibration labels visible on test equipment.
- .5 Calibration records, maintained up-to-date, illustrating; date of last calibration test, results of instruments calibrated or tested, instruments manufacturer name, instrument model, and serial number, scales, percentage error, accuracy, correction factors if applicable, and name of calibration firm.
- .6 Calibrating standard to have higher accuracy than that of instrument tested.

1.6 **SHORT CIRCUIT ANALYSIS/ EQUIPMENT EVALUATION STUDY, ARC FLASH HAZARD ANALYSIS AND PROTECTIVE SERVICE COORDINATION STUDY REPORT**

- .1 Report to include:
 - .1 Title page (illustrating report title), Project Name, Project address, Project Number, date and complete name and address of firm
 - .2 Table of Contents
 - .3 Summary of project short circuit analysis study
 - .4 Summary of project equipment evaluation study
 - .5 Summary of project protective device coordination study
 - .6 Summary of arc flash hazard analysis
 - .7 Tabulated System Input Data;
 - .1 Utility Short Circuit Capacity
 - .2 Motor Data
 - .3 Cable Data
 - .4 Transformer Data
 - .8 Tabulated short circuit analysis results
 - .9 Tabulated equipment evaluation
 - .10 Official Utility correspondence of supply feeders present and ultimate available short circuit capacity and supply feeder protective device settings
 - .11 Detailed review of protective device study procedure and proposed setting
 - .12 Comments on the coordination curves
 - .13 Coordination time-current graphs
 - .14 Tabulated protective device settings
 - .15 Single line diagram with appropriate source, branch and bus number nomenclature

1.7 **INSPECTION, TESTING AND COMMISSIONING REPORT**

- .1 Inspection, testing and commissioning report to include:
 - .1 Title page Inspection, Testing and Commissioning Report, Project Name, project address, Project number, date, and complete name and address of testing firm
 - .2 Table of contents
 - .3 Summary of project inspection, testing and commissioning
 - .4 Description of test
 - .5 Itemized list of equipment and electrical system tested
 - .6 Inspection and test results
 - .7 Conclusions and recommendations
 - .8 Completed inspection and test forms for each equipment and system
 - .9 Itemized list of test instruments used with appropriate nameplate data

1.8 DEFICIENCY REPORT

- .1 Deficiency report to include:
 - .1 Title page, Deficiency Report, project name, project addresses, project number, date and complete name and addresses of testing firm
 - .2 Summary of project deficiencies
 - .3 Itemized list of each deficiency
 - .4 Confirmation of corrected deficiencies
- .2 Itemized list of deficiencies to in a table format and includes:
 - .1 Correct device name in accordance to project drawings
 - .2 Complete description of deficiencies
 - .3 Date the deficiency was noted
 - .4 Date the deficiency was corrected

1.9 SUBMITTALS

- .1 Submit with tender the following documentation.
 - .1 Company user list of short circuit analysis, equipment evaluation study and protective device coordination study projects which are similar in scope of work, complete with project dates, references and telephone numbers.
- .2 Submit the following documentation within 2 weeks of contract award:
 - .1 Company user list of inspection, testing and commissioning projects which are similar in scope of work, complete with project dates references and telephone numbers.
 - .2 Inspection and test forms sample for, each type of equipment appropriate to this project.
 - .3 Schedule indicating time to:
 - .1 Submit, short circuit analysis and equipment evaluation study report
 - .2 Submit, protective device coordination study report
 - .3 Commence on site inspection, testing and commission
 - .4 Submit, inspect, testing and commissioning report.
- .3 Schedule of on site inspection, testing and commission as coordinated with installation contractors.
- .4 Submit reports in latest version of Microsoft Word.
- .5 Submit 6 copies of the complete short circuit analysis, equipment evaluation study and protective device coordination study report.
- .6 Submit 6 copies of the complete inspection testing, and commissioning report no later than 2 weeks after completion of testing in the field.
- .7 Submit 6 copies of complete deficiency report, no later than 2 weeks after completion of testing in the field. Resubmit revised deficiency report after correction in the field no later than 1 week after correction of deficiency.

1.10 **EQUIPMENT AND ELECTRICAL SYSTEM LIST**

- .1 Inspect, Test and Commission following items of equipment and electrical installation as herein specified.
 - .1 Dry Type Power Transformers
 - .2 Low Voltage Motors
 - .3 Power Panelboards
 - .4 Low Voltage Power Feeders
 - .5 Thermographic Survey for all Medium Voltage and 600V Terminations

PART - 2 PRODUCTS

2.1 **APPROVED TESTING COMPANIES**

- .1 For field testing and commissioning services, engage a third party testing company subject to approval by Consultant.

PART - 3 EXECUTION

3.1 **COORDINATION OF ELECTRICAL PROTECTIVE DEVICES**

- .1 Obtain from the utility authority the supply feeder overcurrent and ground fault protective devices settings (time overcurrent, lowest, highest, etc.) and the available RMS symmetrical short circuit MVA (design and actual). Following receipt of shop drawings, obtain from manufacturers time-current curves of all protective devices in medium voltage switchgear low voltage main switchboards and downstream distribution equipment.
- .2 Coordinate the setting of relays, rating of fuses and trip elements of circuit breakers, so that the protective device immediately ahead of any fault operates before any upstream protection, establish selective coordination throughout the system, and provide optimum equipment and system protection.
- .3 Determine settings for and set protective relays, timers, etc. for complete protection and control.
- .4 Prepare on Keuffel & Esser Catalogue No. 485258 size Log-Log graph paper complete set of curves showing:
 - .1 The phase overcurrent and ground fault time-current coordination for all protective devices from and including the supply authority (circuit breaker, fuse) down to and including the largest protective device downstream of each low voltage switchboard feeder. Also, for emergency generator to the largest protective device downstream of the emergency panel board
 - .2 Utility overcurrent and ground fault protective devices
 - .1 Time overcurrent
 - .2 Low set instantaneous
 - .3 High set instantaneous
 - .3 Transformer three phase, phase to phase, and phase to ground damage curves
 - .4 Transformer full load current and inrush point
 - .5 Cable conductor and shield damage curves

- .6 Emergency generators damage and decrement curve
 - .7 Emergency generator voltage control unit curve
 - .8 Motor full load current, starting current at full voltage and reduced voltage, safe stall point and acceleration curve
 - .9 Three phase bolted symmetrical and ground fault level at all buses
 - .10 Protective devices stating manufacturer type, current transformer ratios, settings and/or size.
- .5 Prepare the graphs in cooperation with equipment manufacturers.
 - .6 Select the protective device settings or size to provide the required coordination.
 - .7 Submit two sets of all graphs to Consultant for review and after any revisions requested, 6 for record.
 - .8 Tabulate all protective device settings illustrating present and recommended settings.

3.2 **INSPECTION, TESTING AND VERIFICATION**

- .1 Verify by measurement correct phase sequence throughout systems and application of colour codes to equipment and cables.
- .2 Verify cable sizes, and equipment ratings, conform to specifications and coordination study.
- .3 Verify alarms, protection and control. Submit comprehensive written procedures (step-by-step) one week prior to test date.
- .4 Perform polarity checks on current transformers.
- .5 Functionally test relays using three phase current injection and voltage. Do not use single phase test instruments.
- .6 Test power transformer using Dobo transformer tester.
- .7 Overpotential testing to be ac Hi-Pot.

3.3 **INSPECTION, TESTING AND COMMISSIONING REPORT DOCUMENTATION**

- .1 Provide separate inspection and test forms for each individual equipment and item as follows:
 - .1 Power Transformer
 - .2 Low Voltage Breaker
 - .3 Panelboard Assembly
 - .4 Low Voltage Cables
- .2 Document each qualitative inspection specified herein complete with description of Inspection and assessment (i.e. poor, satisfactory, good, excellent).
- .3 Document each quantitative test specified herein, complete with appropriate calculation, acceptable maximum and minimum values, obtained test value and assessment.
- .4 Inspection and Test forms to include:
 - .1 Correct device name in accordance to project drawings

- .2 Complete nameplate data
- .3 Itemized list of inspection and assessment
- .4 Complete test data for each test conducted
- .5 Acceptable maximum and minimum test values
- .6 Date and time of test

3.4 INSTRUMENT TRANSFORMERS

- .1 Inspect and test in accordance with NETA ATS, Section 7.10 - Instrument Transformers.
- .2 Do not perform current transformer insulation resistance test, ration verification test, excitation test, burden measurement and dc dielectric withstandability test on low voltage breaker trip unit sensors.

3.5 ROTATING MACHINERY, AC MOTORS

- .1 Inspect and test in accordance with NETA ATS, Section 7.15.1 Rotating Machinery - AC Motors.
- .2 Delete DC overpotential test requirements.
- .3 Delete insulation power factor and surge comparison tests requirements.
- .4 Delete surge protection device test requirements.
- .5 Delete voltage drop test requirements on the excitation system.

3.6 LOW VOLTAGE CABLE, 600 V MAXIMUM SERVICE

- .1 Inspect and test in accordance with NETA ATS, Section 7.3.1, Cables - Low Voltage 600 V Maximum.

3.7 LOW VOLTAGE MOULDED CASE BREAKERS

- .1 Inspect and test in accordance with NETA ATS, Section 7.6.1.1, Circuit Breakers - Low Voltage Insulated Case.
- .2 Delete primary current injection test requirements.
- .3 Perform secondary current injection test for moulded case breaker with solid state trip units.

3.8 LOW VOLTAGE FUSED OR UNFUSED SWITCH

- .1 Inspect and test in accordance with the NETA ATS, Section 7.5.1.1, Air Switches - Low Voltage.

3.9 DEMONSTRATION TESTING OF LOW VOLTAGE ELECTRICAL AND AUXILIARY SYSTEMS.

- .1 After third party testing and commissioning has been completed and deficiencies rectified, provide demonstration services to Consultant to ensure the operability and interoperability of systems.
- .2 Prepare a demonstration and test plan complete with data sheets and submit for Consultant's approval minimum 6 weeks prior to testing.

- .3 Demonstrate to the satisfaction of Consultant the following systems:
 - .1 Electric Heat Tracing
 - .2 Power Distribution Unit
 - .3 Uninterruptible Power Supply
 - .4 Motor Controls
 - .5 Emergency Generator and Transfer Scheme
 - .6 Fire Alarm System
 - .7 Public Address System
 - .8 Metering
 - .9 Central Emergency Inverter
 - .10 Interoperability and interconnection to systems of other trades such as but not limited to:
 - .1 Building automation
 - .2 Generator Ventilation
 - .3 Variable Speed Drives
 - .4 Telephone and Security Systems
- .4 Complete Consultant witnessed data sheets and other required test data and submit in report format.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section including, but not limited to, the following:
 - .1 Lighting equipment as per the luminaire schedule and as specified herein.
 - .2 Refer to Architectural reflected ceiling plans for exact location of luminaires.
 - .3 Check latest ceiling finish schedule in areas where recessed luminaires are specified to ensure that luminaires have suitable ceiling trim for particular ceiling finish.

1.2 RELATED SECTIONS

- .1 Section 03 30 00: Cast-In-Place Concrete
 - .1 Furnishing of anchor bolts (anchorage assembly) and installation in concrete pole foundations.

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit certified copies of photometric test data, for each luminaire type, prepared by independent testing laboratory. Photometric data to include total input watts, candlepower summary, candlepower distribution, zonal lumen summary, luminaire efficiency, coefficient of utilization table, lamp type, ballast type and manufacturer, and lumen rating in accordance with IESNA testing procedures.

1.4 REFERENCES

- .1 CSA C22.2 No. 9-M1988 Luminaires
- .2 CSA C22.2 No. 34-M1987 Electrode Receptacles, Fittings, and Connectors for Gas Tubes
- .3 CSA C22.2 No. 43-M1984 Lampholders
- .4 CSA C22.2 No. 66-1988 Specialty Transformers
- .5 CSA C22.2 No. 74-92 Equipment for Use with Electric Discharge Lamps
- .6 CSA C22.2 No. 141-M1985 Unit Equipment for Emergency Lighting
- .7 ANSI/IEEE C62.41 Guide for Surge Voltages in Low Voltage AC Power Circuits

1.5 CODES AND STANDARDS

- .1 All wiring to be in accordance with the Ontario Electrical Safety Code.
- .2 Provide only equipment bearing a label acceptable to the Electrical Safety Authority (ESA) to indicate that the equipment has been tested to applicable CSA standards.

PART - 2 PRODUCTS

2.1 LUMINAIRES

.1 General

- .1 Furnish luminaires in accordance with CSA C22.2 No. 9.
- .2 Luminaire finishes shall resist chipping, crazing, discolouration.
- .3 Luminaires to contain no asbestos.
- .4 Furnish luminaires with flanges and gaskets to eliminate light leaks.

.2 Exit Light Luminaires

- .1 Cast aluminum housing, stencil face, knock-out directional arrows.
- .2 Universal ceiling, end-to-wall, surface back-to-wall mounting or recessed mounting if indicated.
- .3 Connection for emergency 12V source where indicated.
- .4 LED type with diffusing lens.

2.2 LAMPS

.1 LED's

- .1 The screw based and pin based LEDs shall have life rated at L70 and shall be tested to LM 79 and LM 80 specifications. They shall be thermally tested to operate within design parameters. CRI shall be 80+. 50,000 hrs plus life, retain 80% lumen output after 50,000 hrs operation. Matching colour temperature and bin matching.
- .2 Power Supply:
 - .1 Power Supply suitable for LEDs shall be electronically stabilized and meet industry standards. Input voltage shall be 120v AC and output shall be suitable for the LED modules typically 10v DC or 24v DC or as specified for the given LED module. The Power supply shall have protection features against open circuit, short circuit, overload and overheating. The power supply shall be rated for damp locations. It shall be suitable for Class 2 output. The Power supply shall be suitable for input voltage variation of +/- 10%. The input frequency shall be 50/60Hz. The max case temperature shall not exceed 60 deg C. The Power Supply shall be suitable for ambient temperature between -20 deg C and + 50 deg C. It shall comply with FCC 47 CFR Part 15 and RoHS. Also, the power supply/its components shall be UL/ CSA/ETL listed or recognized as applicable. Warranty shall be min. 5 years.
- .3 Dimming Units for LEDS:
 - .1 The dimming units shall conform to specifications as listed above for Power Supply and shall be compatible with the Power Supply and the system used to drive the LEDs. They shall have PWM (Pulse Width Modulation) as basis for dimming the LEDs. The dimming of LEDs shall be flicker-less and ensure that there is no colour shift. The dimming shall be linear. The dimming unit shall be suitable for use with 1-10v DC controllers
 - .2 Any control interface or potentiometers used shall be compatible as a system and also conform to relevant standards such as those mentioned above. RGB mixing or DMX controls used shall be compatible.

- .3 Proper wiring and installation information should be provided
- .2 Acceptable lamp manufacturers:
 - .1 Osram- Sylvania
 - .2 Philips
 - .3 GE
- 2.3 **EMERGENCY BATTERY UNITS**
 - .1 Supply voltage 120 V.
 - .2 Output voltage 12 V dc.
 - .3 Batteries: sealed lead acid calcium alloy grid type sized to operate the lamp load to 91% of initial voltage for 30 minutes.
 - .4 Battery charger: solid state, multi-rate, voltage/current regulated, sized to restore battery to full charge in 12 hours.
 - .5 Low voltage disconnect: solid state, modular, operates at 80% battery voltage.
 - .6 EEMAC 1 code gauge steel housing.
 - .7 Auxiliary equipment:
 - .1 "AC Power ON"
 - .2 "Fast charge" pilot light
 - .3 Voltmeter
 - .4 Test switch
 - .5 5 minute time delay relay
 - .6 Cord and plug
 - .8 Lamp heads: mounted as indicated, 360° horizontal and 180° vertical adjustment, (20W) (quartz halogen composite) lamps.
 - .9 Acceptable Manufacturers:
 - .1 Rycroft - Lumacell
 - .2 Emergi-Lite
 - .3 Beluce

PART - 3 EXECUTION

3.1 INSTALLATION - GENERAL

- .1 Provide supports for luminaires. Support single units from luminaire studs in outlet boxes. For continuous row fluorescent type, provide support for each end plus at least one for each channel section, or additional as required. Swivel mount stems. Provide concrete inserts at points of luminaire support in unfinished areas where a concrete slab serves as ceiling. Provide support from concrete floor and roof steel above ceiling as applicable.
- .2 Align luminaires in rows, maintain required heights, and install luminaires clear of other work.

- .3 Clean and relamp existing luminaires being removed and installed in new locations.
- .4 Keep luminaires covered and protected from construction dust and debris until building is broom clean and free of suspended dust clouds.
- .5 Do not lamp luminaires until ready for testing and use. Obtain Owner's approval before lamping. Install lamps in lampholders.
- .6 When installation is complete, demonstrate operation to satisfaction of Owner.
- .7 Standard octagonal boxes may be supplied where conduits feeding luminaires in finished areas are exposed on ceiling if hanger canopies entirely cover outlet boxes and are neatly notched for conduit. Otherwise, provide cast conduit outlet boxes with a diameter larger than canopies.
- .8 Attach boxes or hickies directly to poured concrete with 6 mm minimum diameter bolts and lead expansion anchors where luminaires are suspended directly from concrete slabs. Use 8 mm minimum bolts through precast slabs, welded to 100 mm x 100 mm minimum, 3.5 mm plate above slabs.
- .9 Do not mount luminaires above pipes, ducts or equipment. In event of unavoidable tight locations, provide hangers to clear obstructions. Check layouts of other trades on job and plan cooperatively. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown.
- .10 Provide continuous 12 mm x 38 mm channel above ceiling, where luminaires are suspended or mounted on furred ceilings. Fasten luminaires to channel with two 6 mm minimum diameter studs with minimum 1220 mm on centre.
- .11 Where two 4'-0" surface or suspended fluorescent luminaires occur in tandem, an 8'-0" body may be used. Where two single lamp luminaires occur in tandem, a common lamp ballast may be used.
- .12 Verify catalogue number of luminaires with description prior to ordering, and check for final ceiling finish in areas where recessed luminaires are called for in order to provide ceiling trim, flanges and mounting brackets to suit particular construction used where luminaires are installed.
- .13 Support luminaires in an approved manner to comply with the Ontario Electrical Safety Code and the Ontario Building Code.
- .14 Provide steel luminaire studs, brackets and hangers. Where luminaires are hung on chain hangers, provide chain of closed link type capable of supporting ten times luminaire weight. Use U-bolts for chain ends; S-hooks are not acceptable.
- .15 Provide normal and emergency measurements of footcandle levels achieved.

3.2 **INSTALLATION - INDUSTRIAL**

- .1 For industrial luminaires suspended from ceiling outlet boxes, provide ½" rigid combination conduit stems, luminaire stud, and self-aligning hangers. In other locations, except as otherwise detailed or required, provide ceiling or wall outlet boxes with 3/8", no-bolt luminaire studs. Provide special hangers for support of any luminaire which weighs more than 50 pounds.
- .2 In high vibration areas, mount luminaires with cushion hangers.

- .3 Where specified, provide safety restraint device (safety chain or safety cord) of minimum length as recommended by the manufacturer.
- .4 The manufacturer to certify that the safety restraint device has been drop tested for the actual luminaire and restraint length.

3.3 INSTALLATION - EMERGENCY AND EXIT LIGHTS

- .1 Exit sign installation shall meet all requirements of the authorities having jurisdiction.
- .2 Install emergency battery units where shown. Support on brackets supplied by manufacturer.
- .3 Aim heads to properly illuminate exit path.

3.4 INSTALLATION - CEILINGS

- .1 Suspend luminaires mounted from or in a suspended T-bar ceiling directly from building structure, independent of the T-bar system, to ULC, Local Fire Marshal's Office, governing Building Code, Ontario Electrical Safety Authority (OESA) and Consultant's approval.
- .2 In non-accessible ceilings wire with not more than 1200 mm of AC90 or RW90 XLPE wire in flexible conduit to adjacent outlet boxes placed above finished ceiling within reach of the luminaire openings.
- .3 In accessible ceilings wire with not more than 1800 mm of AC90 or RW90 XLPE wire in flexible conduit to adjacent outlet boxes, locations as shown on the Drawings.
- .4 Provide suitable trim for all luminaires installed in drywall ceilings or within lay-in or snap-in tiles.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 DIMENSIONS AND QUANTITIES

- .1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to shop drawings and field measurement.
- .2 Quantities or lengths indicated in any of the Contract Documents are approximate only.
- .3 Make necessary changes to routing of cables and the like to accommodate structural, mechanical, electrical and architectural conditions. Coordinate with other trades and make allowance for conditions that will arise from work in progress under separate contract.
- .4 Plan cable pathway routing to ensure compliance with cable performance specifications, reference standards, and to avoid electromagnetic interference effects.
- .5 Report to the engineer immediately upon identification of any condition that may result in the performance criteria of the cabling being compromised.
- .6 Mark up areas on communications rooms backboards to indicate locations for installation and mounting of communications terminal blocks, security, related devices and electronic equipment, public address and paging, related equipment and terminal blocks and areas allocated for public carrier for over voltage protection devices, demarcation terminal blocks and CATV distribution and amplification devices. Use removable type to prepare proposed layout for Consultant's review. Overlay with black permanent marker after review by Engineer.

1.3 WORKING DRAWINGS AND DOCUMENTS

- .1 Where the word "HOLD" appears on Drawings and other Contract Documents, the Work is included in the Contract. Execute such Work only after verification of dimensions and materials and obtaining Consultant's written permission to proceed.

1.4 ACCEPTABLE MANUFACTURERS

- .1 Submit a tender that includes only those products identified in this and related sections in this Division of the specification.

1.5 QUALIFIED CONTRACTORS

- .1 Submit a tender to undertake work described under this division only if fully qualified to undertake the work by the manufacturer(s) of the product(s) proposed in the tender.
- .2 Do not propose the use of products or to provide contracting services if the manufacturer of the products proposed will not warranty the work to the best warranty most beneficial to the owner.

1.6 SUBMISSION OF COMPETENCY

- .1 Submit with the tender documents a statement from the cabling manufacturer indicating the bidder's good standing with the manufacturer and the manufacturer's willingness to

underwrite the performance warranty on the final installation. Failure to comply may result in the disqualification of the tender at the sole discretion of the owner.

1.7 MANUFACTURER'S ATTENDANCE AND REPORT

- .1 Provide manufacturer's representatives to verify installation practices for each part of the Work relevant to components including wiring and terminations.
- .2 Provide a construction review report prepared and signed by a representative of the manufacturer of wiring and terminations describing summary assessment for acceptability to meet warranty terms and conditions of work in progress for work described in this section and related sections affecting the work. Submit a construction review report to accompany the first progress claim to include 50% of the work by installed value. Submit second report on substantial completion of work.
- .3 Manufacturer's report is an essential component of the work and must be submitted to the engineer before Consultant's project deficiency review.

1.8 FIELD INSPECTION

- .1 Provide field technician for inspection and certification of cables, connectors, and associated equipment and accessories during installation, testing and commissioning as required. Provide a field technician possessing industry recognized credentials. Submit as a shop drawing within 5 days of receiving a request from the engineer or within 5 days of award of contract, whichever is the sooner, the technician's credentials.
- .2 Acceptable credentials include certificates of qualifications issued or assessed by a registered telecommunications industry association, a registered college or university, a registered training institution, a registered labour union, or a certificate of installer training issued by the manufacturer of the products in use for the work.

1.9 QUALITY ASSURANCE

- .1 These Specifications supplement the Electrical and Electronic Manufacturers Association of Canada, Canadian Standards Association Standards, Electronic Industries Association, Telecommunications Industries Association standards and recommendations. Conditions of the EEMAC, CSA, EIA, TIA and ISO/IEC standards and recommendations apply unless superseded or modified by this Specification.
- .2 Where requirements of the specifications exceed referenced standards, the specifications apply. Where standards differ between authorities, the most stringent applies.
- .3 Requirements of the specifications that are substandard to referenced standards should be brought to the attention of Consultant during bidding period in sufficient time to allow suitable action to be taken and addenda issued as necessary.
- .4 Equipment must be acceptable to electrical inspection authorities.
- .5 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
- .6 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.

1.10 AREA CLASSIFICATION

- .1 No area in the Work is classified as Hazardous.

1.11 **SUBMITTALS**

- .1 Refer to section 01 33 00 – Submittal Procedures if included with this Division.
- .2 Submit the following:
 - .1 Shop drawings:
 - .1 All component types prior to their use on site.
 - .2 Drawing illustrating front elevation of rack layouts prior to assembling said equipment.
 - .3 Drawing illustrating equipment room layouts where different from contract drawings. Identify dimensions of clearances to front, rear and sides of floor mounted components.
 - .4 Drawings illustrating cabling identification scheme prior to use on site.
 - .2 Record drawings.
 - .3 Test reports, submit within 3 days of testing.
 - .4 Site maintained working progress drawings for Consultant's review when requested. Site maintained copy of site instructions, change orders, change directives, minutes of site and trades coordination meetings for Consultant's review when requested.
 - .5 Operating and Maintenance Manuals.
 - .6 "As Built" Record Drawings.
 - .1 Prepare and submit drawings in hard copy format and in electronic machine readable computer aided drafting (CAD) format describing the work as completed. Submit drawings in AUTOCAD format of release level no older than two versions prior to current release. Request copy of standards and conventions for use when creating and maintaining CAD files. Comply with layer conventions as indicated in CAD standards and practices documentation, or use existing layering conventions in existing files when machine readable files are available.
 - .2 Where wires or communications raceways are underground or under floor or below finished grade, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades. Indicate inverts at point of penetration of conduits into below-grade hand wells, or below-grade maintenance chambers.
 - .3 Record deviations from cable numbers shown on the Contract Drawings.
 - .4 Prepare records of interconnecting and cross-connecting wiring between items of equipment including equipment supplied by Owner and under other Specification Sections. Provide the records loaded into a data base. Select the data base by mutual agreement with the Consultant.
 - .5 Approved Data Base Products
 - .1 Microsoft Access
 - .2 Microsoft Excel
 - .6 Prepare drawings clearly identifying routes taken by cable where the cable is not supported along its length by an approved electrical raceway.

- .7 Submit record drawings no later than 10 days following submitting a claim for substantial performance.

1.12 **PATHWAYS – HANGERS AND SUPPORTS**

- .1 Supports for structured cabling to segregate cabling from electrical and mechanical sources of interference or sources of potential damage.
- .2 Conduit, cable tray, cable runway fitted with cable protective accessories to limit bending and to prevent damage to cables. Conduit guards fitted on each conduit opening.
- .3 Open hook hangers and cable retention wraps permitted only as expressly indicated.
- .4 Flexible liquid-tight metallic conduit for isolation and protection of communications cables installed below access floors.

1.13 **GROUNDING AND BONDING**

- .1 Comply with electrical safety codes in effect at the time of installation.
- .2 Comply with grounding and bonding as indicated in the contract electrical drawings.
- .3 Provide Technical Single Point Ground as telecommunications systems ground reference.
 - .1 Grounding and bonding system for telecommunications to achieve an independent electrical grounding and bonding scheme separate and isolated from other grounds including building ground, lightning ground, process and controls ground or grounds, with exception that technical ground and electrical safety ground bonded at single point only, being closest to the source of incoming electrical power or as indicated.
 - .2 Technical grounding bus bars in telecommunications rooms, computer equipment rooms, telecommunications carrier building entrance and service rooms. Use Type T-300 in all locations other than main technical ground bus bar and unless indicated otherwise on the drawings.
 - .3 Main technical grounding bus bar(s). Use type TM-300 unless drawings indicate otherwise
 - .4 Bonding conductors between technical grounding bus bars and main technical grounding bus bar as indicated using conductor of size whichever is greater of #6 AWG or as required by electrical safety code or as indicated on the contract drawings.
 - .5 Bonding between main technical grounding bus bar and electrical safety ground.
 - .6 Computer and communications equipment cabinets bonded to technical ground
- .4 Common Electrical Ground
 - .1 Overvoltage protection building entrance devices bonded to electrical power safety ground.
 - .2 Communications metallic conduits, cable trays, cable runways, electrical enclosures, raceways bonded to electrical power safety ground.
 - .3 Grounding conductors in buried telecommunications ducts bonded to electrical safety ground.
- .5 Pathways Grounding and Bonding
 - .1 Communications cable tray, cable runway, bonded to electrical safety ground.

PART - 2 PRODUCTS

2.1 MANUFACTURERS

- .1 Where manufacturers are stipulated, use only the products indicated: Do not substitute with products by alternative manufacturers.
- .2 Where manufacturers are indicated as preferred, use the products as the basis of the tender and subsequent work.
- .3 Where manufacturers are identified as acceptable alternatives, voluntarily propose the use of the products and provide justification for substitution and perceived benefit to the contract. Do not use alternative products without engineer's written approval.
- .4 Avoid substitution of products that are not beneficial to the contract. Demonstrate benefit to the contract and obtain approval prior to use of products not stipulated in the contract drawings.

2.2 COMMUNICATIONS GROUNDING AND BONDING

- .1 Use products that comply with Ontario Electrical Safety Code.

2.3 PATHWAYS FOR COMMUNICATIONS SYSTEMS

.1 General

- .1 Refer also to 27 11 00 – equipment room fittings for overhead cable runway.
- .2 Use approved electrical raceways described elsewhere in this specification with the addition of items described herein.

.2 Cable Hangers and Supports

- .1 For use only where expressly indicated as permitted
- .2 Cable supports of open hook construction with 54 mm wide cable bearing surface curved with radius greater than minimum required by supported cable.
- .3 Listed manufacturers and products:
 - .1 Panduit
 - .2 Ideal
 - .3 Le Grand
- .4 Cable retention wraps, soft, reusable hook-and-loop tie, coloured to match colour code indicated. Plenum rated.
 - .1 Panduit: HLTP and HLSP series

.3 Conduit Guard

- .1 Plastic protection press-on bushings to suit EMT and rigid galvanized steel conduit; size to suit conduit to maximum 103 diameter. Suitable for use in air supply or return plenum spaces.

.4 Flexible Corrugated Non-Metallic Conduit of nominal inside diameters 25 mm 32 mm in fire ratings FT4, FT6.

- .1 Manufacturers:
 - .1 Arlington

- .5 Flexible fabric thin wall inner duct sleeve white with colour identification stripe including pull tape in 1-, 2-, 3-cell on micro-cell format. Fire ratings of normal, riser and plenum with optional copper 18 gauge tracing strips.
 - .1 Listed manufacturer and products:
 - .1 Max cell
 - .1 3-cell: 103 mm MXC4003XX series
 - .2 3-cell: 78 mm MXC3456XX series
 - .3 2-cell: 53 mm MXC2002XX series
 - .4 Micro 2-cell: 27 mm MXCM3302XX series
- .6 Flexible Liquid-Tight Metallic Conduit
 - .1 Corrugated heavy gauge electro galvanized flexible steel strip helically wound conduit with integral copper bonding wire and PVC jacket, colour blue or grey in nominal inside diameter sizes 21 mm, 25 mm, 32 mm, with fire ratings FT4, FT6, to CSA C22.2 No. 0.3
 - .2 Manufacturers:
 - .1 Delikon, Type YF-604
- .7 Flexible Metallic Conduit
 - .1 Corrugated heavy gauge electro galvanized flexible steel strip helically wound conduit with integral copper bonding wire in nominal inside diameter sizes 21 mm, 25 mm, 32 mm.
 - .2 Manufacturers:
 - .1 Delikon, Type YF-504

PART - 3 EXECUTION

3.1 COMMUNICATIONS GROUNDING AND BONDING

- .1 General
 - .1 Install grounding and bonding to comply with Ontario Electrical Safety Code and all applicable codes.
 - .2 Install inside grounding cables and conductors in electrical raceways, cable trays, cable runways, or in rigid PVC conduits as indicated. Install outside grounding cables and conductors in PVC rigid conduit or direct buried as indicated.
 - .3 Install inside grounding to comply with BICSI/JSTD-607-A, TIA-607 and BICSI published Telecommunications Design Methods Manual.
 - .4 Install outside grounding to comply with BICSI published Customer Owned Outside Plant Manual (Latest edition).
- .2 Communications Shields
 - .1 Bond communication shields to technical ground at both terminations when sharing a common single point ground system. Bond communications shield to technical ground at termination distant from work area outlets when terminations do not share a common ground system.

- .2 Make grounding connections to telecommunications cable conductive shields as indicated, using components designed for purpose and following manufacturer's instructions.
- .3 Protect finished communications grounding against making unwanted connections to dissimilar grounding systems.
- .3 Flexible Conduits
 - .1 Bond armour and bonding wire to ground through manufactured conduit accessories.
- 3.2 **ELECTRICAL SAFETY GROUND**
 - .1 Bond electrical conduit for telecommunications, cable trays for telecommunications, cable runways directly to electrical safety ground. Do not bond directly to technical ground.
 - .2 Bond main technical ground bus bar to electrical safety ground.
- 3.3 **PATHWAYS FOR COMMUNICATIONS SYSTEMS**
 - .1 General
 - .1 Pathways laid out and installed to comply with latest release of ANSI/TIA 569.
 - .2 Pathway run lengths to comply with latest release of ANSI/TIA 568. Notify Engineer in event of any inside path length exceeding 90 m
 - .3 Inside pathways installed parallel or perpendicular to building lines.
 - .4 Submit drawings of proposed installation, and indicating deviation from cable routing shown on drawings to the Engineer for review prior to commencing installation.
 - .5 Maintain clearances from outer container of electrical and heat sources
 - .1 Unit substations 10 m
 - .2 Power transformers enclosure (greater than 30 kVA) 10 m
 - .3 Transformers enclosures (up to 30 kVA) 1.2 m
 - .4 Motors casings (greater than 1 HP) 10 m
 - .5 Motors casings (up to 1 HP) 1.2 m
 - .6 Switch gear enclosures (greater than 600V) 10 m
 - .7 Feeder cable / conduit (600V and above) 1 m
 - .8 Distribution cable / conduit (less than 600V) 750 mm
 - .9 EMT conduit (Enclosing 30A branch circuits) 300 mm
 - .10 ENT conduit (Enclosing 30A branch circuits) 450 mm
 - .11 EMT conduit (Enclosing 20A branch circuits) 75 mm
 - .12 ENT conduit (Enclosing 20A branch circuits) 150 mm
 - .13 EMT conduit (Enclosing 15A branch circuits) 65 mm
 - .14 ENT conduit (Enclosing 15A branch circuits) 100 mm
 - .15 Control cabling (in separate conduit) zero
 - .16 Control cabling (exposed) 100 mm

- | | | |
|-----|--------------------------------------|--------|
| .17 | Class 2 wiring (in separate conduit) | zero |
| .18 | Class 2 wiring (exposed) | 100 mm |
| .19 | Conduit (All others) | 75 mm |
| .20 | Fluorescent luminaires | 600 mm |
| .21 | Pipes (gas, oil, water, etc.) | 300 mm |
| .22 | HVAC (equipment, ducts, etc.) | 150 mm |
- .2 Cable Protection
- .1 Provide protective cable sleeving to prevent damage to cables at transition from cable tray, conduit, pull box, junction box, maintenance hole, pull point. Provide sleeve to reduce friction, bending and crushing forces. Install split sleeve where impracticable to install solid.
- .3 Cable Hangers and Supports
- .1 Where expressly indicated, support cables by use of cable hangers spaced at max 1000 spacing.
- .2 Limit cables to 24 per hanger.
- .3 Apply cable retention wraps without causing tension, pressure or other deformation of cable and cable bundles. Complete wrap with 100 mm overlap. Spacing between wraps not more than 1200 mm except for cables in horizontal cable tray. Avoid wrapping cables in bundles in horizontal sections of cable tray. Secure cables in bundles in vertical portion of cables tray with supports at spacing of not more than 600 mm. Place and secure cables in tray to prevent edges pressing against cable jacket.
- .4 Conduit
- .1 Extend distribution and backbone conduit to cable tray.
- .2 Form field-formed raceway to comply to TIA 569 specifications
- .3 Fit conduit guard bushings on each exposed entrance to conduit raceway
- .5 Innerduct Sleeving
- .1 Install flexible corrugated non-metallic conduit for protection against abrasion and bending, and as protection of optical fibre cables in open cable tray. Colour: orange except black or grey where indicated; inside diameter: 25 mm except 32 mm where indicated; fire ratings: FT6 except FT4 where indicated
- .2 Install flexible fabric low friction pre-lubricated innerduct sleeve in backbone conduits, and conduits below grade and where indicated. Colour coded, with pre-installed pulling tape; electrically traceable where indicated
- .1 3-cell construction for installation in 103 conduits
- .2 3-cell construction for installation in 78 conduits
- .3 2-cell construction for installation in 54 conduits
- .4 Micro 2-cell construction for installation in 27 conduits
- .6 Flexible Conduit
- .1 Install flexible metallic liquid-tight conduit below access flooring between communications raceways and individual outlet device boxes.

- .2 Install conduit of trade size as indicated on the drawings or described in the specification or 21 mm diameter whichever is the greatest.
- .3 Install cable below access flooring with jacket to FT6 flame test rating.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.
 - .2 Label cables, cords, power strips, cabinets, electrical raceways, grounding conductors, outlets, faceplates, firestops in accordance with latest revision of TIA-606 and as described on the contract drawings and herein
 - .3 Coloured marking using standardized colours consisting of the following Pantone reference colours or the indicated commercial equivalent:
 - .1 Red: Pantone 186C or 184C
 - .1 Benjamin Moore: 133-20
 - .2 Armour coat: Fire Red 98-4748-6
 - .2 Blue: Pantone 300C or 291C
 - .1 Benjamin Moore: 133-33
 - .2 Armour coat: Commodore Blue 98-4745-2
 - .3 White: Pantone White C
 - .1 Benjamin Moore: 133-01
 - .2 Armour coat: Gloss White
 - .4 Orange: Pantone 166C or 150C
 - .1 Benjamin Moore: 007
 - .2 Armour coat: Zesty orange
 - .5 Yellow: Pantone Yellow C or 101C
 - .1 Benjamin Moore: 133-12
 - .2 Armour coat: Holland Yellow
 - .6 Green: Pantone 336 or 353C
 - .1 Benjamin Moore: 133-40
 - .2 Armour coat: Shutter Green
 - .7 Brown: Pantone 478C or 465C
 - .1 Benjamin Moore: 133-60
 - .2 Armour coat: Havana Brown
 - .8 Black: Pantone Black C
 - .1 Benjamin Moore: 133-80
 - .2 Armour coat: Gloss Black
 - .9 Purple: Pantone 257C or 264C
 - .1 Benjamin Moore: 1396

- .2 Armour coat: N/A
- .10 Grey: Pantone 422C
 - .1 Benjamin Moore: not specified
 - .2 Armour coat: not specified
- .4 Identify conduits, electrical raceways, pullboxes, junction boxes, for communications according to the colour scheme indicated on the contract drawings and herein.
- .5 Identify cables, outputs, faceplates, jacks, grounding components and cabinets for communications according to the labelling and identification scheme indicated in the contract drawings and herein.
- .6 Use cables, jacks, cords, icons, manufactured in the colours identified in the contract drawings and herein.
- .7 Use the identification scheme as indicated.
- 1.2 **SUBMITTALS**
 - .1 Prepare a sample printed copy of the identification labels and submit to the Consultant for review.
- PART - 2 PRODUCTS**
- 2.1 **MANUFACTURERS**
 - .1 Furnish or install products manufactured by stipulated manufactures where so indicated on the contract documents.
 - .2 Avoid use of products by manufacturers not stipulated on the contract documents.
 - .3 Occurrence of products in these specifications other than those stipulated for use is not to be interpreted as authorization to use such products.
- 2.2 **COLOURS**
 - .1 Product colours as indicated on the contract drawings or herein.
- 2.3 **WRAP-AROUND COLOUR IDENTIFICATION MARKERS**
 - .1 Coloured Metallic Cable Ties
 - .1 Coloured aluminum cables ties,
 - .1 Width 8 mm
 - .2 Lengths 140 mm, 201 mm, 362 mm to suit cable or conduit diameters of 25 mm, 51 mm, 102 mm
 - .3 Colours: Blue, Green, Red, Yellow, Black, Clear Aluminum
 - .2 Listed Manufacturers and representative products:
 - .1 Panduit: MLT1H-LPAL, MLT2H-LPAL, MLT4H-LPAL etc
 - .2 Coloured Hook and Loop Non-Metallic Cable Ties
 - .1 Coloured non-metallic cables ties, adjustable and reusable, hook-and-loop material, -18C to 104C,

- .1 Widths 8.4 mm, 13 mm, 19 mm
- .2 Lengths 150 mm, 300 mm, 457 mm
- .3 Colours: Black, Red, Orange, Yellow, Green, Blue, Grey, White
- .2 Listed Manufacturers and representative products:
 - .1 Panduit: HLT2I-X0 etc
- .3 Electrical Colour Coding Tape
 - .1 PVC backing, 0.178 mm thick indoor outdoor suitable, pressure sensitive rubber adhesive, colored, fade resistant, abrasion and weather resistant, to CSA C22.2 No 197-M1983,
 - .1 Widths: 13 mm, 19 mm
 - .2 Colours: Black, Brown, Red, Orange, Yellow, Green, Blue, Grey, White, Violet
 - .2 Listed manufacturers and representative products:
 - .1 Scotch 35 vinyl electrical colour coding tape
- 2.4 **PAINT**
 - .1 Refer to specification 09 91 00 other wise treat as Shop Primed Ferrous Metal - Alkyd Finish
 - .1 1 coats alkyd, Paint Code 48, gloss enamel
 - .2 Paint Code: 48 - Interior Alkyd Gloss Enamel: Conforming to CAN/CGSB-1.60-M; Benjamin Moore 133, ICI Devoe 4308 Series, Para 400, PPG 6-282, Sherwin Williams B35-200 Series or Sico 888-111.
- 2.5 **LABELS**
 - .1 General
 - .1 Use products that comply with TIA-606A and CSA-T528.
 - .2 Prepare labels by use machine printing. Avoid use of handwritten labels.
 - .3 Manufacturer: same as original equipment supplier otherwise Panduit.
 - .2 Cable Labels
 - .1 Self-adhesive, self-laminating material, white engrave area.
 - .2 Minimum two times full wrap-around cable.
 - .3 Faceplate Labels
 - .1 Labels to suit selected faceplate.
 - .4 Grounding Bus Bars
 - .1 Self adhesive, white engraved areas, minimum size 25 x 50 mm, characters minimum height 12 mm.
 - .5 Patch Panels
 - .1 Self adhesive, white engraved areas to suit selected patch panel or termination strip.

- .6 Rack and Cabinets
 - .1 Self adhesive, white engraved areas, minimum size 50 x 75 mm, characters minimum height 12 mm.

PART - 3 EXECUTION

3.1 COLOURS

- .1 Use components in the colour as indicated.

3.2 LABELLING

- .1 General
 - .1 Apply labels so that the printed information may be read without the need to disturb the cables.
 - .2 Apply labels on cables as close to the end of the cable jacket as practicable and no closer than 10 mm and not concealed by obstructions.
 - .3 Apply labels on jacks, faceplates and patch panels in the manner prescribed by the original equipment manufacturer
 - .4 Apply more than one label where immediate obstructions may prevent ease of reading the prescribed label.
 - .5 Apply a label on the inside of the electrical device outlet box corresponding to each cable terminated on the face plate mounted on the device box.
 - .6 Use only approved cable marking materials.
 - .7 Clearly identify all outlets, patch-panels, patch-cords, cables, racks enclosures, spaces, closets, conduit, and raceways according to the administration system shown on the contract drawings.
 - .8 Use only machine printed labelling for outlets.
 - .9 Use only engraved plastic plates for the labelling of enclosures and racks.
- .2 Horizontal Distribution Cabling
 - .1 Use the identification scheme as stipulated in the contract documents
 - .2 Scheme B: Basic Numbering
 - .1 General
 - .1 Where an outlet is indicated on the contract drawings designate each jack as a communications jack suitable for data or voice or other services, with the following exceptions.
 - .2 Where an outlet is tagged on the contract drawings as "T", designate the jack for convenience telephone service.
 - .3 Where an outlet is tagged on the contract drawings as "P" designate the cable for payphone service.
 - .4 Where an outlet is tagged on the contract drawings as "M", designate the cable for monitored line service.
 - .5 Where an outlet is tagged on the contract drawing as "I", designate the cables for Intercom service.

- .6 Where an outlet is tagged on the contract drawing as “C”, designate the cables for special communications service.
- .7 Where an outlet is tagged on the contract drawing as “W”, designate the cables for wireless access point service.
- .2 Facility Prefix
 - .1 Prefix all identifiers with a building identifier. Default this field to BLANK if there is only one building.
 - .2 Prefix all identifiers with a numeric value indicating the floor within the premises or facility for the telecommunications room where the cable is terminated.
 - .1 Example: Floor 2: 02; Basement: B1; ground floor: 01
 - .3 Follow the Prefix with a hyphen separator and an Alpha character and a hyphen separator to identify the specific telecommunications room where there is more than one to any floor.
 - .4 Reserve the special value of “Z” to indicate a building entrance service room
 - .1 Example: first and only telecom room: -A-; second telecom room on common floor: -B-; building entrance room: -Z-
- .3 Numeric Ordinals
 - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification within new or with existing cabling.
- .4 Communications Cables
 - .1 Identify cables as nnn where nnn is a unique numeric ordinal beginning at 001 to 999.
 - .1 Example: Cable #1: 001; cable #50: 050
- .5 Telephone Cables
 - .1 Identify Telephone cables as Tnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and T is a literal value.
 - .1 Example: Telephone Cable #1: T001; telephone cable #50: T050
- .6 Monitored Line Cables
 - .1 Identify Monitored line cables as Mnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and M is a literal value.
 - .1 Example: Monitored line cable #1: M001; Monitored line cable #2: M002
- .7 Intercom Cables
 - .1 Identify Intercom line cables as Innn where nnn is a unique numeric ordinal beginning at 001 to 999 and I is a literal value.
 - .1 Example: Intercom line cable #1: I001; Intercom line cable #2: I002

- .8 Work Area Outlet
 - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
- .9 Telecommunications Room Horizontal Cable Patch Panel Termination
 - .1 Label the jacks at the patch panel with the same identification as the cable connecting to the jack.
 - .2 Label the communications cable termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally, left to right, and progressing vertically as each row of jacks is completed. Example: 001, 002, 003 etc.
 - .3 For each non generic cable, label the termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, beginning a new row for each non-generic type
 - .1 Example
 - .1 P001, P002, P003, P004
 - .2 T001, T002, T003, T004,
 - .3 M001, M002, M003, M004,
 - .4 C001, C002, C003, C004,
- .10 Cable identification examples
 - .1 A-01-A-001: Building A, floor 01, room A, cable 001
 - .2 A-B1-Z-P001: Building A, basement B1, room Z (entrance room), pay phone 001.
- .3 Backbone Cabling
 - .1 General Scheme
 - .1 Designate backbone multi-pair copper cables as MC/01/02/nnn, where 01 designates the terminal in or nearest to the building entrance room, 02 designates the next telecommunications room and nnn is a unique numeric ordinal beginning at 001 to 999. The ordinal is maintained unique throughout this cable type; it does not revert to 001.
 - .1 Example
 - .1 MC/A-B1-Z/A-01-A/001 Multi-pair copper cable, from: building A, basement B1, entrance room (Z); to building A, floor 01, room A; cable number 001
 - .2 Designate backbone optical fibre multimode cable as OM-01-02-nnn where 01 designates the terminal in or nearest to the building entrance room, 02 designates the next telecommunications room and nnn is a unique numeric ordinal beginning at 001 to 999. The ordinal is maintained unique throughout this cable type; it does not revert to 001.
 - .3 Designate backbone optical fibre single mode cable as OS-01-02-nnn where 01 designates the terminal in or nearest to the building entrance room, 02 designates the next telecommunications room and nnn is a unique numeric ordinal beginning at 001 to 999. The ordinal is maintained unique throughout this cable type, it does not revert to 001.

- .4 Designate backbone crossover copper 4-pair cable as Xnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and X is a literal value. The ordinal is maintained unique throughout this cable type; it does not revert to 001.
- .2 Multi-Pair Copper Backbone Cables
 - .1 Label the termination field with the identification of the cable that terminates thereon.
- .3 Optical Fibre Backbone Cables
 - .1 Label the optical fibre termination patch field with the identification of the cable that terminates thereon.
- .4 Backbone Crossover Cables
 - .1 Label the crossover termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally, left to right, and progressing vertically as each row of jacks is completed. Example: X001, X002, X003 etc.
- .4 Connecting Cords
 - .1 Identify each connecting cord with a label affixed at each end within 50 mm of the jack
 - .1 Label each cable as follows where "LL" is length expressed in meters, left padded with zero, "xxx" is cord ordinal, left padded with zero, beginning at 001. Ordinal does not reset for different values of LL.
 - .1 LL-xxx

3.3 **ELECTRICAL PATHWAY IDENTIFICATION**

- .1 Mark surface mounted metallic or non-metallic conduit raceways by use of combination of coloured couplers and painted stripes, electrical identification plastic tape, or wrap-around markers. Use primary identifiers to identify electrical systems. Use secondary and tertiary markers to identify subsystems when so directed on the contract drawings.
- .2 Do not identify surface raceways mounted below ceiling line in finished areas. Do not apply colour code identifier markings to outlet faceplates.
- .3 Identify raceways at termination of raceway and transition to other raceways or enclosures. Apply markings on each side of transit through architectural partitions or floors or ceilings.
- .4 Employ system colours as indicated in table below.
- .5 Apply a small area of paint to inside of outlet, junction and pull boxes.
- .6 Apply identifying mark as paint to full surface of junction box and pull box cover panels for boxes of 150 x 150 or smaller.
- .7 Apply identifying mark as stripe for junction and pull boxes greater than 150 x 150.
- .8 Use wrap around identification bands to identify conduit where painting is impracticable or prohibited or has potential to damage cabling or adjacent materials. Avoid obscuring labels. Avoid obscuring inspection windows.
- .9 Use wraparound identification bands to identify exposed communications cabling according to system where indicated on the drawings.

- .10 Identify metallic sheathed or armoured cables according to system where indicated on the drawings.
- .11 Apply one or more markings per the table below as indicated in the contract drawings.
- .12 Apply a primary marking band of minimum 19 mm wide. Where indicated, apply secondary and tertiary marking of minimum 8 mm maximum 12 mm each. Apply marking with separation of 12 mm to 20 mm between adjacent bands. Apply the primary marking band nearest to the junction of the conduit with the junction box, outlet box or pull box.

Electrical Communications Raceway Identification			
Style code	Service	primary	secondary
C0	Communications	BLUE	
C1	Communications – backbone	BLUE	BLUE
C2	Communications – backbone – copper -public	BLUE	BLUE
C3	Communications – backbone – fibre - public	BLUE	BLUE
C4	Communications – backbone – copper -private	BLUE	BLUE
C5	Communications – backbone – fibre - private	BLUE	BLUE
C6	Communications – distribution	BLUE	GREEN
C7	Communications – distribution –copper	BLUE	GREEN
C8	Communications – distribution - fibre	BLUE	GREEN

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 SUBMITTALS

- .1 Submit test reports for review by Consultant. Include in Operating Maintenance Manual.
- .2 Submit test data in a machine readable format approved by the Consultant. Submit a "reader" program designed and as required for use with the test data file.
- .3 Submit a hard copy version of each test report. Use 2-sided printing where practicable.
- .4 Submit a PDF® (Portable document format) version of each test report.
- .5 Submit a summary report for each copper cable indicating Pass/Fail and length for each cable tabulating each result by cable number.
- .6 Submit detail test results for all copper cables including backbone and distribution communications cables.
- .7 Deliver the reports in a media format selected from the following:
 - .1 CD-ROM
 - OR
 - .2 Owner's approved format
- .8 Submit evidence from each third party warranting performance guarantees of any part of the cabling system of their agreement that testing and site inspection procedures are fit for the purpose of upholding the warranty.

1.3 TEST REPORTS

- .1 For each check and test performed prepare and submit a Test Report, signed by the Test engineer, and where witnessed, by the Consultant.
- .2 Test Reports to include a record of all tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test engineer, witnesses, also calibration record of all test instruments used together with manufacturers name, serial number and model number.
- .3 Calibration record to include performance level of test equipment.
- .4 Tests performed with instruments that have not been calibrated or certified as Fit For Purpose within 12 months preceding the date of use may be rejected at sole discretion of the owner.
- .5 Undertake either full or sample testing daily and have reports available for review by the Consultant as an assurance that standards of working practices are being maintained.
- .6 Complete test records and certification of such records prior to project cutover or beneficial use of the facility by Owner.

- .7 Configure the test equipment according to the cable under test. Install product specific parameters.

1.4 **MANUFACTURER'S ATTENDANCE**

- .1 Provide manufacturer's representatives to verify installation practices for each part of the Work as may be relevant to all components including wiring and terminations.

1.5 **FIELD INSPECTION**

- .1 Provide field engineer for inspection and certification of facilities during installation, testing and commissioning as required.
- .2 Perform visual inspection of all exposed cable to verify compliance with bend radius protection, sheath protection and protection against harsh environment.
- .3 Perform visual verification that all cables, outlets, jacks and patch cords are labelled according to this specification. Confirm that cable numbers and jack numbers align.
- .4 Prepare summary report attesting to the findings of the field inspection.

1.6 **QUALITY ASSURANCE**

- .1 These Specifications supplement the Electrical and Electronic Manufacturers Association of Canada, Canadian Standards Association Standards, Electronic Industries Association, Telecommunications Industries Association standards and recommendations. Conditions of the EEMAC, CSA, EIA, TIA and ISO/IEC standards and recommendations apply unless superseded or modified by this Specification.
- .2 Where requirements of the specifications exceed referenced standards, the specifications apply. Where standards differ between authorities, the most rigid applies.
- .3 Requirements of the specifications that are substandard to referenced standards should be brought to the attention of Consultant during bidding period.
- .4 Where any part of the Work fails tests, replace the defective material.
- .5 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.
- .6 Identify and indicate in the test results, the type/style/category/product number of cables under test.

PART - 2 PRODUCTS

2.1 **TEST INSTRUMENTS**

- .1 Use only one style of test instrument for all measurements; use instruments of only one manufacturer for all measurements
- .2 Use instruments manufactured by one of the following:
 - .1 Agilent
 - .2 Fluke

PART - 3 EXECUTION

3.1 TESTING AND REPAIRING

- .1 Test horizontal and backbone copper cables according to the following criteria:
 - .1 For cables up to and including Category 3, test all pairs of each horizontal and backbone cables for continuity, short circuits, open circuits, continuity to ground, correct polarity, length, attenuation and near end crosstalk to a minimum of 16 MHz. Perform tests in accordance with TIA 568B.
 - .2 For Category 6A cabling, test all pairs for continuity, short circuits, open circuits, continuity to ground and correct polarity. Test each cable for length, attenuation, near end crosstalk, far end cross talk, delay, delay skew to a minimum of 1000 MHz. Perform tests in accordance with TIA 568B
 - .3 For Category 6A cabling, and on request of the engineer, conduct tests to 1000 MHz for Alien Cross Talk measurements on an audit basis as per TIA 568 B2-10 on two samples of 6-around-one cable sets selected by the engineer.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section Includes
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 MANUFACTURER'S ATTENDANCE

- .1 Provide manufacturer's representatives to verify installation practices for each part of the Work as may be relevant to all components including wiring and terminations.

1.3 FIELD INSPECTION

- .1 Provide field engineer for inspection and certification of equipment during installation, testing and commissioning as required.

1.4 SYSTEM DESCRIPTION

- .1 Horizontal cabling and connectivity components to effect a fully functional horizontal distribution cabling Information Transport System.

PART - 2 PRODUCTS

2.1 HORIZONTAL COPPER CABLES

- .1 Unshielded twisted copper 24 AWG 4-paired cables of characteristic impedance 100Ω: to CMR (FT4) and CMP (FT6) as indicated
 - .1 Performance to ISO11801 and TIA 568-C.2
- .2 Cable type C15
 - .1 4-pair U/UTP, Category 6 – matching with existing
 - .1 Le Grand
 - .2 Panduit
 - .3 AMP/Tyco Electronics
 - .4 Belden
 - .5 Systemax

2.2 JACKS

- .1 Modular Jack (8p8c) - 8 Position, - Non-Keyed
 - .1 Modular plastic formed telecommunications 8-pin 8-conductor ("RJ45") outlet jack non-keyed, comply with ISO11801 specification and TIA 568-C.2, compatible with flush- and surface-mount telecommunications outlet faceplates, modular furniture faceplate adapters, utility service pole adapter plates, floor box adapter plates, conduit poke-through adapter plates, rack mount modular patch panels, with colour coded removable identification icon, compatible with shielded panel and shielded cable options
 - .2 Jack face parallel with face of faceplate

- .3 Modular cable strain relief
- .4 Pair wiring comply with ISO11801 Specification pinning convention.
 - .1 Pair 1 Pins 4-5 Blue pair
 - .2 Pair 2 Pins 1-2 Orange pair
 - .3 Pair 3 Pins 3-6 Green pair
 - .4 Pair 4 Pins 7-8 Brown pair
- .5 Jack body colour:
 - .1 White
 - .2 Black
 - .3 Blue
 - .4 Red
- .6 Colour-coded icon colour
 - .1 White
 - .2 Black
 - .3 Blue
 - .4 Red
- .7 Jack type J55
 - .1 UTP, Category 6A, one port
 - .1 Le Grand
 - .2 Panduit
 - .3 AMP/Tyco
 - .4 Belden
 - .5 Systemax

2.3 **WALL PLATES**

- .1 Plastic faceplate, single or double gang position to suit jack quantity
- .2 Colour to match electrical faceplate, or else white if not specified
- .3 Blank cover plate to match
- .4 Manufacturer same as jack

PART - 3 EXECUTION

3.1 **GENERAL**

- .1 Place cable in conduits and cable tray and other designated cabling pathways
- .2 Terminate cables at connectors in work area and in telecommunications rooms
- .3 Apply channel identification labels at each end of cable
- .4 Record deviation of cabling shown on drawings in as-constructed drawings.

- .5 Avoid scraping, denting, crushing, twisting, kinking or otherwise damaging cables, before, during or after installation. Replace damaged cables without cost to the contract.
- .6 Pull cables in a continuous run. Avoid splicing horizontal cables.
- .7 Install cables in accordance with manufacturer's specifications. Ensure proper installation techniques are observed and cable maximum pull-force and minimum bend radius specifications are adhered to.
- .8 Use protected cable pathways such as formed slots, formed sleeves, conduits, cable trays, ducts, raceways and furniture system channels.
- .9 Avoid placing cabling in crevices or other gaps in the building infrastructure not expressly intended for cabling.
- .10 Protect cables against risk of damage at edges of furniture, cable tray, raceway etc. Install cable in flexible plastic conduit.
- .11 Protect cable at pathway transitions by use of flexible plastic conduit or manufactured "waterfall" elements.
- .12 Neatly bundle, secure cables. Use light pressure soft wraps.
- .13 Bundle and dress cables in groups of 12 or 24, at patch panels and within cabinets. Dress cables neatly and orderly within cabinets. Follow manufacturer's recommended practices to ensure performance compliance.
- .14 Support cables within cabinets at rear of patch panel and at intervals of 450 mm.
- .15 Support horizontally placed cables in trays or conduit.
- .16 Support vertically placed cables by attaching to a support, firmly attached to the building fabric, at intervals of 600 mm.
- .17 Separate voice and data cables when identified.
- .18 Maintain clearance from power cables as described in the specification. Maintain clearance from other signal cables including mechanical systems, security cables, and BMS cables minimum 100 mm.
- .19 Do not maintain bundles for distances greater than 1 m in cable trays.
- .20 Pass cables at backboard terminations through holes positioned in the center of the termination mount.
- .21 Do not exceed manufacturer's recommended bending of cable. Maintain a radius or 4 times cable diameter or 25 mm for copper UTP or FTP or STP, whichever is the greater. Maintain a radius of 10 times cable diameter or 30 mm for optical fibre cables.
- .22 Do not untwisted exposed pairs at terminations for more than 13 mm.
- .23 Bond to ground all metallic cable strength members and metallic sheaths to manufacturer's specifications.
- .24 Do not strap cables to, or lay cables on, any length of conduit, pipe, ventilation duct or other building element not expressly installed for the purpose of cable support.
- .25 Terminate all pairs of UTP cable at both ends.

- .26 Where practicable and where the maximum allowable cable length is not exceeded, provide 3 m of slack UTP cable at the workstation end of each distribution cable. Neatly coil slack in ceiling space and store suspended.
- .27 Where the telecommunications outlet is mounted on a wall box or floor box or system furniture, provide working slack allowance for UTP cable of 300 mm. Coil neatly and secure.
- .28 Select least obstructed pathway through modular or system furniture. Where available, use eye-level pathways in preference to base-level pathways.
- .29 Install blank filler plates for all unused modular jack positions on faceplates.
- .30 Install blank cover plates for all unused or abandoned outlet boxes.
- .31 Inform Consultant immediately of any horizontal cable runs exceeding 90 m in length.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 RELATED SECTIONS

- .1 Division 21: Fire Suppression
- .2 Section 26 05 01 – Common Work Results for Electrical

1.3 REFERENCES

- .1 CAN/ULC-S524-19 - Standard for the Installation of Fire Alarm Systems
- .2 CAN/ULC-S536-19 - Standard for the Inspection and Testing of Fire Alarm Systems
- .3 CAN/ULC-S537-19 - Standard for the Verification of Fire Alarm Systems
- .4 CAN/ULC-S1001-11 - Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.4 MANUFACTURER'S ATTENDANCE

- .1 Provide services of manufacturer's representative in accordance with section 26 05 01.

1.5 SUBMITTALS

- .1 Shop Drawings
 - .1 Where applicable submit shop drawings in accordance with Division 01 for following and prior to commencing installation. Do work in accordance with reviewed shop drawings.
 - .2 Systems functional description and actual sequence of operation.
 - .3 Project specific detailed riser diagram

PART - 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 GE Edwards (Existing System)

PART - 3 EXECUTION

3.1 CONNECTIONS TO OTHER SYSTEMS

- .1 Sprinkler and Fire Standpipe Systems
 - .1 Provide wiring and connections from the central fire alarm panel to all alarm check valves, supervised valves and pressure switches supplied and installed under Mechanical Division.

- .2 Provide wiring and connections from the central fire alarm panel to sprinkler and fire standpipe system pumps supervisory contacts supplied and installed under Division 23 Mechanical, for "Loss of Power" and "Pump(s) Running" annunciation.
- .3 Wire all excess pressure pumps.
- .2 Existing System
 - .1 Existing system shall remain operation all time, any shutdown required for connection to existing system to be coordinated and approved by station operational staff.

3.2 **INSTALLATION**

- .1 Install to CAN/ULC S524.
- .2 Connect new devices to existing fire alarm system as required.
- .3 Install wiring for standard type initiating circuits in separate raceway system from alarm signal circuits, unless wiring is individually shielded and single point ground connected and acceptable to equipment manufacturer.
- .4 Wire alarm signals in accordance with requirements by manufacturer and operation. Install end-of-line device for signal circuit in suitable box adjacent to last signal of signal circuit or mounted on suitable terminal strips in control panel.
- .5 Equip raceways with separate green ground-wire and bond to ground lug at each outlet box of device and bond ground wires directly to ground bus in control panel.
- .6 Clear wiring of shorts, opens and grounds on completion of work.
- .7 Mount detectors on ceiling as per CAN/ULC-S524 Standard unless otherwise specified herein with minimum and maximum distances as required for respective type of detector, at highest point where variations in ceiling height exist. Do not mount detectors on sides, undersides, or less than 600 mm from walls, beams, joints, ducts, open web steel joists or any structure projecting below actual ceiling height and especially from lighting fixtures and air exhaust handling or heating outlets, but 900 mm from air supply handling or heating outlet.
- .8 Should interference from obstruction, lamp positions, air outlets or heat radiating surfaces be encountered in locating any detector where indicated, locate detector as near as possible to indicated position, clear of obstacles, to satisfaction of Owner's Designee, but maintain clear space of 600 mm on ceiling, below and around.
- .9 Identify signal circuit, alarm initiating circuit, auxiliary circuit and other wiring at fire alarm control panel, annunciator, terminal boxes or elsewhere on completion of work with appropriate marking labels. Mark single conductors with suitable self adhesive type, indelible numbered markers, identify cables with clear polyester tag, attached with self-locking TY-RAP.
- .10 Provide, install and connect wiring and interconnecting wires and cables as specified herein, as required by control panel manufacturer and as indicated on Drawings.
- .11 Conductors shall be solid copper. The minimum size of conductor shall be:
 - .1 16 AWG for individual conductors
 - .2 18 AWG for integral assembly of two or more conductor cables

- .3 14 AWG for control and audible signal circuits. In no case shall the voltage drop exceed 10%.
- .4 All conductors to match with existing.
- .12 Class A wiring shall be used for all alarm initiating devices.
- .13 Provide rigid conduits (matching with existing) with screw fittings with nylon insulated thread as manufactured by T & B or approved equal. Size conduits to Code requirements or larger sizes where indicated.
- .14 Should interference from obstructions, lamp positions or heat radiating surfaces be encountered in locating any fire alarm device where shown, the device shall be located as near as possible to indicated position, clear of obstacles, to the satisfaction of Consultant.

3.3 **FIELD QUALITY CONTROL**

- .1 Inspection and Verification
 - .1 Only directly prior to verification, remove smoke detector protectors and clean smoke detectors thoroughly.
 - .2 Inspect and verify each individual device in entire system for proper connection, supervision and function in accordance with CAN/ULC-S537. Identify detectors, manual pull stations and signal appliances not installed within requirements of CAN/ULC-S524 in remarks column of verification report and bring to Owner's Designee's attention prior to acceptance test.
 - .3 Obtain verification certificate and verification report from manufacturer showing each device checked, and that this work has been carried out. Utilize standard verification forms similar to Canadian Fire Alarm Association (C.F.A.A.) forms.
 - .4 Inspection and checking shall include smoke testing of each ionization or photoelectric smoke detector when installed with similar material found in area protected or as directed otherwise by Owner's Designee. Submit smoke detectors sensitivity calibration reading, as read on place of installation as part of verification report.
 - .5 Fire alarm manufacturer shall supply to electrical contractor reasonable amounts of technical assistance with respect to any changes necessary to execute work during period of inspection by manufacturer, electrical contractor shall make available, to manufacturer, electricians as designated by manufacturer.
 - .6 Verify only when entire system is fully operational and no subsequent work will be performed, unless project is designated for phased occupancy.
 - .7 For phased occupancy construction provide interim testing and verification service and retest entire system at the end of the project.
 - .8 Issue certificate of verification only after completion of deficiencies noted during verification have been corrected and re-verified.

3.4 **FINAL COMMISSIONING**

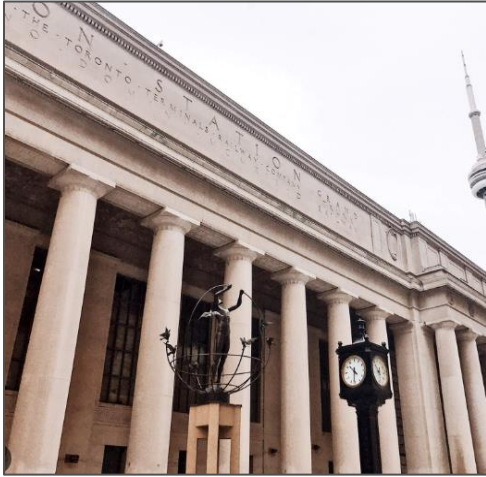
- .1 After completion of above inspection and verification, make arrangement with Owner's Designee, manufacturer of control equipment and other installers of related and connected equipment to perform functional acceptance tests, giving ample notice to parties concerned to be present.
- .2 Re-program existing fire alarm system adding new devices.

- .3 Tests to include:
 - .1 Spot check of devices to ensure proper connections and supervision.
 - .2 Operation of at least 1 alarm initiating device on each detection circuit to verify required operation of alarm devices, annunciator and other installations.
 - .3 Testing of signal devices for correct operation and function.
 - .4 Testing of smoke detectors with similar material found in area to be protected.
 - .5 Record sound pressure levels in each room during an alarm condition and at ambient levels.
- .4 Perform and document integrated tests between the fire alarm system and fire protection system to the requirements of CAN/ULC S1001.

3.5 **DEMONSTRATION**

- .1 Provide 20 hrs familiarization and instruction period, to familiarize user and Owner's maintenance staff with working and function of system and equipment and to instruct maintenance personnel about proper maintenance.

END OF SECTION



Hazardous Building Materials Assessment (Pre-construction)

Third Floor Security Offices
Union Station
65 Front Street West, Toronto,
Ontario

Prepared for:

NORR Limited

175 Bloor Street East, North Tower, 15th
Floor
Toronto, Ontario, M4W 3R8

September 16, 2024

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EXECUTIVE SUMMARY

NORR Limited (Client) retained Pinchin Ltd. (Pinchin) to conduct a hazardous building materials assessment at Union Station located at 65 Front Street West, Toronto, Ontario. Pinchin performed the assessment on August 30, 2024.

The objective of the assessment was to identify specified hazardous building materials in preparation for building renovation activities. The proposed work as identified by the Client includes renovations to existing floor, wall, and ceiling finishes, install new window wells, raised flooring, and fire hose cabinets.

The results of this assessment are intended for use with a properly developed scope of work or performance specifications and safe work procedures.

SUMMARY OF FINDINGS

The following is a summary of significant findings; refer to the body of the report for detailed findings:

Asbestos:

- Parging cement on pipe fittings
- Pipe insulation
- Carpet mastic
- Levelling compound
- Spray applied fireproofing (presumed)
- Vinyl floor tile (presumed)
- Window caulking (presumed)
- Terrazzo (presumed)
- Thin-set (presumed)

Lead:

- Lead is present in paints and coatings.
- Batteries of emergency lights are presumed to contain lead acid.
- Caulking on cast iron pipe joints (bell and spigot) contains lead.

Silica: Crystalline silica is present in concrete and other materials such as masonry, mortar, plaster, ceramic tiles and grout.

Mercury: Mercury vapour is present in lamp tubes.



Polychlorinated Biphenyls (PCBs): Based on the date of construction, PCBs may be present in light ballasts.

Mould and Water Damage: Water damage was observed to be affecting the drywall ceiling within the Women's Washroom (Location 3).

SUMMARY OF RECOMMENDATIONS

The following is a summary of significant recommendations; refer to the body of the report for detailed recommendations.

1. Conduct further investigation of the following items, which was not completed during this assessment:
 - a. Room 310 (Location 8); Locked at the time of assessment.
 - b. Any items listed as exclusions in this report, prior to disturbance.
2. Prepare a scope of work or specifications and safe work procedures for the hazardous materials removal required for the planned work.
3. Do not disturb suspected hazardous building materials discovered during the planned work, which have not been identified in this report and arrange for further evaluation and testing.
4. Remove and properly dispose of asbestos-containing materials prior to demolition or renovation activities.
5. Remove and properly dispose of PCB ballasts when fixtures are decommissioned. All PCB lamp ballasts must be removed from service and properly disposed of by December 31, 2025.
6. Recycle mercury-containing lamp tubes when removed from service.
7. Follow appropriate safe work procedures when handling or disturbing asbestos, lead, silica, and mould.

This Executive Summary is subject to the same standard limitations as contained in the report and must be read in conjunction with the entire report.



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APPENDICES

APPENDIX I	Drawings
APPENDIX II-A	Asbestos Analytical Certificates
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APPENDIX VI	HMIS All Data Report



1.0 INTRODUCTION AND SCOPE

NORR Limited (Client) retained Pinchin Ltd. (Pinchin) to conduct a hazardous building materials assessment at Union Station located at 65 Front Street West, Toronto, Ontario.

Pinchin performed the assessment on August 30, 2024. The surveyor was unaccompanied during the assessment. The assessed area was unoccupied at the time of the assessment.

The objective of the assessment was to identify specified hazardous building materials in preparation for building renovation activities.

Planned renovations include upgrades to existing floor, wall, and ceiling finishes, and installation of new window wells, raised flooring and fire hose cabinets.

The results of this assessment are intended for use with a properly developed scope of work or performance specification.

1.1 Scope of Assessment

The **assessed area** is limited to the portion(s) of the building to be renovated, as described by the Client, and identified in the drawings in Appendix I.

The assessment was performed to establish the type of specified hazardous building materials, locations and approximate quantities incorporated in the structure(s) and its finishes.

For the purpose of the assessment and this report, hazardous building materials are defined as follows:

- Asbestos
- Lead
- Silica
- Mercury
- Polychlorinated Biphenyls (PCBs)
- Mould

The following Designated Substances are not typically found in building materials in a composition/state that is hazardous and were not included in this assessment:

- Arsenic
- Acrylonitrile
- Benzene
- Coke oven emissions



- Ethylene oxide
- Isocyanates
- Vinyl chloride monomer

2.0 METHODOLOGY

Pinchin conducted a room-by-room assessment to identify the hazardous building materials as defined in the scope.

The assessment included limited demolition of wall and ceiling finishes (drywall or plaster) to view concealed conditions at representative areas as permitted by the current building use. Limited destructive testing of flooring was conducted where possible (under ceramic tiles, carpets, or multiple layers of flooring). Demolition of exterior building finishes, masonry walls (chases, shafts etc.), and structural surrounds was not conducted.

Sampling of roofing materials was not conducted.

For further details on the methodology including test methods, refer to Appendix III.

3.0 BACKGROUND INFORMATION

3.1 Building Description

Description Item	Details
Use	Transportation Hub, Retail Space, Office Space
Number of Floors	The building is four storeys plus two level(s) below grade.
Total Area	The assessed area is 3,150 square feet.
Year of Construction	The building was constructed in 1917 and 1927.
Structure	Brick and steel beam construction
Exterior Cladding	Prefabricated concrete block
HVAC	Not Assessed
Roof	Not Assessed
Flooring	Carpet, vinyl floor tile, concrete, ceramic tile
Interior Walls	Plaster, drywall, concrete
Ceilings	Plaster, drywall, concrete

3.2 Existing Reports

Pinchin was provided with the following reports:



- “Designated Substances and Hazardous Materials Survey, Union Station, 65 Front Street West, Toronto, Ontario” dated December 8, 2023, prepared by Fisher Engineering, Project No. FE 23-13293.

3.3 Inaccessible Locations

The following rooms or areas were not accessible and are therefore not included in the report.

Area or Room	Loc No.	Reason
Room 310 – 3-C018	8	Locked

4.0 FINDINGS

The following section summarizes the findings of the assessment and provides a general description of the hazardous building materials identified. For details on approximate quantities, condition, friability, accessibility, and locations of hazardous building materials; refer to the Hazardous Material Summary / Sample Log and All Data Report in Appendices V and VI.

Any quantities listed in this report or data tables are estimated based on visual approximations only and are subject to variation.

4.1 Asbestos

4.1.1

Brown spray-applied fireproofing, presumed to be asbestos-containing, is present on structural steel outside of the assessed area within the B2 Fan Room and Corridor as well as the 7th floor Mechanical Room.

White spray-applied fireproofing, present on structural steel throughout the building, does not contain asbestos (previous samples 23-2070-9-13; report reference FE 23-13293).

Dust or spray-applied fireproofing within ducts, fan units etc. was not sampled. Although the brown spray-applied fireproofing was not identified within the assessed area, as per O.Reg. 278/05 (Sections 12 (3) 10 and 12 (4) 3), filters, air handling equipment and ducts in a building with asbestos-containing spray-applied fireproofing are considered to be asbestos-contaminated in absence of sampling. In areas where asbestos-containing spray-applied fireproofing is present, assume filters, air handling equipment and ducts to have asbestos-containing spray-applied fireproofing or associated dust.

4.1.2 Pipe Insulation

Parging cement, containing chrysotile asbestos, was previously identified present on pipe fittings (elbows, valves, tees, hangers etc.), on piping systems in the assessed area (previous samples 003, 005, 006, 014, 018, 021, 028, and 067; report reference FE 23-13293); however, these materials were not observed at the time of the assessment but are presumed present in concealed areas.

A white preformed block insulation (trade name Magnesia Block), containing chrysotile and amosite asbestos, is present on straight sections of pipes in the assessed area (previous samples 007-010, and 026, report reference FE 23-13293).

Remaining pipes within the assessed area are either uninsulated or insulated with non-asbestos fibreglass.

Pipes insulated with asbestos-containing insulations may be present in inaccessible spaces such as above solid ceilings, in chases, in column enclosures and within shafts.



Preformed block insulated piping within East Corridor
(Location 9)



Non-asbestos pipe insulation with foil fittings.

4.1.3 Duct Insulation and Mastic

Ducts are either uninsulated or insulated with non-asbestos fibreglass (foil-faced).

Grey duct mastic present at seams / joints on the exterior of ducts throughout the assessed area does not contain asbestos (samples S0006A-C).

4.1.4 Mechanical Equipment Insulation


Mechanical equipment (e.g. fan units, radiators) are either uninsulated or insulated with non-asbestos fibreglass.

4.1.5 Vermiculite

Loose fill vermiculite was not observed within wall cavities.

4.1.6 Acoustic Ceiling Tiles

The following is a summary of acoustic ceiling tiles sampled.

Description	Sample Location	Sample Number, Date Code or Material Composition	Asbestos	Photo
2x4' lay in acoustical tile with large and small pinholes	Kitchenette (Location 4)	2008	No	
2x4' lay in acoustical tile with pinholes and fissures	Location 7 - Bulkhead	2009	No	

Ceiling tiles in the above table are presumed to be non-asbestos based on the age of the materials determined from the age of the building construction. The tiles were manufactured after asbestos stopped being used in acoustic ceiling tiles.

4.1.7 Plaster and Stucco



Plaster present on walls and ceilings throughout the assessed area does not contain asbestos (samples S0002A-G and S0004A-G).

4.1.8 Drywall Joint Compound

Drywall joint compound present on wall and ceiling finishes throughout the assessed area does not contain asbestos (samples S0001A-G).

4.1.9 Vinyl Floor Tiles, Baseboard, and Stair Flooring

The following is a summary of vinyl floor tiles sampled.

Description	Sample Location (Location #)	Sample Number	Asbestos (Tile / Adhesive)	Photo
12x12" white vinyl floor tile with blue flecks	West Corridor (Location 11)	V9500	Presumed asbestos-containing ¹	
Carpet mastic under blue carpet roll	Room 304 (Location 5)	S0005A-C	Chrysotile	

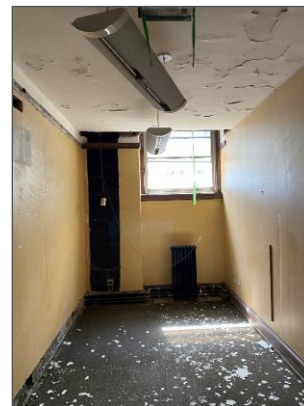
¹ Materials will not be impacted by planned renovations.

4.1.10 Levelling Compound

Levelling compound, containing chrysotile asbestos, is present beneath the carpet within Locations 5, 6 and 7 (samples S0005A-C).



Carpet floor concealing asbestos-containing levelling compound in Location 5



Carpet floor concealing asbestos-containing levelling compound in Location 6

4.1.11 Sealants, Caulking, and Putty

Caulking, present around window panels throughout the assessed area, is presumed to contain asbestos.

4.1.12 Other Building Materials

Wall covering adhesive present on walls within the East Corridor and West Corridor, does not contain asbestos (samples S0008A-C).

Mortar present in the concrete brick does not contain asbestos (samples S0007A-C).

Terrazzo flooring material located within the East Corridor (Location 9) and West Corridor (Location 10) is presumed to contain asbestos. ¹

Thin set material found behind the ceramic tiles on the floors and ceilings within the Men's Washroom (Location 1) and Women's Washroom (Location 3) is presumed to contain asbestos. ¹

¹ Materials will not be impacted by planned renovations.

4.1.13 Excluded Materials


The following is a list of materials which may contain asbestos and was excluded from the assessment. These materials are presumed to contain asbestos until otherwise proven by sampling and analysis:






- Electrical components
- Sealants on pipe threads

4.2 Lead

4.2.1 Paints and Surface Coatings

The following table summarizes the analytical results of paints sampled.

Sample Number	Colour, Substrate Description	Sample Location	Lead (%)	Photo
L0001	Green on concrete	Janitors Closet (Location 2)	2.7	

Sample Number	Colour, Substrate Description	Sample Location	Lead (%)	Photo
L0002	White on drywall ceiling	Women's Washroom (Location 3)	0.00026	
L0003	Yellow on plaster walls	West Corridor (Location 9)	1.8	
L0004	White on plaster ceiling	Kitchenet (Location 4)	0.017	
L0005	Red floor paint	Kitchenet (Location 4)	2.7	
L0005	White on plaster ceiling	Corridor (Location 9)	0.0011	

Results above 0.1% (1,000 mg/kg) are considered lead-containing, and over 0.5% (5,000 mg/kg) are considered lead-based.



Results less than or equal to 0.1% (1,000 mg/kg), but equal to or greater than 0.009% (90 mg/kg), are considered low-level lead paints or surface coatings in accordance with the EACC guideline.

4.2.2 *Lead Products and Applications*

Lead-containing batteries are presumed present in emergency lighting.

4.2.3 *Excluded Lead Materials*

Lead is known to be present in several materials which were not assessed or sampled. The following materials, where found, should be presumed to contain lead.

- Electrical components, including wiring connectors, grounding conductors, and solder
- Solder on pipe connections
- Glazing on ceramic tiles

4.3 **Silica**

Crystalline silica is assumed to be a component of the following materials where present in the building.

- Concrete
- Masonry and mortar
- Ceramic tiles and grout
- Plaster

4.4 **Mercury**

4.4.1 *Lamps*

Mercury vapour is present in fluorescent lamp tubes and other lighting that is known to contain mercury such as mercury vapour lamps.

4.4.2 *Mercury-Containing Devices*

Mercury-containing devices were not found during the assessment.

4.5 **Polychlorinated Biphenyls**

4.5.1 *Lighting Ballasts*

The building has not been comprehensively re-lamped with energy efficient light fixtures (evidence of T-12 fixtures, and as such, a percentage of light ballasts may be manufactured prior to 1980 and may contain PCBs.

4.5.2 Transformers

Transformers were not found during the assessment.

4.5.3 Excluded PCB Materials

PCBs are known to be present in several materials and equipment which were not assessed or sampled. The following materials, where found, should be presumed to contain PCBs until sampling proves otherwise.

- Paints

4.6 Mould and Water Damage

Visible water staining is present on drywall ceiling within the Women's Washroom (Location 3).



Visible water damage on drywall within Women's Washroom (Location 3)

5.0 RECOMMENDATIONS

5.1 General

1. Prepare scope of work or performance specifications for hazardous material removal required for the planned work. The specifications should include safe work practices, personal protective equipment, respiratory protection, and disposal of waste materials.
2. If suspected hazardous building materials are discovered during the planned work, which are not identified in this report, do not disturb, and arrange for further testing and evaluation.
3. Conduct further investigation of the following items, areas, or locations, which were not completed during this assessment:
 - a. Room 310; Locked at the time of assessment



- b. Any items listed as exclusions in this report, prior to disturbance.
4. Provide this report and the detailed plans and specifications to the contractor prior to bidding or commencing work.
5. Retain a qualified consultant to specify, observe and document the successful removal of hazardous materials.
6. Update the asbestos inventory upon completion of the abatement and removal of asbestos-containing materials and any other relevant findings.

5.2 Building Renovation Work

The following recommendations are made regarding renovation involving the hazardous materials identified.

5.2.1 Asbestos

Remove asbestos-containing materials (ACM) prior to renovation, alteration, or maintenance if ACM may be disturbed by the work. If the identified ACM will not be removed prior to commencement of the work, any potential disturbance of ACM must follow asbestos precautions appropriate for the type of work being performed.

Asbestos-containing materials must be disposed of at a landfill approved to accept asbestos waste.

5.2.2 Lead

For lead-containing or lead-based paints (i.e., greater than the EACC guideline of 0.1% (1,000 mg/kg) for lead-containing paints, and 0.5% (5,000 mg/kg) for lead-based), construction disturbance may result in over-exposure to lead dust or fumes. The need for work procedures, engineering controls and personal protective equipment should be assessed on a site-specific basis to comply with Ministry of Labour, Training and Skills Development regulations and guidelines.

For paints identified as having low levels of lead (i.e., equal to or above 0.009% (90 mg/kg) but less than or equal to the EACC guideline of 0.1% (1,000 mg/kg) for lead-containing paints) special precautions are not recommended unless aggressive disturbance (grinding, blasting, torching) is planned. Exposure from construction disturbance of paints containing lead less than 0.009% (90 mg/kg) is assumed to be insignificant.

Lead-containing items should be recycled when taken out of service.



5.2.3 *Silica*

Construction disturbance of silica-containing products may result in excessive exposures to airborne silica, especially if performed indoors and dry. Cutting, grinding, drilling or demolition of materials containing silica should be completed only with proper respiratory protection and other worker safety precautions that comply with applicable regulations and guidelines.

5.2.4 *Mercury*

Do not break lamp. Recycle and reclaim mercury from fluorescent lamps when taken out of service. Mercury is classified as a hazardous waste and must be disposed of in accordance with applicable regulations.

5.2.5 *PCBs*

Prior to demolition, remove light fixtures and examine light ballasts for PCB content. If ballasts are not clearly labelled as “non-PCB” or are suspected to contain PCBs, package and ship ballasts for destruction at a federally permitted facility.

As light fixtures are removed from service, examine light ballasts for PCB content. If ballasts are not clearly labelled as “non-PCB” or are suspected to contain PCBs, package, and ship ballasts for destruction at a federally permitted facility. As per the PCB Regulation (SOR/2008-273), all PCB light ballasts must be removed from service and properly disposed of by December 31, 2025.

5.2.6 *Mould*

Mould growth / water damage was noted in areas affected by the planned work. Retain a qualified consultant to perform an intrusive investigation to determine the full extent of hidden mould growth.

Use appropriate precautions and protect workers during removal, using methods that comply with provincial guidelines. A qualified consultant should specify, review, and verify the successful removal of mould-impacted finishes.

6.0 **TERMS AND LIMITATIONS**

This work was performed subject to the Terms and Limitations presented or referenced in the proposal for this project.

Information provided by Pinchin is intended for Client use only. Pinchin will not provide results or information to any party unless disclosure by Pinchin is required by law. Any use by a third party of reports or documents authored by Pinchin or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties.



Pinchin accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted. No other warranties are implied or expressed.

7.0 REFERENCES

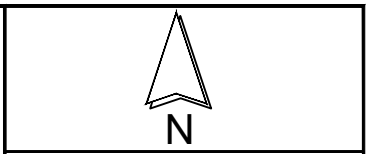
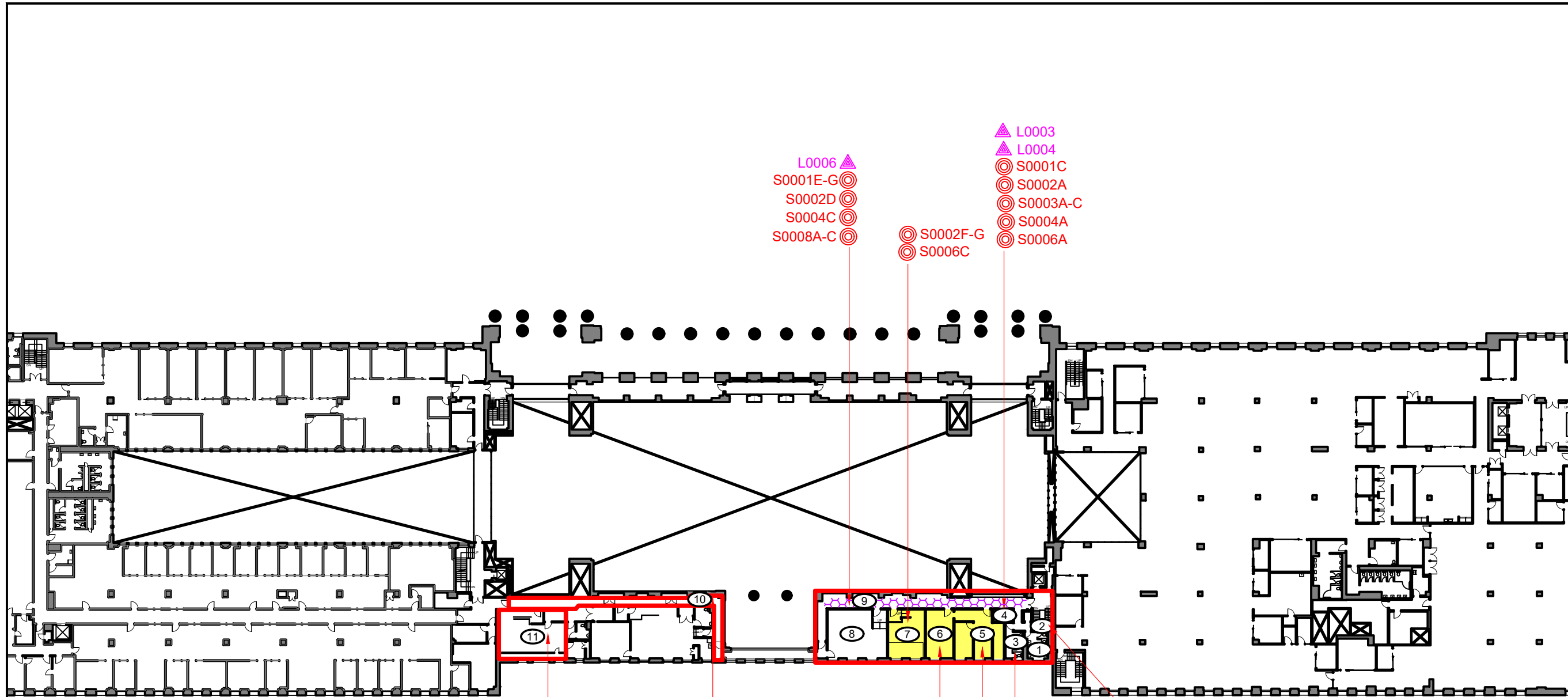
The following legislation and documents were referenced in completing the assessment and this report:

1. Asbestos on Construction Projects and in Buildings and Repair Operations, Ontario Regulation 278/05.
2. Designated Substances, Ontario Regulation 490/09.
3. Lead on Construction Projects, Ministry of Labour Guidance Document.
4. The Environmental Abatement Council of Canada (EACC) Lead Guideline for Construction, Renovation, Maintenance or Repair.
5. Ministry of the Environment Regulation, R.R.O. 1990 Reg. 347 as amended.
6. Ministry of the Environment Regulation, R.R.O. 1990 Reg. 362 as amended.
7. Silica on Construction Projects, Ministry of Labour Guidance Document.
8. Alert – Mould in Workplace Buildings, Ontario Ministry of Labour.
9. PCB Regulations, SOR/2008-273, Canadian Environmental Protection Act.
10. Surface Coating Materials Regulations, SOR/2016-193, Canada Consumer Product Safety Act.
11. Consolidated Transportation of Dangerous Goods Regulations, including Amendment SOR/2019-101, Transportation of Dangerous Goods Act.
12. Mould Guidelines for the Canadian Construction Industry, Standard Construction Document CCA 82 – 2004 (Revised 2018), Canadian Construction Association.







\\pinchin.com\m\iss\Job\3466000s\0346672.000 NORR,65FrontSt,HAZ,ASSMT\Deliverables\346672.000-Report for HMBA-Union Station 3rd Floor-65FrontStW,Toronto,ON-NORR Ltd. - Sept 18, 2024.docx

Template: Master Report for Hazardous Materials Assessment (Pre-Construction), HAZ, June 19, 2024

APPENDIX I
Drawings



LEGEND

-  PINCHIN LOCATION NUMBER
-  ASBESTOS BULK SAMPLE
-  LEAD BULK SAMPLE
-  SURVEY BOUNDARY/ASSESSED AREA
- ASBESTOS-CONTAINING MATERIALS:
-  MASTIC & LEVELING COMPOUND
-  MAGNESIA BLOCK PIPE INSULATION

NOT ALL KNOWN OR SUSPECTED HAZARDOUS BUILDING MATERIALS MAY BE DEPICTED ON THE DRAWING. REFER TO THE HAZARDOUS BUILDING MATERIALS ASSESSMENT REPORT FOR A COMPLETE LIST OF KNOWN AND SUSPECTED HAZARDOUS BUILDING MATERIALS.

LEGEND IS COLOUR DEPENDENT. NON-COLOUR COPIES MAY ALTER INTERPRETATION.

BASE PLAN PROVIDED BY CLIENT.



















PROJECT NAME:
HAZARDOUS BUILDING MATERIALS ASSESSMENT















CLIENT NAME:
NORR LIMITED

PROJECT LOCATION:
**FLOOR 3, UNION STATION
65 FRONT STREET WEST
TORONTO, ONTARIO**

FIGURE NAME:
**UNION STATION
FLOOR 3**

PROJECT NUMBER: 346672.000	SCALE: NOT TO SCALE
DRAWN BY: BJ	REVIEWED BY: AW
DATE: SEPT 2024	FIGURE NUMBER: 1 OF 1

-  S0004E
-  S0002E
-  S0004D
-  S0004F-G
-  S0002C
-  L0005
-  S0001B
-  L0002
-  S0001D
-  S0002B
-  S0004B
-  S0005A-C
-  S0006B
-  S0007A-C
-  S0001A
-  L0001

-  L0006
-  S0001E-G
-  S0002D
-  S0004C
-  S0008A-C
-  S0002F-G
-  S0006C
-  L0003
-  L0004
-  S0001C
-  S0002A
-  S0003A-C
-  S0004A
-  S0006A

APPENDIX II-A
Asbestos Analytical Certificates



Your Project #: 346672
 Site Location: 65 FRONT STREET WEST, TORONTO, ON
 Your C.O.C. #: N/A

Attention: Andres Gimenez

Pinchin Ltd
 225 Labrador Drive
 Unit #1
 Waterloo, ON
 CANADA N2K 4M8

Report Date: 2024/09/11
 Report #: R8314898
 Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4R6261

Received: 2024/09/05, 10:51

Sample Matrix: Solid
 # Samples Received: 36

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Asbestos by PLM - 0.5 RDL (1)	33	N/A	2024/09/10	COR3SOP-00002	EPA 600R-93/116
Asbestos by PLM - 0.5 RDL (1)	3	N/A	2024/09/11	COR3SOP-00002	EPA 600R-93/116

Remarks:
 Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, EPA, APHA or the Quebec Ministry of Environment.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested. This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Bureau Veritas' Asbestos Laboratory is accredited by NVLAP for bulk asbestos analysis by polarized light microscopy, NVLAP Code 600136-0.

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Bureau Veritas' scope of accreditation includes EPA -- 40 CFR Appendix E to Subpart E of Part 763, "Interim Method for the Determination of Asbestos in Bulk Insulation Samples" and EPA-600/R-93/116: "Method for the Determination of Asbestos in Bulk Building Materials".

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.



Your Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Your C.O.C. #: N/A

Attention: Andres Gimenez

Pinchin Ltd
225 Labrador Drive
Unit #1
Waterloo, ON
CANADA N2K 4M8

Report Date: 2024/09/11
Report #: R8314898
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4R6261

Received: 2024/09/05, 10:51

(1) P.O.B. - Percent of Bulk

When Asbestos data is reported with other data, this report contains data that are not covered by the NVLAP accreditation.

Encryption Key



**AUTHORIZED REPORT
RAPPORT AUTORISÉ**

Bureau Veritas

11 Sep 2024 14:25:06

Please direct all questions regarding this Certificate of Analysis to:

Antonella Brasil, Senior Project Manager
Email: Antonella.Brasil@bureauveritas.com
Phone# (905)817-5817

=====

This report has been generated and distributed using a secure automated process.

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.



BUREAU VERITAS

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0001A DRYWALL COMPOUND - LOCATION 2 - CEILING					
Bureau Veritas ID: ABXO23		Date Analyzed: 2024/09/10			
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>
Layer 1	100	Homogeneous white drywall joint compound	Not Detected		Non-Fibrous

S0001B DRYWALL COMPOUND - LOCATION 3 - CEILING					
Bureau Veritas ID: ABXO24		Date Analyzed: 2024/09/10			
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>
Layer 1	100	Homogeneous white drywall joint compound	Not Detected		Non-Fibrous

S0001C DRYWALL COMPOUND - LOCATION 4 - WALL					
Bureau Veritas ID: ABXO25		Date Analyzed: 2024/09/10			
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>
Layer 1	100	Homogeneous white drywall joint compound	Not Detected		Non-Fibrous

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
Date Format : yyyy/mm/dd



BUREAU
VERITAS

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0001D DRYWALL COMPOUND - LOCATION 5 - WALL					
Bureau Veritas ID: ABXO26		Date Analyzed: 2024/09/10			
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>
Layer 1	100	Homogeneous white drywall joint compound	Not Detected		Non-Fibrous

S0001E DRYWALL COMPOUND - LOCATION 9 - CEILING					
Bureau Veritas ID: ABXO27		Date Analyzed: 2024/09/10			
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>
Layer 1	100	Homogeneous white drywall joint compound	Not Detected		Non-Fibrous

S0001F DRYWALL COMPOUND - LOCATION 9 - WALL					
Bureau Veritas ID: ABXO28		Date Analyzed: 2024/09/10			
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>
Layer 1	100	Homogeneous white plaster	Not Detected		Non-Fibrous

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
Date Format : yyyy/mm/dd



BUREAU
VERITAS

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0001G DRYWALL COMPOUND - LOCATION 9 - WALL					
Bureau Veritas ID: ABXO29		Date Analyzed: 2024/09/10			
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>
Layer 1	100	Homogeneous white plaster	Not Detected		Non-Fibrous

S0002A PLASTER CEILING - LOCATION 4					
Bureau Veritas ID: ABXO30		Date Analyzed: 2024/09/10			
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>
Layer 1	100	Homogeneous white plaster	Not Detected		Non-Fibrous

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
Date Format : yyyy/mm/dd



BUREAU VERITAS

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0002B PLASTER CELLING - LOCATION 5						
Bureau Veritas ID: ABXO31		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>	
Layer 1	25	Homogeneous white drywall joint compound	Not Detected		Non-Fibrous	
Layer 2	25	Homogeneous white/light grey plaster	Not Detected		Non-Fibrous Perlite	
Layer 3	25	Homogeneous white plaster	Not Detected		Non-Fibrous	
Layer 4	25	Homogeneous grey plaster	Not Detected	Synthetic fibres	<0.50%	Non-Fibrous

S0002C PLASTER CELLING - LOCATION 6						
Bureau Veritas ID: ABXO32		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>	
Layer 1	65	Non-homogeneous white/off-white drywall joint compound	Not Detected		Non-Fibrous	
Layer 2	33	Homogeneous white plaster	Not Detected		Non-Fibrous	
Layer 3	2	Homogeneous grey plaster	Not Detected	Synthetic fibres	<0.50%	Non-Fibrous
	Comment: Layer is small in size					

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
Date Format : yyyy/mm/dd



Bureau Veritas Job #: C4R6261
 Report Date: 2024/09/11

Pinchin Ltd
 Client Project #: 346672
 Site Location: 65 FRONT STREET WEST, TORONTO, ON
 Sampler Initials: EW

Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0002D PLASTER CEILING - LOCATION 9						
Bureau Veritas ID: ABXO33		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>	
Layer 1	5	Homogeneous white/off-white drywall joint compound	Not Detected		Non-Fibrous	
Layer 2	45	Homogeneous white plaster	Not Detected		Non-Fibrous	
Layer 3	50	Homogeneous grey plaster	Not Detected	Synthetic fibres	<0.50%	Non-Fibrous

S0002E PLASTER CEILING - LOCATION 10						
Bureau Veritas ID: ABXO34		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>	
Layer 1	40	Homogeneous white plaster	Not Detected		Non-Fibrous	
Layer 2	60	Homogeneous grey plaster	Not Detected	Synthetic fibres	<0.50%	Non-Fibrous

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
 Date Format : yyyy/mm/dd



Bureau Veritas Job #: C4R6261
 Report Date: 2024/09/11

Pinchin Ltd
 Client Project #: 346672
 Site Location: 65 FRONT STREET WEST, TORONTO, ON
 Sampler Initials: EW

Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0002F PLASTER CELLING - LOCATION 7						
Bureau Veritas ID: ABXO35		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>		<u>Particulate</u>
Layer 1	40	Homogeneous white plaster	Not Detected			Non-Fibrous
Layer 2	60	Homogeneous grey plaster	Not Detected	Synthetic fibres	<0.50%	Non-Fibrous

S0002G PLASTER CEILING - LOCATION 7						
Bureau Veritas ID: ABXO36		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>		<u>Particulate</u>
Layer 1	45	Homogeneous white plaster	Not Detected			Non-Fibrous
Layer 2	55	Homogeneous grey plaster	Not Detected	Synthetic fibres	<0.50%	Non-Fibrous

S0003A SINK MASTIC - WHITE - LOCATION 4						
Bureau Veritas ID: ABXO37		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>		<u>Particulate</u>
Layer 1	100	Homogeneous off-white mastic	Not Detected	Cellulose	7%	Non-Fibrous

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
 Date Format : yyyy/mm/dd



Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0003B SINK MASTIC - WHITE - LOCATION 4						
Bureau Veritas ID: ABXO38		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>		<u>Particulate</u>
Layer 1	100	Homogeneous off-white mastic	Not Detected	Cellulose	7%	Non-Fibrous

S0003C SINK MASTIC - WHITE - LOCATION 4						
Bureau Veritas ID: ABXO39		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>		<u>Particulate</u>
Layer 1	100	Homogeneous off-white mastic	Not Detected	Cellulose	7%	Non-Fibrous

S0004A PLASTER WALL - LOCATION 4						
Bureau Veritas ID: ABXO40		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>		<u>Particulate</u>
Layer 1	5	Homogeneous white drywall joint compound	Not Detected			Non-Fibrous
		Comment: Another phase is present but is too small to analyze (grey-plaster)				
Layer 2	95	Homogeneous white plaster	Not Detected			Non-Fibrous

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
Date Format : yyyy/mm/dd



BUREAU VERITAS

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0004B PLASTER WALL - LOCATION 5						
Bureau Veritas ID: ABXO41		Date Analyzed: 2024/09/10				
	P.O.B	Sample Morphology	Asbestos	Other Fibres	Particulate	
Layer 1	98	Homogeneous white plaster	Not Detected		Non-Fibrous	
Layer 2	2	Homogeneous grey plaster	Not Detected	Synthetic fibres	<0.50%	Non-Fibrous
Comment: Layer is small in size						

S0004C PLASTER WALL - LOCATION 9						
Bureau Veritas ID: ABXO42		Date Analyzed: 2024/09/10				
	P.O.B	Sample Morphology	Asbestos	Other Fibres	Particulate	
Layer 1	10	Homogeneous white drywall joint compound	Not Detected		Non-Fibrous	
Comment: Another phase is present but is too small to analyze (grey-plaster)						
Layer 2	90	Homogeneous white plaster	Not Detected		Non-Fibrous	

S0004D PLASTER WALL - LOCATION 10						
Bureau Veritas ID: ABXO43		Date Analyzed: 2024/09/10				
	P.O.B	Sample Morphology	Asbestos	Other Fibres	Particulate	
Layer 1	99	Homogeneous white plaster	Not Detected		Non-Fibrous	
Layer 2	1	Homogeneous grey plaster	Not Detected	Synthetic fibres	<0.50%	Non-Fibrous
Comment: Layer is small in size						

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
Date Format : yyyy/mm/dd



Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0004E PLASTER WALL - LOCATION 11						
Bureau Veritas ID: ABXO44		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>	
Layer 1	50	Homogeneous white drywall joint compound	Not Detected		Non-Fibrous	
Layer 2	47	Homogeneous white plaster	Not Detected		Non-Fibrous	
Layer 3	3	Homogeneous grey plaster	Not Detected	Synthetic fibres <0.50%	Non-Fibrous	

S0004F PLASTER WALL - LOCATION 10						
Bureau Veritas ID: ABXO45		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>	
Layer 1	100	Homogeneous white plaster	Not Detected		Non-Fibrous	
Comment: Another phase is present but is too small to analyze (grey-plaster)						

S0004G PLASTER WALL - LOCATION 10						
Bureau Veritas ID: ABXO46		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>	
Layer 1	99	Homogeneous white plaster	Not Detected		Non-Fibrous	
Layer 2	1	Homogeneous grey plaster	Not Detected	Synthetic fibres <0.50%	Non-Fibrous	
Comment: Layer is small in size						

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
 Date Format : yyyy/mm/dd



Bureau Veritas Job #: C4R6261
 Report Date: 2024/09/11

Pinchin Ltd
 Client Project #: 346672
 Site Location: 65 FRONT STREET WEST, TORONTO, ON
 Sampler Initials: EW

Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0005A CARPET MASTIC - LOCATION 5							
Bureau Veritas ID: ABXO47		Date Analyzed: 2024/09/11					
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>		<u>Other Fibres</u>		<u>Particulate</u>
Layer 1	47	Non-homogeneous colourless mastic	Chrysotile	<0.50%			Non-Fibrous
Layer 2	50	Non-homogeneous grey levelling compound	Chrysotile	0.5%	Cellulose	5%	Non-Fibrous
Layer 3	3	Non-homogeneous dark brown mastic	Chrysotile	0.5%			Non-Fibrous

S0005B CARPET MASTIC - LOCATION 5							
Bureau Veritas ID: ABXO48		Date Analyzed: 2024/09/11					
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>		<u>Other Fibres</u>		<u>Particulate</u>
Layer 1	20	Non-homogeneous colourless mastic	Chrysotile	<0.50%			Non-Fibrous
Layer 2	20	Non-homogeneous grey levelling compound Comment: Not Analyzed - Positive Stop	N/A				
Layer 3	60	Homogeneous brown vinyl material	Not Detected		Glass Fibres	5%	Non-Fibrous

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
 Date Format : yyyy/mm/dd



Bureau Veritas Job #: C4R6261
 Report Date: 2024/09/11

Pinchin Ltd
 Client Project #: 346672
 Site Location: 65 FRONT STREET WEST, TORONTO, ON
 Sampler Initials: EW

Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0005C CARPET MASTIC - LOCATION 5						
Bureau Veritas ID: ABXO49		Date Analyzed: 2024/09/11				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>		<u>Other Fibres</u>	<u>Particulate</u>
Layer 1	20	Non-homogeneous colourless mastic	Chrysotile	<0.50%		Non-Fibrous
Layer 2	20	Non-homogeneous grey levelling compound Comment: Not Analyzed - Positive Stop	N/A			
Layer 3	60	Homogeneous brown vinyl material	Not Detected		Glass Fibres 5%	Non-Fibrous

S0006A GREY DUCT MASTIC - LOCATION 4						
Bureau Veritas ID: ABXO50		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>		<u>Other Fibres</u>	<u>Particulate</u>
Layer 1	100	Homogeneous grey mastic	Not Detected			Non-Fibrous

S0006B GREY DUCT MASTIC - LOCATION 5						
Bureau Veritas ID: ABXO51		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>		<u>Other Fibres</u>	<u>Particulate</u>
Layer 1	100	Homogeneous grey mastic	Not Detected			Non-Fibrous

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
 Date Format : yyyy/mm/dd



Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0006C GREY DUCT MASTIC - LOCATION 7						
Bureau Veritas ID: ABX052		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>	
Layer 1	100	Homogeneous grey mastic	Not Detected			Non-Fibrous

S0007A BRICK MORTAR - LOCATION 5						
Bureau Veritas ID: ABX053		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>	
Layer 1	100	Homogeneous grey cementitious material	Not Detected			Non-Fibrous

S0007B BRICK MORTAR - LOCATION 5						
Bureau Veritas ID: ABX054		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>	
Layer 1	100	Non-homogeneous grey cementitious material	Chrysotile <0.50%	Synthetic fibres <0.50%		Non-Fibrous

S0007C BRICK MORTAR - LOCATION 5						
Bureau Veritas ID: ABX055		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>	<u>Particulate</u>	
Layer 1	100	Homogeneous grey cementitious material	Not Detected	Synthetic fibres <0.50%		Non-Fibrous

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
Date Format : yyyy/mm/dd



Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0008A TEXTILE WALL COVERING MASTIC - LOCATION 9						
Bureau Veritas ID: ABX056		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>		<u>Particulate</u>
Layer 1	90	Homogeneous brown textile	Not Detected	Cellulose	90%	Non-Fibrous
Layer 2	10	Homogeneous beige mastic	Not Detected			Non-Fibrous

S0008B TEXTILE WALL COVERING MASTIC - LOCATION 9						
Bureau Veritas ID: ABX057		Date Analyzed: 2024/09/10				
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>		<u>Particulate</u>
Layer 1	90	Homogeneous brown textile	Not Detected	Cellulose	90%	Non-Fibrous
Layer 2	10	Homogeneous beige mastic	Not Detected			Non-Fibrous

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
 Date Format : yyyy/mm/dd



BUREAU
VERITAS

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

Asbestos Analytical Results

EPA/600R-93/116 by Polarized Light Microscopy

S0008C TEXTILE WALL COVERING MASTIC - LOCATION 9						
Bureau Veritas ID:		ABX058	Date Analyzed:		2024/09/10	
	<u>P.O.B</u>	<u>Sample Morphology</u>	<u>Asbestos</u>	<u>Other Fibres</u>		<u>Particulate</u>
Layer 1	90	Homogeneous brown textile	Not Detected	Cellulose	90%	Non-Fibrous
Layer 2	10	Homogeneous beige mastic	Not Detected			Non-Fibrous

The limit of quantitation is 0.50%, although asbestos may be qualitatively detected at concentrations less than 0.50%. Samples for which asbestos is detected at <0.50% are reported as trace, "<0.50%". "Not Detected" indicates that no asbestos fibres were observed.

Calibrated Visual Estimate (%)
Date Format : yyyy/mm/dd



BUREAU
VERITAS

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

TEST SUMMARY

Bureau Veritas ID: ABXO23
Sample ID: S0001A DRYWALL COMPOUND - LOCATION 2 - CEILING
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO24
Sample ID: S0001B DRYWALL COMPOUND - LOCATION 3 - CEILING
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO25
Sample ID: S0001C DRYWALL COMPOUND - LOCATION 4 - WALL
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO26
Sample ID: S0001D DRYWALL COMPOUND - LOCATION 5 - WALL
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO26 Dup
Sample ID: S0001D DRYWALL COMPOUND - LOCATION 5 - WALL
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO27
Sample ID: S0001E DRYWALL COMPOUND - LOCATION 9 - CEILING
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO28
Sample ID: S0001F DRYWALL COMPOUND - LOCATION 9 - WALL
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif



BUREAU
VERITAS

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

TEST SUMMARY

Bureau Veritas ID: ABXO29
Sample ID: S0001G DRYWALL COMPOUND - LOCATION 9 - WALL
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO30
Sample ID: S0002A PLASTER CEILING - LOCATION 4
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO31
Sample ID: S0002B PLASTER CELLING - LOCATION 5
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO32
Sample ID: S0002C PLASTER CELLING - LOCATION 6
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO33
Sample ID: S0002D PLASTER CEILING - LOCATION 9
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO34
Sample ID: S0002E PLASTER CEILING - LOCATION 10
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO35
Sample ID: S0002F PLASTER CELLING - LOCATION 7
Matrix: Solid
Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif



BUREAU VERITAS

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

TEST SUMMARY

Bureau Veritas ID: ABXO36
Sample ID: S0002G PLASTER CEILING - LOCATION 7
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO36 Dup
Sample ID: S0002G PLASTER CEILING - LOCATION 7
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO37
Sample ID: S0003A SINK MASTIC - WHITE - LOCATION 4
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO38
Sample ID: S0003B SINK MASTIC - WHITE - LOCATION 4
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO39
Sample ID: S0003C SINK MASTIC - WHITE - LOCATION 4
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO40
Sample ID: S0004A PLASTER WALL - LOCATION 4
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO41
Sample ID: S0004B PLASTER WALL - LOCATION 5
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif



BUREAU
VERITAS

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

TEST SUMMARY

Bureau Veritas ID: ABXO42
Sample ID: S0004C PLASTER WALL - LOCATION 9
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO43
Sample ID: S0004D PLASTER WALL - LOCATION 10
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO44
Sample ID: S0004E PLASTER WALL - LOCATION 11
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO45
Sample ID: S0004F PLASTER WALL - LOCATION 10
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO46
Sample ID: S0004G PLASTER WALL - LOCATION 10
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO46 Dup
Sample ID: S0004G PLASTER WALL - LOCATION 10
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO47
Sample ID: S0005A CARPET MASTIC - LOCATION 5
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif



TEST SUMMARY

Bureau Veritas ID: ABXO48
Sample ID: S0005B CARPET MASTIC - LOCATION 5
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO49
Sample ID: S0005C CARPET MASTIC - LOCATION 5
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO50
Sample ID: S0006A GREY DUCT MASTIC - LOCATION 4
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO51
Sample ID: S0006B GREY DUCT MASTIC - LOCATION 5
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO52
Sample ID: S0006C GREY DUCT MASTIC - LOCATION 7
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO53
Sample ID: S0007A BRICK MORTAR - LOCATION 5
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABXO54
Sample ID: S0007B BRICK MORTAR - LOCATION 5
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif



TEST SUMMARY

Bureau Veritas ID: ABX055
Sample ID: S0007C BRICK MORTAR - LOCATION 5
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABX056
Sample ID: S0008A TEXTILE WALL COVERING MASTIC - LOCATION 9
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABX056 Dup
Sample ID: S0008A TEXTILE WALL COVERING MASTIC - LOCATION 9
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABX057
Sample ID: S0008B TEXTILE WALL COVERING MASTIC - LOCATION 9
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif

Bureau Veritas ID: ABX058
Sample ID: S0008C TEXTILE WALL COVERING MASTIC - LOCATION 9
Matrix: Solid

Collected: 2024/09/03
Shipped:
Received: 2024/09/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Asbestos by PLM - 0.5 RDL	MIC	9627781	N/A		Dina Yousif



**BUREAU
VERITAS**

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

GENERAL COMMENTS

Results relate only to the items tested.



BUREAU
VERITAS

Bureau Veritas Job #: C4R6261
Report Date: 2024/09/11

Pinchin Ltd
Client Project #: 346672
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Jon Delos Santos, Laboratory Supervisor

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.



NONT-2024-09-657

Analyzed by: _____

Reviewed by: _____

Report Sent by: _____




Special Instructions:

**Pinchin Ltd. - Asbestos Laboratory
Internal Asbestos Bulk Sample Chain of Custody**

Client Name:	Norr Ltd.	Project Address:	65 Front Street West, Toronto, ON
Portfolio/Building No:		Pinchin File:	346672
Submitted by:	Eric Walsh	Email:	ewalsh@pinchin.com
CC Results to:	Andres Gimenez	CC Email:	agimenez@pinchin.com
Invoice to:	AP@pinchin.com	Invoice Email:	AP@pinchin.com
Date Submitted:	September 3 2024	Required by:	September 10 2024
# of Samples:	36	Priority:	5 Day Turnaround
Year of Building Construction (Mandatory Field):	1921		
Do NOT Stop on Positive (Sample Numbers):	S0001, S0002, S0004		
Pinchin Group Company (Mandatory Field):	Pinchin		

To be Completed by Lab Personnel Only:			
Lab Reference #:		Time:	24 hour clock
Received by:		Date:	Month Day 2021
Name(s) of Analyst(s):			

Sample Prefix	Sample No.	Sample Suffix	Sample Description/Location (Mandatory)
S	0001	A	Drywall compound - Location 2 - Ceiling
S	0001	B	Drywall compound - Location 3 - Ceiling
S	0001	C	Drywall compound - Location 4 - Wall
S	0001	D	Drywall compound - Location 5 - Wall
S	0001	E	Drywall compound - Location 9 - Ceiling


 2024/09/05 (05) Page 1 of 4



Sample Prefix	Sample No.	Sample Suffix	Sample Description/Location (Mandatory)
S	0001	F	Drywall compound - Location 9 - Wall
S	0001	G	Drywall compound - Location 9 - Wall
S	0002	A	Plaster Ceiling - Location 4
S	0002	B	Plaster Ceiling - Location 5
S	0002	C	Plaster Ceiling - Location 6
S	0002	D	Plaster Ceiling - Location 9
S	0002	E	Plaster Ceiling - Location 10
S	0002	F	Plaster Ceiling - Location 7
S	0002	G	Plaster Ceiling - Location 7
S	0003	A	Sink Mastic - White - Location 4
S	0003	B	Sink Mastic - White - Location 4
S	0003	C	Sink Mastic - White - Location 4
S	0004	A	Plaster Wall - Location 4
S	0004	B	Plaster Wall - Location 5
S	0004	C	Plaster Wall - Location 9

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09/05/24

1057



Sample Prefix	Sample No.	Sample Suffix	Sample Description/Location (Mandatory)
S	0004	D	Plaster Wall - Location 10
S	0004	E	Plaster Wall - Location 11
S	0004	F	Plaster Wall - Location 10
S	0004	G	Plaster Wall - Location 10
S	0005	A	Carpet Mastic - Location 5
S	0005	B	Carpet Mastic - Location 5
S	0005	C	Carpet Mastic - Location 5
S	0006	A	Grey Duct Mastic - Location 4
S	0006	B	Grey Duct Mastic - Location 5
S	0006	C	Grey Duct Mastic - Location 7
S	0007	A	Brick Mortar - Location 5
S	0007	B	Brick Mortar - Location 5
S	0007	C	Brick Mortar - Location 5
S	0008	A	Textile wall covering mastic - Location 9
S	0008	B	Textile wall covering mastic - Location 9

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10/10/2024 (05)



Sample Prefix	Sample No.	Sample Suffix	Sample Description/Location (Mandatory)
S	0008	C	Textile wall covering mastic - Location 9

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09/05/24 (25)
Page 4 of 4



TRANSMITTAL

TO:	Bureau Veritas 6740 Campobello Road Mississauga, ON L5N 2L8
-----	---

ATTENTION:	Analytical Lab
PHONE:	

FROM:	C. Hendsbee
-------	-------------

DATE:	SEP 04 2024
-------	-------------

PROJECT #:	
%:	

ITEM NO.	Lead PCB Bulk	DESCRIPTION
1	Bulk	3.35747.174
2	Bulk	200782.644
3	Bulk	346672
4	LEAD	346077.036
5	Bulk	346745
6	Lead	347002
7	Bulk	332747.092
8		
9		
10		
11		
12		

Notes:

Cheryl H.

Signature

APPENDIX II-B
Lead Analytical Certificates



Your Project #: 346672.000
 Site Location: 65 FRONT STREET WEST, TORONTO, ON
 Your C.O.C. #: N/A

Attention: Eric Walsh

Pinchin Ltd
 225 Labrador Drive
 Unit #1
 Waterloo, ON
 CANADA N2K 4M8

Report Date: 2024/09/06
 Report #: R8308300
 Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4R4435

Received: 2024/09/03, 12:44

Sample Matrix: Bulk
 # Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Metals in Paint	6	2024/09/05	2024/09/05	CAM SOP-00408	EPA 6010D m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, EPA, APHA or the Quebec Ministry of Environment.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.



Your Project #: 346672.000
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Your C.O.C. #: N/A

Attention: Eric Walsh

Pinchin Ltd
225 Labrador Drive
Unit #1
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Received: 2024/09/03, 12:44

Encryption Key



**AUTHORIZED REPORT
RAPPORT AUTORISÉ**

Bureau Veritas

06 Sep 2024 11:04:33

Please direct all questions regarding this Certificate of Analysis to:

Nilushi Mahathantila, Project Manager
Email: Nilushi.Mahathantila@bureauveritas.com
Phone# (905) 817-5700

=====

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BUREAU VERITAS

Bureau Veritas Job #: C4R4435
Report Date: 2024/09/06

Pinchin Ltd
Client Project #: 346672.000
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

ELEMENTS BY ATOMIC SPECTROSCOPY (BULK)

Bureau Veritas ID		ABTS90		ABTS91		ABTS92		
Sampling Date								
COC Number		N/A		N/A		N/A		
	UNITS	L0001 GREEN ON CONCRETE WALL - LOCATION 2	RDL	L0002 WHITE ON DRYWALL - LOCATION 3	RDL	L0003 YELLOW ON PLASTER - LOCATION 4	RDL	QC Batch

Metals								
Lead (Pb)	%	2.7	0.0042	0.00026	0.00016	1.8	0.010	9619143
RDL = Reportable Detection Limit QC Batch = Quality Control Batch								

Bureau Veritas ID		ABTS92		ABTS93		ABTS94		
Sampling Date								
COC Number		N/A		N/A		N/A		
	UNITS	L0003 YELLOW ON PLASTER - LOCATION 4 Lab-Dup	RDL	L0004 WHITE ON PLASTER - LOCATION 4	RDL	L0005 RED FLOOR PAINT - LOCATION 4	RDL	QC Batch

Metals								
Lead (Pb)	%	1.8	0.010	0.017	0.00019	2.7	0.018	9619143
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate								

Bureau Veritas ID		ABTS95		
Sampling Date				
COC Number		N/A		
	UNITS	L0006 WHITE ON DRYWALL - LOCATION 9	RDL	QC Batch

Metals				
Lead (Pb)	%	0.0011	0.00023	9619143
RDL = Reportable Detection Limit QC Batch = Quality Control Batch				



BUREAU
VERITAS

Bureau Veritas Job #: C4R4435
Report Date: 2024/09/06

Pinchin Ltd
Client Project #: 346672.000
Site Location: 65 FRONT STREET WEST, TORONTO, ON
Sampler Initials: EW

TEST SUMMARY

Bureau Veritas ID: ABTS90
Sample ID: L0001 GREEN ON CONCRETE WALL - LOCATION 2
Matrix: Bulk

Collected:
Shipped:
Received: 2024/09/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9619143	2024/09/05	2024/09/05	Japneet Gill

Bureau Veritas ID: ABTS91
Sample ID: L0002 WHITE ON DRYWALL - LOCATION 3
Matrix: Bulk

Collected:
Shipped:
Received: 2024/09/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9619143	2024/09/05	2024/09/05	Japneet Gill

Bureau Veritas ID: ABTS92
Sample ID: L0003 YELLOW ON PLASTER - LOCATION 4
Matrix: Bulk

Collected:
Shipped:
Received: 2024/09/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9619143	2024/09/05	2024/09/05	Japneet Gill

Bureau Veritas ID: ABTS92 Dup
Sample ID: L0003 YELLOW ON PLASTER - LOCATION 4
Matrix: Bulk

Collected:
Shipped:
Received: 2024/09/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9619143	2024/09/05	2024/09/05	Japneet Gill

Bureau Veritas ID: ABTS93
Sample ID: L0004 WHITE ON PLASTER - LOCATION 4
Matrix: Bulk

Collected:
Shipped:
Received: 2024/09/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9619143	2024/09/05	2024/09/05	Japneet Gill

Bureau Veritas ID: ABTS94
Sample ID: L0005 RED FLOOR PAINT - LOCATION 4
Matrix: Bulk

Collected:
Shipped:
Received: 2024/09/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9619143	2024/09/05	2024/09/05	Japneet Gill

Bureau Veritas ID: ABTS95
Sample ID: L0006 WHITE ON DRYWALL - LOCATION 9
Matrix: Bulk

Collected:
Shipped:
Received: 2024/09/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9619143	2024/09/05	2024/09/05	Japneet Gill



GENERAL COMMENTS

Sample ABTS90 [L0001 GREEN ON CONCRETE WALL - LOCATION 2] : Metals Analysis: Due to limited amount of sample available for analysis, a smaller than usual portion of the sample was used. Detection limits were adjusted accordingly.

Sample ABTS91 [L0002 WHITE ON DRYWALL - LOCATION 3] : Metals Analysis: Due to limited amount of sample available for analysis, a smaller than usual portion of the sample was used. Detection limits were adjusted accordingly.

Sample ABTS93 [L0004 WHITE ON PLASTER - LOCATION 4] : Metals Analysis: Due to limited amount of sample available for analysis, a smaller than usual portion of the sample was used. Detection limits were adjusted accordingly.

Sample ABTS94 [L0005 RED FLOOR PAINT - LOCATION 4] : Metals Analysis: Due to limited amount of sample available for analysis, a smaller than usual portion of the sample was used. Detection limits were adjusted accordingly.

Sample ABTS95 [L0006 WHITE ON DRYWALL - LOCATION 9] : Metals Analysis: Due to limited amount of sample available for analysis, a smaller than usual portion of the sample was used. Detection limits were adjusted accordingly.

Results relate only to the items tested.



BUREAU
VERITAS

Bureau Veritas Job #: C4R4435

Report Date: 2024/09/06

QUALITY ASSURANCE REPORT

Pinchin Ltd

Client Project #: 346672.000

Site Location: 65 FRONT STREET WEST, TORONTO, ON

Sampler Initials: EW

QC Batch	Parameter	Date	Matrix Spike		Method Blank		RPD		QC Standard	
			% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
9619143	Lead (Pb)	2024/09/05	NC	75 - 125	<0.00010	%	3.0	35	100	75 - 125

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)



BUREAU
VERITAS

Bureau Veritas Job #: C4R4435

Report Date: 2024/09/06

Pinchin Ltd

Client Project #: 346672.000

Site Location: 65 FRONT STREET WEST, TORONTO, ON

Sampler Initials: EW

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Cristina Carriere, Senior Scientific Specialist

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.

200 Boulevard Road Suite 103 Bedford Nova Scotia B4B 1G9 Tel: 902 426 0203 Fax: 902 426 8612 Toll Free: 1 800 565 7227 49 55 Elizabeth Avenue St Johns, N.S. B1A 1W9 Tel: 709 754 0033 Fax: 709 754 8612 Toll Free: 1 888 492 1227 465 George Street Unit G Sydney NS B1P 1K5 Tel: 902 561 1226 Fax: 902 539 6504 Toll Free: 1 888 535 7770 www.bvlabs.com E-mail: CustomerService@bvlabs.com		ATLYCO 00149 / 24 Page <u> </u> of <u> </u>																																																																																																			
CHAIN OF CUSTODY RECORD		COC #: <u> </u>																																																																																																			
Invoice Information Company Name: <u>Pinchin Ltd.</u> Contact Name: <u>Eric Walsh</u> Address: <u>225 Labrador Dr, Waterloo, ON</u> Postal Code: <u>N2K 4M8</u> Phone: <u>226.979.5486</u> Fax: <u> </u> Email: <u>ap@pinchin.com</u>		Report Information (if differs from invoice) Company Name: <u>Pinchin Ltd.</u> Contact Name: <u>Eric Walsh, Andres Gimenez</u> Address: <u> </u> Postal Code: <u> </u> Phone: <u> </u> Fax: <u> </u> Email: <u>ewalsh@pinchin.com</u> <u>agimenez@pinchin.com</u>	Project Information (where applicable) Quotation #: <u> </u> P.O. #: <u> </u> Project #: <u>346072.000</u> Site Location: <u>85 Front Street West, Toronto, ON</u> Site #: <u> </u> Sampled By: <u>Eric Walsh</u>	Turnaround Time (TAT) Required <input type="checkbox"/> Rush TAT (24 hours) PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS. IF RUSH please specify date (Surcharges will be applied) DATE REQUIRED: <u> </u>																																																																																																	
Laboratory Use Only <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td colspan="2">CUSTODY SEAL</td> <td colspan="2">COOLER TEMPERATURES</td> <td colspan="2">COOLER TEMPERATURES</td> </tr> <tr> <td>Present</td> <td>Intact</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="6" style="text-align: center;">COOLING MEDIA PRESENT Y / N</td> </tr> <tr> <td colspan="6" style="text-align: center;">SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS</td> </tr> </table>		CUSTODY SEAL		COOLER TEMPERATURES		COOLER TEMPERATURES		Present	Intact											COOLING MEDIA PRESENT Y / N						SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS						Analysis Requested <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>Metals (Water)</td> <td>Metals (Soil)</td> <td>Regulatory Requirements (Specify)</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td></td> </tr> </table>		Metals (Water)	Metals (Soil)	Regulatory Requirements (Specify)	<input type="checkbox"/>	<input type="checkbox"/>																																																															
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<p>Unless otherwise agreed to in writing, work submitted on this Chain of Custody is subject to Bureau Veritas Laboratories' standard Terms and Conditions. Signing of this Chain of Custody document is acknowledgment and acceptance of our terms which are available for viewing at http://www.bvlabs.com/terms-and-conditions</p>																																																																																																					



NONT-2024-09-221

[Signature] KRUTAGINA 2024/09/03 12:44
 ASP Akhmalzadeh 2024/09/03 16:10

REC'D IN WATERLOO

729151

APPENDIX III
Methodology



1.0 GENERAL

An investigation was conducted to identify the type of Hazardous Building Materials incorporated in the structure and its finishes.

Information regarding the location and condition of hazardous building materials encountered and visually estimated quantities were recorded. The locations of any samples collected were recorded on small-scale plans. As-built drawings and previous reports were referenced where provided.

Sample collection was conducted in accordance with our Standard Operating Procedures.

1.1 Asbestos

The investigation for asbestos included friable and non-friable asbestos-containing materials (ACM). A friable material is a material that when dry can be crumbled, pulverized or powdered by hand pressure, or a material that has already become crushed, pulverized, or powdered.

A separate set of samples was collected of each type of homogenous material suspected to contain asbestos. A homogenous material is defined by the US EPA as material that is uniform in texture and appearance, was installed at one time, and is unlikely to consist of more than one type or formulation of material. The homogeneous materials were determined by visual examination and available information on the phases of construction and prior renovations.

Samples were collected at a rate that is in compliance with the requirements of local regulations and guidelines. The sampling strategy was also based on known ban dates and phase out dates of the use of asbestos; sampling of certain building materials is not conducted after specific construction dates. In addition, to be conservative, several years past these dates are added to account for some uncertainty in the exact start / finish date of construction and associated usage of ACM. In some cases, manufactured products such as asbestos cement pipe were visually identified without sample confirmation.

The asbestos analysis of select materials was completed using a stop-positive approach. Only one result meeting the regulated criteria was required to determine that a material is asbestos-containing, but all samples must be analyzed to conclusively determine that a material is non-asbestos. The laboratory stopped analyzing samples from a homogeneous material once a result equal to or greater than the regulated criteria is detected in any of the samples of that material. All samples of a homogeneous material were analyzed if no asbestos is detected. In some cases, all samples were analyzed in the sample set regardless of result.

The analysis was performed in accordance with Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials, July 1993.

Analytical results were compared to the following criteria:

Jurisdiction*	Friable	Non-Friable
Ontario	0.5%	0.5%
Federal	1%	1%

* If there is a conflict between federal and provincial criteria, the more stringent will apply.

Where building materials are described in the report as “non-asbestos” or “does not contain asbestos”, this means that either no asbestos was detected by the analytical method utilized in any of the multiple samples or, if detected, it is below the lower limit of an asbestos-containing material in the applicable regulation. Additionally, these terms are used for materials which historically are known to not include asbestos in their manufacturing.

Asbestos materials were evaluated in order to make recommendations regarding any remedial work. The priority for remedial action was based on several factors:

- Friability (friable or non-friable)
- Condition (good, fair, poor, debris)
- Accessibility (ranking from accessible to all building users to inaccessible)
- Visibility (whether the material is obscured by other building components)
- Air movement or air erosion (present, not present)
- Efficiency of the work (for example, if damaged ACM is being removed in an area, it may be most practical to remove all ACM in the area even if it is in good condition)

1.2 Lead

Samples of distinctive paint finishes, and surface coatings present in more than a limited application, where removal of the paint is possible were collected. The samples were collected by scraping the painted finish to include base and covering applications.

Analysis for lead in paints or surface coatings was performed in accordance with EPA Method No. 3050B/EPA SW-846-6020B0B, inductively coupled plasma – mass spectrometry.

Analytical results were compared to the following criteria.

Jurisdiction*	Units (%)	Units (ppm) / (mg/kg)
Ontario	0.1	1,000
Federal	0.009	90

* If there is a conflict between federal and provincial criteria, the more stringent will apply.

Other lead building products (e.g. batteries, lead sheeting, flashing) were identified by visual observation only.

1.3 Silica

Building materials known to contain crystalline silica (e.g. concrete, cement, tile, brick, masonry, mortar) were identified by visual inspection only. Pinchin did not perform sampling of these materials for laboratory analysis of crystalline silica content.

1.4 Mercury

Building materials, products or equipment (e.g. thermostats, barometers, pressure gauges, lamp tubes), suspected to contain mercury were identified by visual inspection only. Dismantling of equipment suspected of containing mercury was not performed. Sampling of these materials for laboratory analysis of mercury content was not performed.

1.5 Polychlorinated Biphenyls

The potential for light ballast and oil filled transformers to contain PCBs was based on the age of the building, a review of maintenance records, and examination of labels or nameplates on equipment, where present and accessible. The information was compared to known ban dates of PCBs and Environment Canada publications.

Dry type transformers were presumed to be free of dielectric fluids and hence non-PCB.

Fluids (mineral oil, hydraulic, Aroclor or Askarel) in transformers or other equipment were not sampled for PCB content.

Caulking, sealants, or paints were sampled and submitted for PCB analysis following EPA 3550C/8082A.

Sample results are compared to the criteria of 50 mg/kg for solids as stated in the PCB Regulation, SOR/2008-273.

1.6 Visible Mould

The presence of mould or water damage was determined by visual inspection of exposed building surfaces. If any mould growth or water damage was concealed within building cavities it was not addressed in this assessment.

APPENDIX IV
Location Summary Report

Client: Norr Ltd

Site: 65 Front St West, Toronto, ON

Building Name: Union Station - 3rd Floor Security Offices

Survey Date:
Last Re-Assessment:
Building Phases: A:

Location No.	Name or Description	Area ft ²	Floor No.	Bldg. Phase	Notes
1	Men's Washroom, room no. 3-C010	150	3	A	
2	Janitors Closet, room no. 3-C925	25	3	A	
3	Women's Washroom, room no. 3-C011	150	3	A	
4	Kitchenette, room no. 3-C013	75	3	A	
5	Room 304, room no. 3-C014, 3-C015, 3-C012	800	3	A	
6	Room 306, room no. 3-C016 & 3-C019	400	3	A	
7	Room 308, room no. 3-C017	600	3	A	Raised floor
8	Room 310, room no. 3-C018	0	3	A	NO ACCESS - Locked
9	East Corridor, room no. 3-C927	800	3	A	
10	West Corridor, room no. 3-C912	800	3	A	
11	Eoc Room - behind hoarding wall, room no. 3-C009	600		A	

APPENDIX V

Hazardous Materials Summary Report / Sample Log

Client: Norr Ltd		Site: 65 Front St West, Toronto, ON		Building Name: Union Station - 3rd Floor Security Offices					Survey Date:		
HAZMAT	Sample No	System/Component/Material/Sample Description	Locations	Bldg. Phase	LF	SF	EA	%	Type	Positive	Friability
Asbestos	S0001 ABCDEFGF	Ceiling, Wall, Ceiling, Wall All Drywall And Joint Compound	1,2,3,4,5,7,9,11	A	0	1525	0	0	None Detected	No	
Asbestos	S0002 ABCDEFGF	Ceiling All Plaster Ceiling Plaster; Hole In Plaster 1 Sq Ft	4,5,6,7,9,10	A	0	4675	0	0	None Detected	No	
Asbestos	S0003	Other Mastic, White White Sink Mastic	4	A	0	0	1	0	None Detected	No	
Asbestos	S0004 ABCDEFGF	Wall Plaster	4,5,6,7,9,10,11	A	0	8400	0	0	None Detected	No	
Asbestos	S0005	Floor All Carpet Carpet Mastic	5,6,7	A	0	3200	0	0	Chrysotile	Yes	NF, F
Asbestos	S0006 ABC	Duct All Not Insulated Grey Duct Mastic	3,4,5,7	A	4	0	0	0	None Detected	No	
Asbestos	S0007	Structure All Mortar Brick Mortar	5,6,7,11	A	0	2800	0	0	Chrysotile	No	
Asbestos	S0008	Wall All Mastic Textile Wall Covering	9,10	A	0	3500	0	0	None Detected	No	
Asbestos	V9000	Piping Magnesia Block Fisher Report	9	A	100	0	0	0	Confirmed Asbestos	Yes	F
Asbestos	V9000	Piping Parging Cement Fisher Report	9,10	A	0	0	0	0	Confirmed Asbestos	Yes	F
Asbestos	V9500	Floor All Terrazzo Presumed As Not Impacted By Scope	9	A	0	800	0	0	Presumed Asbestos	Yes	NF
Asbestos	V9500	Floor All Thin-set 12x12 Grey Ceramic, Hexagon Tile	1,3	A	0	300	0	0	Presumed Asbestos	Yes	PF
Asbestos	V9500	Floor All Vinyl Floor Tile Presumed As Not Impacted By Scope	10	A	0	800	0	0	Presumed Asbestos	Yes	NF
Asbestos	V9500	Other Caulking Caulking On Window Frame	3	A	16	0	0	0	Presumed Asbestos	Yes	NF
Asbestos	V9500	Wall All Thin-set 12x12 Brown Wall Tile	3	A	0	300	0	0	Presumed Asbestos	Yes	PF
Asbestos	V0000	Ceiling All Ceiling Tiles (lay-in) 2008	4	A	0	75	0	0	Non Asbestos	No	
Asbestos	V0000	Ceiling Ceiling Tiles (lay-in) 2009	7	A	0	300	0	0	Non Asbestos	No	
Asbestos	V0000	Ceiling Ceiling Tiles (lay-in) 2019	10	A	0	800	0	0	Non Asbestos	No	
Asbestos	V0000	Floor All Concrete (poured)	2	A	0	25	0	0	Non Asbestos	No	
Asbestos	V0000	Floor All Concrete (poured) Rubber Floor Mats On Concrete	4	A	0	75	0	0	Non Asbestos	No	
Asbestos	V0000	Floor Metal	11	A	0	600	0	0	Non Asbestos	No	
Asbestos	V0000	Wall All Marble	1	A	0	0	0	0	Non Asbestos	No	
Asbestos	V0000	Wall Mastic Mastic Behind Rubber Bb	10	A	100	0	0	0	Non	No	

HAZMAT	Sample No	System/Component/Material/Sample Description	Locations	Bldg. Phase	LF	SF	EA	%	Type	Positive	Friability
									Asbestos		
Paint	L0001	Wall Concrete (poured) Green On Concrete	2	A	0	100	0	0	Lead (High)	Yes	-
Paint	L0002	Wall Drywall And Joint Compound White On Drywall Ceiling	3,11	A	0	0	0	0		No	-
Paint	L0003	Wall Drywall And Joint Compound Yellow On Walls	4,5,6,7,9,10	A	0	0	0	0	Lead (High)	Yes	-
Paint	L0004	Ceiling Plaster White On Plaster	4,5,6,7	A	0	75	0	0	Lead (Low)	Yes	-
Paint	L0005	Floor Concrete (poured) Red Floor Paint	4	A	0	75	0	0	Lead (High)	Yes	-
Paint	L0006	Ceiling Plaster Delaminating White	9	A	0	1000	0	0		No	-
Lead Product	V9000	Batteries In Emer. Lights	4,9,10	A	0	0	3	0	Lead Product	Yes	-
PCB	V9500	Light Ballasts	4,5,6,7	A	0	0	14	0	Presumed PCB	Yes	-
Hg	V9000	Light Fixture	4	A	0	0	1	0	Hg	Yes	-

Legend:

Sample number		Units		
S####	Asbestos sample collected	SF	Square feet	NF Non Friable material.
L####	Paint sample collected	LF	Linear feet	F Friable material
P####	PCB sample collected	EA	Each	PF Potentially Friable material
M####	Mould sample collected	%	Percentage	
V####	Material visually similar to numbered sample collected			
V0000	Known non Hazardous Material			
V9000	Material is visually identified as Hazardous Material			
V9500	Material is presumed to be Hazardous Material			
[Loc. No.]	Abated Material			

APPENDIX VI
HMIS All Data Report

Client: Norr Ltd
Location: #1 : Men's Washroom
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C010
Area (sqft): 150
Last Re-Assessment:

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	All	Drywall and joint compound			C	Y		150			SF	V0001	None Detected	N.D.	None	
Floor	All	Thin-set, Hexagon tile		Ceramic Tiles	A	Y		150			SF	V9500	Presumed Asbestos		Presumed Asbestos	PF
Mechanical Equipment	All	None Found														
Piping	All	Not Insulated														
Wall	All	Marble			A	Y						V0000	Non-Asbestos		None	

Client: Norr Ltd
Location: #1 : Men's Washroom
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C010
Area (sqft): 150
Last Re-Assessment:

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Wall								No	

Client: Norr Ltd
Location: #2 : Janitors Closet
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C925
Last Re-Assessment:
Area (sqft): 25

ASBESTOS

System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	All	Drywall and joint compound			C	Y		25			SF	S0001A	None Detected	N.D.	None	
Duct	All	Not Insulated														
Floor	All	Concrete (poured)			A	Y		25			SF	V0000	Non-Asbestos		None	
Piping	All															
Wall	All	Concrete (poured)			A	Y										

Client: Norr Ltd
Location: #2 : Janitors Closet
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C925
Last Re-Assessment:
Area (sqft): 25

PAINT

System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Wall	Concrete (poured)	100		SF	L0001	Green on concrete	Pb: 2.7 %	Lead (High)

Client: Norr Ltd
Location: #3 : Women's Washroom
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C011
Area (sqft): 150
Last Re-Assessment:

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	All	Drywall and joint compound			C	Y		150			SF	S0001B	None Detected	N.D.	None	
Duct		Not Insulated, Duct mastic										V0006	None Detected	N.D.	None	
Floor	All	Thin-set, 12x12 Grey ceramic		Ceramic Tiles	A	Y		150			SF	V9500	Presumed Asbestos		Presumed Asbestos	PF
Mechanical Equipment	All	None Found														
Other		Caulking, Caulking on window frame	Window		A	Y	N	16			LF	V9500	Presumed Asbestos		Presumed Asbestos	NF
Piping	All	Fibreglass		Foil Face	A	Y	N	20			LF					
Wall	All	Thin-set, 12x12 brown wall tile		Ceramic Tiles	A	Y		300			SF	V9500	Presumed Asbestos		Presumed Asbestos	PF

Client: Norr Ltd
Location: #3 : Women's Washroom
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C011
Area (sqft): 150
Last Re-Assessment:

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Wall	Drywall and joint compound	150			L0002	White on drywall ceiling	Pb: .00026 %	No	

Client: Norr Ltd
Location: #4 : Kitchenette
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C013
Last Re-Assessment:
Area (sqft): 75

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling		Plaster, Ceiling plaster; hole in plaster 1 sq ft			A	Y	N	74	1		SF	S0002A	None Detected	N.D.	None	
Ceiling	All	Ceiling Tiles (lay-in), 2008			C	Y		75			SF	V0000	Non-Asbestos		None	
Duct	All	Not Insulated, Grey duct mastic			B	Y	N					S0006A	None Detected	N.D.	None	
Floor	All	Concrete (poured), Rubber floor mats on concrete		Rubber	A	Y		75			SF	V0000	Non-Asbestos		None	
Other		Mastic, White, White sink mastic			A	Y	N	1			EA	S0003	None Detected	N.D.	None	
Piping	All	Not Insulated														
Wall		Plaster			A	Y	N	200			SF	S0004A	None Detected	N.D.	None	
Wall	All	Drywall and joint compound, Two of 4 walls			A	Y		200			SF	S0001C	None Detected	N.D.	None	

Client: Norr Ltd
Location: #4 : Kitchenette
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C013
Last Re-Assessment:
Area (sqft): 75

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Wall	Drywall and joint compound				L0003	Yellow on walls	Pb: 1.8 %	Lead (High)	
Ceiling	Plaster		75	SF	L0004	White on plaster	Pb: .017 %	Lead (Low)	
Floor	Concrete (poured)	75		SF	L0005	Red floor paint	Pb: 2.7 %	Lead (High)	

Client: Norr Ltd
Location: #4 : Kitchenette
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C013
Last Re-Assessment:
Area (sqft): 75

PB PRODUCTS				
Component	Quantity	Unit	Sample	Hazard
Batteries In Emer. Lights	1		V9000	Yes

Client: Norr Ltd
Location: #4 : Kitchenette
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C013
Last Re-Assessment:
Area (sqft): 75

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	1	EA	V9000	Yes

Client: Norr Ltd

Site: 65 Front St West, Toronto, ON

Building Name: Union Station - 3rd Floor Security Offices

Location: #4 : Kitchenette
Survey Date: 2024-08-30

Floor: 3

Room #: 3-C013
Last Re-Assessment:

Area (sqft): 75

PCB						
Component	Quantity	Unit	Sample	Sample Description	Amount	PCB
Light Ballasts	1	EA	V9500			Presumed

Client: Norr Ltd
Location: #5 : Room 304
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C014, 3-C015, 3-C012
Area (sqft): 800
Last Re-Assessment:

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	All	Plaster, 2 layers on wire lathe			C	Y		800			SF	S0002B	None Detected	N.D.	None	
Duct	All	Not Insulated, Grey duct mastic										S0006B	None Detected	N.D.	None	
Floor		Floor Levelling Compound			B	N	N	600			SF	V0005	Chrysotile	0.5-5%	Confirmed Asbestos	F
Floor ¹	All	Carpet, Carpet mastic			A	Y		400			SF	S0005	Chrysotile	0.5-5%	Confirmed Asbestos	NF
Mechanical Equipment	All	None Found														
Piping	All	Fibreglass														
Structure	All	Mortar, Brick mortar			C	N		800			SF	S0007	Chrysotile	<0.5%	None	
Wall		Plaster, Delaminating on north wall			A	Y	N	400	800		SF	S0004B	None Detected	N.D.	None	
Wall	All	Drywall and joint compound, East wall			A	Y		400			SF	S0001D	None Detected	N.D.	None	

1 - leveling compound phase also contains asbestos

Client: Norr Ltd
Location: #5 : Room 304
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C014, 3-C015, 3-C012
Area (sqft): 800
Last Re-Assessment:

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Wall	Concrete (poured)				V0003	Yellow	Pb: 1.8 %	Lead (High)	
Ceiling	Abated Material				V0004	White	Pb: .017 %	Lead (Low)	

Client: Norr Ltd
Location: #5 : Room 304
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C014, 3-C015, 3-C012
Area (sqft): 800
Last Re-Assessment:

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Fluorescent Light Tube				

Client: Norr Ltd
Location: #5 : Room 304
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C014, 3-C015, 3-C012
Area (sqft): 800
Last Re-Assessment:

PCB						
Component	Quantity	Unit	Sample	Sample Description	Amount	PCB
Light Ballasts	4	EA	V9500			Presumed

Client: Norr Ltd
Location: #6 : Room 306
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C016 & 3-C019
Last Re-Assessment:
Area (sqft): 400

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	All	Plaster, 2 layers on wire lathe			C	Y		400			SF	S0002C	None Detected	N.D.	None	
Floor		Floor Levelling Compound			B	N	N	600			SF	V0005	Chrysotile	0.5-5%	Confirmed Asbestos	F
Floor ¹	All	Carpet, Carpet mastic			A	Y		400			SF	V0005	Chrysotile	0.5-5%	Confirmed Asbestos	NF
Mechanical Equipment	All	None Found														
Piping	All	Fibreglass														
Structure	All	Mortar, Brick mortar			C	N		400			SF	V0007	Chrysotile	<0.5%	None	
Wall		Plaster			A	Y	N	1000			SF	V0004	None Detected	N.D.	None	

1 - Leveling compound phase also contains asbestos

Client: Norr Ltd
Location: #6 : Room 306
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C016 & 3-C019
Last Re-Assessment:
Area (sqft): 400

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Wall	Plaster				V0003	Yellow	Pb: 1.8 %	Lead (High)	
Ceiling	Abated Material				V0004	White	Pb: .017 %	Lead (Low)	

Client: Norr Ltd
Location: #6 : Room 306
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C016 & 3-C019
Last Re-Assessment:
Area (sqft): 400

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Fluorescent Light Tube				

Client: Norr Ltd
Location: #6 : Room 306
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C016 & 3-C019
Last Re-Assessment:
Area (sqft): 400

PCB						
Component	Quantity	Unit	Sample	Sample Description	Amount	PCB
Light Ballasts	4	EA	V9500			Presumed

Client: Norr Ltd
Location: #7 : Room 308
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C017
Area (sqft): 600
Last Re-Assessment:

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling		Ceiling Tiles (lay-in), 2009			B	Y	N		100	200	SF	V0000	Non-Asbestos		None	
Ceiling		Drywall and joint compound, Drywall bulkhead for drop ceiling			B	Y	N	100			SF	V0001	None Detected	N.D.	None	
Ceiling		Plaster			A				200	1000	SF	S0002FG	None Detected	N.D.	None	
Ceiling	All	Plaster, 2 layers on wire lathe			C	Y		600			SF	V0002	None Detected	N.D.	None	
Duct		Mastic, Grey duct mastic			A	Y	N	4			LF	S0006C	None Detected	N.D.	None	
Floor		Floor Levelling Compound			B	N	N	600			SF	V0005	Chrysotile	0.5-5%	Confirmed Asbestos	F
Floor ¹	All	Carpet, Carpet mastic			A	Y		600			SF	V0005	Chrysotile	0.5-5%	Confirmed Asbestos	NF
Mechanical Equipment	All	None Found														
Piping	All	Fibreglass														
Structure	All	Mortar, Brick mortar			C	N		600			SF	V0007	Chrysotile	<0.5%	None	
Wall		Concrete (poured), Small drywall section on west wall			A	Y	N	1000			SF	V0004	None Detected	N.D.	None	

Raised floor
1 - Raised floor on top of carpet mastic - Leveling compound phase also contains asbestos

Client: Norr Ltd
Location: #7 : Room 308
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C017
Area (sqft): 600
Last Re-Assessment:

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Wall	Plaster				V0003	Yellow	Pb: 1.8 %	Lead (High)	
Ceiling	Abated Material				V0004	White	Pb: .017 %	Lead (Low)	

Raised floor

Client: Norr Ltd
Location: #7 : Room 308
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C017
Area (sqft): 600
Last Re-Assessment:

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Fluorescent Light Tube				

Raised floor

Client: Norr Ltd

Site: 65 Front St West, Toronto, ON

Building Name: Union Station - 3rd Floor Security Offices

Location: #7 : Room 308
Survey Date: 2024-08-30

Floor: 3

Room #: 3-C017
Last Re-Assessment:

Area (sqft): 600

PCB						
Component	Quantity	Unit	Sample	Sample Description	Amount	PCB
Light Ballasts	5	EA	V9500			Presumed

Raised floor

Client: Norr Ltd
Location: #9 : East Corridor
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C927
Area (sqft): 800
Last Re-Assessment:

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling		Drywall and joint compound, Repairs to plaster made w djc			A	Y	N		500		SF	S0001E	None Detected	N.D.	None	
Ceiling	All	Plaster			C	Y		800			SF	S0002D	None Detected	N.D.	None	
Floor	All	Terrazzo, Presumed as not impacted by scope			A	Y		800			SF	V9500	Presumed Asbestos		Presumed Asbestos	NF
Mechanical Equipment	All	None Found														
Piping		Parging Cement, Fisher report			A	Y	N					V9000	Confirmed Asbestos		Confirmed Asbestos	F
Piping		Magnesia block, Fisher report			B	Y	N	100			LF	V9000	Confirmed Asbestos		Confirmed Asbestos	F
Piping	All	Fibreglass														
Structure	All	Brick			C	N										
Wall		Drywall and joint compound			A	Y	N					S0001FG	None Detected	N.D.	None	
Wall		Plaster, Plaster behind wall covering			A	Y	N	1500			SF	S0004C	None Detected	N.D.	None	
Wall	All	Mastic, Textile wall covering		Textile	A	Y		1500	500		SF	S0008	None Detected	N.D.	None	

Client: Norr Ltd
Location: #9 : East Corridor
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C927
Area (sqft): 800
Last Re-Assessment:

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Wall	Plaster				V0003	Yellow on walls	Pb: 1.8 %	Lead (High)
Ceiling	Plaster	500	500	SF	L0006	Delaminating white	Pb: .0011 %	No

Client: Norr Ltd
Location: #9 : East Corridor
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C927
Area (sqft): 800
Last Re-Assessment:

PB PRODUCTS				
Component	Quantity	Unit	Sample	Hazard
Batteries In Emer. Lights	1	EA	V9000	Yes

Client: Norr Ltd
Location: #10 : West Corridor
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C912
Area (sqft): 800
Last Re-Assessment:

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling		Ceiling Tiles (lay-in), 2019			A	Y	N	800			SF	V0000	Non-Asbestos		None	
Ceiling	All	Plaster			C	Y		800			SF	S0002E	None Detected	N.D.	None	
Floor ¹	All	Vinyl Floor Tile, Presumed as not impacted by scope			A	Y		800			SF	V9500	Presumed Asbestos		Presumed Asbestos	NF
Piping		Parging Cement, Fisher report			A	Y	N					V9000	Confirmed Asbestos		Confirmed Asbestos	F
Piping	All	Fibreglass														
Structure	All	Brick			C	N										
Wall		Plaster, Plaster behind wall covering			A	Y	N	3000			SF	S0004DFG	None Detected	N.D.	None	
Wall		Mastic, Mastic behind rubber bb			A	Y	N	100			LF	V0000	Non-Asbestos		None	
Wall	All	Textile, Textile wall covering		Plaster	A	Y		1000	500		SF	V0008	None Detected	N.D.	None	

1 - White w blue flecks

Client: Norr Ltd
Location: #10 : West Corridor
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C912
Area (sqft): 800
Last Re-Assessment:

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Wall	Plaster				V0003	Yellow on walls	Pb: 1.8 %	Lead (High)	

Client: Norr Ltd
Location: #10 : West Corridor
Survey Date: 2024-08-30

Site: 65 Front St West, Toronto, ON
Floor: 3

Building Name: Union Station - 3rd Floor Security Offices
Room #: 3-C912
Area (sqft): 800
Last Re-Assessment:

PB PRODUCTS				
Component	Quantity	Unit	Sample	Hazard
Batteries In Emer. Lights	1	EA	V9000	Yes

Client: Norr Ltd

Site: 65 Front St West, Toronto, ON

Building Name: Union Station - 3rd Floor Security Offices

Location: #11 : Eoc Room - behind hoarding wall

Floor:

Room #: 3-C009

Area (sqft): 600

Survey Date:

Last Re-Assessment:

ASBESTOS

System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Floor ¹		Metal			A	Y	N	600			SF	V0000	Non-Asbestos		None	
Structure		Mortar		Precast Refractory Brick	A	Y	N	1000			SF	V0007	Chrysotile	<0.5%	None	
Wall		Drywall and joint compound										V0001	None Detected	N.D.	None	
Wall		Plaster			A	Y	N	500			SF	S0004E	None Detected	N.D.	None	

1 - raised flooring

Client: Norr Ltd

Site: 65 Front St West, Toronto, ON

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Location: #11 : Eoc Room - behind hoarding wall

Floor:

Room #: 3-C009

Area (sqft): 600

Survey Date:

Last Re-Assessment:

PAINT

System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Wall	Paint				V0002	White on drywall ceiling	Pb: .00026 %	No

Legend:



Sample number		Units		Other	
S####	Asbestos sample collected	SF	Square feet	A	Access
L####	Paint sample collected	LF	Linear feet	V	Visible
P####	PCB sample collected	EA	Each	AP	Air Plenum
M####	Mould sample collected	%	Percentage	F	Friable material
V####	Material is visually identified to be identical to S####	LF	Linear feet	NF	Non Friable material
V0000	Known non hazardous material			PF	Potentially Friable material
V9000	Material visually identified as a Hazardous Material			Pb	Lead
V9500	Material is presumed to be a hazardous material			Hg	Mercury
				As	Arsenic
				Cr	Chromium

Access	
A	Accessible to all building occupants
B	Accessible to maintenance and operations staff without a ladder
C	Accessible to maintenance and operations staff with a ladder. Also rarely entered, locked areas
D	Not normally accessible

Condition	
Good	No visible damage or deterioration
Fair	Minor, repairable damage, cracking, delamination or deterioration
Poor	Irreparable damage or deterioration with exposed and missing material

Visible	
Y	The material is visible when standing on the floor of the room, without the removal or opening of other building components (e.g. ceiling tiles or access panels).
N	The material is not visible to view when standing on the floor of the room and requires the removal of a building component (e.g. ceilings tiles or access panels) to view and access. Includes rarely entered crawlspaces, attic spaces, etc. Observations will be limited to the extent visible from the access points.
L	The material is partially visible to view when standing on the floor of the room and requires the removal of a building component (e.g. ceiling system or access panels) to view completely and access. Includes partially viewed access points to crawlspaces, attic spaces, etc. without entering. Observations are limited to the extent visible from the access points.

Air Plenum	
Yes or No	The material is in a return air plenum or in a direct airstream or there is evidence of air erosion (e.g. duct for heating or cooling blowing directly on or across an ACM). This field is only completed where Air Plenum consideration is required by regulation.

Colour Coding	
	The material is a hazardous material, either by analytical results or by visible identification.
	The material is presumed to be a hazardous material, based on visual appearance, and was not sampled due to limited access or the non-destructive nature of sampling.