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PROJECT MANUAL

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1	General
1.1	GENERAL
.1	Unless specified otherwise, instructions and requirements specified in this section shall apply to all sections of the Work.
.2	It is the responsibility of the Contractor to direct and implement all the Work shown and specified, including construction facilities and requirements specified herein.
.3	Work specified in the Specification has been divided into technical sections for the purpose of ready reference. Division of Work among Subcontractors and Suppliers is solely the Contractor's responsibility and Consultant assumes no liability to act as an arbiter to establish subcontract limits between sections or divisions of Work.
.4	Do not scale Drawings. Use dimensions indicated.
.5	The General Requirements in this section are over and above the requirements listed in the City of Toronto Master Services Agreement; wherever there is an overlap or conflict, the more stringent requirement is to be followed.

- .6 Canadian Products and Assemblies:
- .1 Bidders are advised that Canadian manufactured products and assemblies are preferred and will be given priority where they meet equivalent performance, availability and schedule requirements.
 - .2 The Contractor shall provide a list of the country of origin for all products and assemblies included in the Contract.
 - .3 This preference aligns with the Owner's procurement strategy.

1.2 **DEFINITIONS**

- .1 Provide: This term means to Furnish, supply, Install and connect, complete and in place, including accessories, finishes, tests, and services required to render item so specified complete ready for use.
- .2 Furnish: This term means fabrication or procurement of materials, equipment, or components, or performance of services to the extent specified and shown. Where used with respect to materials, equipment, or components, the term includes crating and delivery to Project site but is not intended to include installation of item, either temporary or final.
- .3 Install: This term means 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.

1.3 **EXAMINATION OF BID DOCUMENTS**

- .1 The Contractor shall have read all the Bid Documents in conjunction with one another and Consultant shall assume that they are in agreement. Contractor shall have examined all the Bid Documents as soon as possible after receipt thereof and if he had discovered any discrepancies, omissions, errors, ambiguities or conflicts in or among the Bid Documents, or be in doubt as to their meaning or intent, shall have brought the matter to the attention of the Consultant at least four (4) Business Days prior to the date set for receiving Bids.
- .2 The Contractor shall understand and agree that where a discrepancy in Products or systems between Consultant Drawings exists, Contractor shall have allowed in its Bid for the most expensive Product or system indicated, and a Request for Information (RFI) issued to the Consultant to clarify the issue at no increase in Contract Price.
- .3 Contractor shall avoid submitting RFI's on information readily available within the Contract Documents.

1.4 **WORK OF CONTRACT**

- .1 Work of this Contract comprises the supply of all material, equipment and labour necessary for the complete construction of new works, alterations and additions and all other related Work as shown on the Contract Drawings, specified herein or both, all in accordance with the terms of the Contract.

1.5 **SCHEDULING OF THE WORK**

- .1 The Contractor shall be required to start work immediately upon the execution of the Contract.
- .2 The working hours to be included in the Contract Price are as follows:

- .3 Phase 1 Construction – Pre-FIFA
 - .1 Regular working hours for this contract are considered as:
 - .1 Monday to Friday – 7:00am to 6:00pm
 - .2 Saturday - 9:00am – 6:00pm
 - .2 Non-noisy work:
 - .1 Monday to Friday – 7:00pm – 6:00am
 - .2 Saturday - 7:00pm – 9:00am
 - .3 Sunday - 9:00am – 5:00pm
- .4 Phase 2 Construction – Post-FIFA, All other works
 - .1 Regular working hours for this contract are considered as:
 - .1 Monday to Friday – 7:00am to 6:00pm
 - .2 Saturday - 9:00am – 6:00pm
- .5 The Contractor shall include all costs required in order to obtain labour, plant, materials or equipment or other critical items including all delivery and installation, protection of new and existing services at the site in order to meet the completion dates of the scope of work and the project completion date.
- .6 The Contractor shall include all costs on account of schedule interfacing, coordination and cooperation with other Owner Contractors, Subcontractors or Vendors who will be carrying out work during the progress of this Contract in order to meet the completion date for the work and the overall completion date of the project.
- .7 The Owner will not entertain hardship claims or tolerate delays and interruptions in the work.

1.6 **METHODS OF PROCEDURE**

- .1 All Work that interfaces with the existing building systems or Work that occurs within critical areas within the building, which include but are not limited to: IT spaces, UPS Rooms, Electrical Rooms, Mechanical Rooms, and Fire Safety Rooms require the production of a Methods of Procedure (MOP) document that must be submitted to the Owner and the Consultant for review and approval. Refer to MOP sample template attached.
- .2 The Contractor is responsible for the production of all Methods of Procedure documents necessary to complete the work. The Contractor shall include all costs associated with the production and revision of Methods of Procedures documents. The Contractor is responsible for all required revisions the Methods of Procedures documents so that they meet the approval of the Owner.
- .3 The Contractor shall include all costs associated with the production of a look ahead schedule that outlines all construction activities occurring within the next predetermined period of the Project. The duration of the schedule and the frequency with which the schedule will be updated shall be determined by the Owner and submitted to the Consultant and the Owner for review. The frequency of updates shall not be less than once in a two-week period. The determination as to which activities will require the production of Methods of Procedures documents will be based on the Consultant's and the Owner's review of the look ahead schedule.

1.7 DRAWINGS AND INSTALLATION

- .1 The Drawings are intended to show the general character and scope of the Work and not necessarily the detail design, or exact details of the installation. Contractor shall provide all items, articles, materials, services and incidentals, including detail design with Drawings, whether or not expressly specified or shown on Drawings, to make finished Work complete and fully operational, consistent with the intent of the Contract Documents.
- .2 The Contractor shall supply and install all items of Work, goods and services that are listed or shown, or that may reasonably be inferred from the Contract Documents, as being required to produce the intended result.
- .3 The location, arrangement and connection of equipment and materials shown on the Drawings represent a close approximation to the intent and requirements of the Contract. The right is reserved by the Consultant to make reasonable changes required to accommodate conditions arising during the progress of the Work, at no extra cost to the Owner.
- .4 The location and size of existing services shown on the Drawings are based on the best available information. The Contractor shall ensure that the actual location of existing services be verified in the field before Work is commenced. Particular attention shall be paid to buried or concealed services and structures.
- .5 Changes and modifications necessary to ensure coordination and avoidance of interference and conflicts with other trades or to accommodate existing conditions, shall be the responsibility of the Contractor and made at no extra cost to the Owner.
- .6 The Contractor shall reimburse the Consultant for the latter's time spent on answering any questions or requests for information where the answer is clearly stated or shown on the Drawings or Specifications.

1.8 EXISTING CONDITIONS

- .1 In the case of renovation projects, certain new installations may be dependent upon existing conditions for support as indicated on Drawings. The Contractor shall, by way of a Site visit during Bidding period, carefully examine such existing conditions and satisfy itself as to the structural adequacy of such existing substrates. By commencing Work in the field, Contractor implies acceptance of existing conditions.

1.9 CULTURAL HERITAGE RESOURCES

- .1 If cultural heritage resources (such as archaeological sites, artifacts, building and structural remains, and/or human burials) are encountered during performance of Work, contact Consultant immediately and suspend Work in immediate area until assessment has been completed by Ministry of Culture, Tourism and Recreation. Perform required measures to mitigate negative impacts on found resources to acceptance of Consultant.

1.10 REGULATORY DOCUMENTS

- .1 Nothing contained in the Drawings and Specifications shall be so construed as to conflict with any law, by-law or regulation of the municipal, provincial or other authorities having jurisdiction. Work shall be performed in conformity with all such laws, by-laws and regulations.
- .2 Contract forms, codes, Specifications, standards, manuals and installation, application and maintenance instructions referred to in the Specifications are to be of the latest published editions at the date of signing the Contract.

- .3 In addition to codes and standards specified in individual sections of the Specifications, comply with the latest edition of the following:
 - .1 Association of Heating, Refrigeration and Air-Conditioning Engineers
 - .2 American Society for Testing and Materials
 - .3 Canadian Gas Association
 - .4 Canadian General Standards Board
 - .5 Canadian Standards Association
 - .6 Illuminating Engineering Society of North America
 - .7 National Building Code of Canada
 - .8 National Fire Prevention Association
 - .9 National Standards of Canada
 - .10 Ontario Building Code
 - .11 Ontario Hydro Electrical Safety Code
 - .12 Ontario Ministry of the Environment and Climate Change
 - .13 Ontario Ministry of Labour
 - .14 Ontario Occupational Health and Safety Association
 - .15 Underwriters' Laboratories of Canada
- 1.11 **PERMITS**
 - .1 The Owner will apply and pay for the building permit. Contractor shall expedite and pick up the building permit.
- 1.12 **CONSTRUCTOR**
 - .1 The Contractor shall be the "Constructor" as defined in the Occupational Health and Safety Act. As such, the Contractor shall be responsible for ensuring that the provisions of the statutes, regulations and by-laws pertaining to the duties, obligations, and safe performance of the Work in accordance with the obligations of the Constructor as set out in the Occupational Health and Safety Act are observed.
- 1.13 **MANDATORY PRE-CONSTRUCTION SITE MEETING**
 - .1 After the tender award, the Contractor and applicable Subcontractor shall attend a pre-construction site meeting .
 - .2 Contractor shall bring their abatement Subcontractor to the pre-construction site meeting of building where abatement work is going to occur.
- 2 Environmental Protection
- 2.1 **GENERAL**
 - .1 The Contractor shall be responsible for monitoring, reporting and ensuring the Work is done in compliance with the requirements of all environmental legislation and regulations governing the Place of the Project.

- .2 Protection of the environment in all aspects of the Project is of prime importance to the Owner.
- .3 Should the Contractor fail to comply with any environmental requirements when instructed, the Owner will undertake the corrective action and the costs for such corrective action shall be borne by the Contractor.
- .4 Directions given by the Owner or Consultant with respect to action to be taken to correct environmental deficiencies must be acted upon immediately.

3 Project Coordination

3.1 **GENERAL**

- .1 The Contractor shall ensure that the Contract Documents are fully coordinated with all trades involved in the Project.
- .2 The Contractor shall perform a site survey to ensure all buried, embedded, and underground pipes, conduits, power lines, elements and utilities are identified prior to beginning any demolition work both inside and outside of a building
- .3 The Contractor shall coordinate progress of the Work, progress schedules, submittals, use of Site, temporary utilities, construction facilities and construction Work, in conjunction with the progress of work of other Contractors.
- .4 The Contractor shall ensure all trades cooperate with and work together so that the Work will fit together and make a complete and satisfactory job in every detail. Ensure each Subcontractor maintains its own quality assurance program.
- .5 The Contractor shall comply with Owner's instructions for access to Owner occupied areas.
- .6 The Contractor shall coordinate with all government departments and agencies, Authorities Having Jurisdiction and utilities such as the City's Building Department, ESA, TSSA, Toronto Hydro, Enbridge Gas, but not limited to, and organize all required inspections and approvals for the completion of construction Work. It will be the full responsibility of the Contractor to ensure that all conditions of permits and approvals are met during construction Work and all permits are closed.

3.2 **CONSTRUCTION ORGANIZATION AND START-UP**

- .1 The Contractor shall comply with Contract requirements for staging areas of the Site. **The Contractor shall use the area allocated for parking, as indicated in architectural drawing No. A002 – gridlines (-1 / A G), for their field offices, storage areas, access and parking facilities, and temporary utilities and construction facilities.**

3.3 **WORK SEQUENCE**

- .1 The Contractor shall coordinate the stages of Work to accommodate Project requirements during construction; and the sequence and direction of execution to meet Project schedule.
- .2 The Contractor shall coordinate the progress schedule with the Owner's requirements during construction.
- .3 The Contractor shall construct Work in stages or manner to provide for continuous operation of all facilities under this Contract. Do not close off public or Owner usage of any area of the Site which are not defined as part of the Contractor's work areas.

- .4 Work is not to proceed on site until all required materials are in place for each stage or area of Work, including demolition of areas and spaces. It is the Contractor's sole responsibility to ensure that material is on site prior to starting demolition or Work. No delays for supplier delivery times will be accepted.

3.4 **COORDINATION AND INTERFERENCE DRAWINGS**

- .1 The Contractor shall coordinate placement of materials and equipment to ensure that all components will be properly accommodated within the spaces provided prior to commencement of Work.
- .2 The Contractor shall take complete responsibility for any remedial Work that results from failure to coordinate any aspect of the Work prior to its fabrication/installation.
- .3 The Contractor shall ensure that all accesses and clearances required by jurisdictional authorities and/or for easy maintenance of equipment are provided in the layout of equipment and services.
- .4 The Contractor shall prepare interference Drawings indicating the co-relation of the architectural, mechanical, electrical, security/communications and process systems and the building structure, and review with trades at Contractor's coordination meetings. Agree with trades on proposed installation and routing of systems prior to installation. Interference Drawings shall contain information based on reviewed Shop Drawings.
- .5 The purpose of the interference Drawings coordination is to enable efficient use of available space, proper sequencing of the Work, and to resolve conflicts or interferences at no extra cost to the Owner. The Contractor shall sequence the production and review of interference Drawings in advance of the actual Work being performed to allow construction to proceed as scheduled.
- .6 The Contractor shall prepare and distribute minutes of interference coordination meetings to all parties.

3.5 **CONTRACTOR'S USE OF PREMISES**

- .1 The Contractor shall carry out Work in such manner as to cause a minimum of noise or interference to adjacent properties. Secure the approval of authorities having jurisdiction before proceeding with any Work which may cause interference. Provide all necessary precautions to protect existing property and people.
- .2 To ensure coordination and communication is maintained between the Contractor, Owner, and building occupants, the Contractor is required to provide an up-to-date Construction Schedule and phasing plan to the building occupants 2 weeks prior to the start of Work. Day to day operations and housekeeping rules are to be discussed and adhered to by the Contractor. Schedule and Phasing plan to be discussed with the Owner and building occupants and revised as needed prior to commencing Work. Any changes to the Schedule and Phasing Plan are to be discussed first with the Owner and building occupants.
- .3 The Contractor shall coordinate use of premises with Owner and building end users to avoid interference with the Owner's normal operations of the facility. Day to day operations and housekeeping rules are to be discussed and adhered to by the Contractor.
- .4 The Contractor shall assume full responsibility for protection and security of Products and Work under this Contract.
- .5 The Contractor shall limit operations to the prescribed areas including installation operations, storage areas and movement of vehicles and equipment.

- .6 Access and egress to and from the Site of Work areas shall be by the prescribed routes only.
- .7 The Contractor shall allow free and unrestrictive access to the Site by Owner, Consultant or his Representatives, or by any authorized person representing the Owner, and allow them to enter upon and inspect any or all parts of the Work under this Contract.

3.6 **NOISE**

- .1 Construction Work undertaken shall not contravene the requirements of local noise and pollution by-laws and all other regulatory requirements. Any construction Work that requires drilling, cutting, coring or hammering, must be undertaken after hours and/or on weekends. No additional overtime charges will be paid for the Work performed after hours and/or on weekends.

3.7 **OWNER'S OCCUPANCY**

- .1 The Owner will occupy existing premises during FIFA May 15, 2026 until August 1, 2026 period for execution of normal operations.
 - .1 The Contractor shall coordinate with the Owner in scheduling operations to minimize conflict and to facilitate Owner's usage.
 - .2 The Contractor shall provide an emergency contact list to the Owner and building occupants.
 - .3 Contractor shall allow for:
 - .1 Access for Owner's personnel
 - .2 Maintenance and use of parking facilities outside of the Contractor's areas as defined in the Contract Documents
 - .3 Owner's movement of equipment, vehicles and material
 - .4 Operation of HVAC, electrical systems and equipment

3.8 **SUPERINTENDENCE**

- .1 The Contractor shall provide the following full-time staff with responsibilities as stated below. All staff shall have relevant formal training and experience with similar Project size and complexity.
 - .1 Project Manager or Construction Manager and Site Supervisor whose responsibilities include managing all administrative aspects of the Project including administration of Contracts and changes with the Owner, the Subcontractors and Suppliers. This role will also include for administration of all Contract administration documents required by the Contract Documents including schedules, logs, reports, meeting minutes, RFI's, Site instruction, change orders, change directives, and monthly progress payment invoice. This person shall be on Site full time for the complete duration of the Project and must chair the site kick-off meeting, and the regular progress and coordination meetings. The Project Manager will be the main point of contact for the City and for the Consultant on this Project, shall maintain complete involvement, coordinate with all stakeholders (internal and external to the City) and attend regular construction progress on site bi weekly meetings.
 - .2 Site Engineer or Site Coordinator whose responsibility includes planning and coordination of the Work, review of submittals and Shop Drawings, maintaining as-built records, and assisting the Site Superintendent and Construction

Manager. This person shall be on Site full time for the complete duration of the Project.

- .2 The Contractor shall provide other foremen as necessary to direct and control the Work on Site, such personnel to be well experienced, competent in their specialized fields and having full knowledge and experience in directing the Work under their charge.
- .3 In addition to the full time Superintendent that the Contractor shall place in full charge of the Work on Site, ensure that each major Subcontractor maintains a full time Superintendent to be in charge and responsible for their respective Work and who shall report to the Contractor's site superintendent.
- .4 In addition to the above, a Representative of the Contractor is required to be present when work is occurring on a building.

4 Cutting and Patching

4.1 **APPROVALS**

- .1 The Contractor shall submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of any element of the 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 separate Contractor.

4.2 **INSPECTION**

- .1 The Contractor shall inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, Contractor shall inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.

4.3 **EXECUTION**

- .1 The Contractor shall execute cutting, fitting, and patching to complete the Work.
- .2 The Contractor shall provide supports to assure structural integrity of surroundings; including devices and methods to protect other portions of the Project from damage.
- .3 The Contractor shall employ appropriate trades with skilled labour to perform cutting Work.
- .4 Cut materials using proper equipment and methods.
- .5 The Contractor shall remove and replace defective and non-conforming Work.
- .6 The Contractor shall execute Work to avoid damage to other Work.
- .7 Prepare proper surfaces to receive patching and finishing.
- .8 Fit all Work segments together to integrate with penetrations through surfaces and with other Work.

- .9 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .10 At penetration of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-rated or fire-resistant material, specified to the full thickness of the construction element.
- .11 Existing exterior walls with glazing when exposed to construction in progress must be protected by 5/8" type "X" gypsum board on suitable framing for the duration of the construction. Other openings in the existing exterior walls such as doors, louvers, etc., must be similarly protected.
- .12 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.
- .13 Where Drawings indicate or Specifications call for items to be relocated, perform Work to the same quality of workmanship specified for new Work. Replace damaged or missing items at no extra cost to the Owner. Provide new fasteners; for exterior, use stainless steel.

5 Field Engineering

5.1 **UTILITY SURVEYS**

- .1 Locate and mark the routing of embedded or subsurface utilities located within the construction Site. This includes, but is not limited to, electrical conduits, telephone lines, storm sewers, sanitary sewers, water mains, communication cabling, gas lines, duct banks, and hidden or obtrusive plants.
- .2 Examine pre-existing concrete floors before cutting or penetration where the structural integrity may be compromised.
- .3 Use ground penetrating radar (GPR) devices and other similar equipment and software to provide the most accurate depiction of surveyed areas and to best determine the horizontal locations and relative depths of both metallic and non-metallic utilities. Survey Work to include the following:
 - .1 Clearly mark inferred positions of each utility or subsurface object by means of visible paint or flags.
 - .2 Show located utilities and subsurface objects on Drawing prints, scalable with dimensions, for use in final reports upon completion of surveys.
 - .3 Submit final reports. Include in the report, details of field procedures and identification of potential impediments to construction.
 - .4 Describe the limitations of technologies used during surveys and identify variations between the inferred utility positions during surveys and the actual positions of underground plant, when uncovered.
- .4 Provide well-trained and well-equipped technicians in the use of detection systems and locating devices for utility surveys. Technical staff shall be deemed to be proficient with the latest technological advances in subsurface detection.
- .5 Employ a professional firm to conduct the above operations.

6 Project Meetings

6.1 **ADMINISTRATIVE**

- .1 Schedule and administer bi-weekly Project meetings throughout the progress of the Work.
- .2 Notify in writing, Owner and Consultant to attend meeting a minimum of one week in advance of meeting.
- .3 Prepare agenda for the meeting.
- .4 Provide physical space and make arrangements for meetings.
- .5 The Contractor will record the minutes of the meetings. Minutes to include significant proceedings and decisions and identify "action by" parties. Meeting minutes will be issued to all attendees within 42 hours after the meeting is concluded.
- .6 Reproduce and distribute copies of minutes no later than three Working Days after each meeting and transmit to meeting participants, including affected parties not in attendance.
- .7 Representatives of Contractor, Subcontractor and Suppliers attending meetings shall be qualified and authorized to act on behalf of the party each represents.

6.2 **KICK-OFF MEETING**

- .1 The Consultant will arrange a kick-off meeting immediately upon award of Contract. Attendance by authorized Representatives of Owner, Consultant and Contractor is mandatory. The purpose of this meeting is to commence the Work under this Contract, to acquaint the Contractor's and Owner's designated personnel with each other, and to discuss methods and means by which full cooperation and coordination of all participants can be achieved during the execution of the Work.

6.3 **SAFETY MEETING**

- .1 The Contractor shall conduct safety meetings as required by the Owner and OHSA.
- .2 Agenda may include the following:
 - .1 Safe work practices
 - .2 Accident reporting and investigations
 - .3 Health and safety inspections
 - .4 Health and safety committees
 - .5 Orientation and training
 - .6 Emergency preparedness

6.4 **PROGRESS AND COORDINATION MEETINGS**

- .1 The Consultant will conduct and record bi-weekly progress and coordination meetings and other extraordinary meetings as may be required from time to time by the Owner.
- .2 Agenda may include the following:
 - .1 Review, approval of minutes of previous meeting;
 - .2 Review of Work progress since previous meeting;

- .3 Field observations, problems, conflicts and interferences
- .4 Problems which impede construction schedule;
- .5 Review of off-site fabrication delivery schedules;
- .6 Corrective measures and procedures to regain Project schedule;
- .7 Revisions to construction schedule;
- .8 Progress, schedule, during forthcoming work period;
- .9 Review submittal schedules; expedite as required;
- .10 Maintenance of quality standards;
- .11 Pending changes and substitutions;
- .12 Review proposed changes for effect on construction schedule and on completion date;
- .13 Other business.

7 Submittals

- .1 Refer to Section 01 33 00 Submittal Procedures.

7.2 **MONTHLY EARNED VALUE PROGRESS**

- .1 With each monthly progress claim provide an "S" curve indicating the actual earned progress compared against the planned earned progress.

7.3 **REQUEST FOR INFORMATION (RFI)**

- .1 Requests for Information shall be completed and submitted by the Contractor if items are not indicated on the Drawings or contained in the Project Manual that is required to properly perform the Work. RFI's shall include a detailed written statement that indicates the specific Drawings or specification sections that require clarification.
- .2 Upon receipt of a RFI the Consultant will provide a response to the Contractor within five Business Days. Business Days are considered Monday to Friday.

7.4 **CONTEMPLATED CHANGE ORDERS**

- .1 The Contractor shall prepare, as a minimum, a detailed, itemized Contemplated Change Order breakdown in accordance with, but not limited to, the requirements below. Subcontractor or Material Supplier pricing shall follow the same requirements.
 - .1 Labour: Include hourly wage, number of hours including overtime.
 - .2 Equipment rentals: No rental charges will be allowed for hand tools, minor equipment, etc.
 - .3 Materials: Material purchased by the Contractor and incorporated into the Work, showing costs, quantities or unit prices of all items, as appropriate.
 - .4 Delivery charges for material or equipment.
 - .5 Overhead and taxes.

.2 The following shall *not* be included in a Contemplated Change Order breakdown:

.1 Owned equipment costs.

.3 The Contract Administrator or the Owner reserves the right to request reasonable additional information to support the Contemplated Change Order.

8 Schedules

8.1 **SCHEDULES REQUIRED**

.1 Detailed building schedule with all tasks and critical path shown.

.2 Work schedule with workforce loading.

.3 Submittal Schedule for System Design and Engineering, Shop Drawings, Product Data, As-Built Drawings, Operating and Maintenance Manuals, Samples.

.4 Delineation Plan

8.2 **SUBMISSION**

.1 The Contractor shall submit initial schedules within seven days after award of Contract.

.2 Consultant and Owner will review schedule and return reviewed copy within ten (10) Business Days after receipt.

.3 The Contractor shall resubmit finalized schedule within three days after return of reviewed copy.

.4 Submit updated progress schedule with each application for payment and as otherwise instructed by Owner.

.5 Distribute copies of the reviewed schedule to job Site, Subcontractors and other concerned parties.

8.3 **RESPONSIBILITY**

.1 The Contractor shall perform overall planning and control of the Project.

.2 Plan and schedule the Work to provide a continuous and efficient flow of the Work to achieve the Contract completion date.

.3 The Contractor shall develop a detailed schedule as previously described, based on sequencing, phasing, and direction of installation required by the Project.

.4 At the regular scheduling meetings, The Contractor shall report on the actual progress of each element of Work, including work of Subcontractors.

.5 The Contractor shall report on firm established delivery and/or start dates for all critical material and equipment, of own trades and of Subcontractors. Immediate notice shall be given to the Owner of all problems or anticipated problems in respect of deliveries of critical materials or trade operations.

8.4 **CONSTRUCTION SCHEDULES**

.1 The Contractor shall prepare and submit to the Owner a detailed schedule. Schedule shall be created using the scheduling software Microsoft Project at no extra cost to the Owner, based on sequencing, phasing, and direction of installation required by the Project.

- .1 Prepare schedule in the form of a horizontal bar chart and with manpower loading figures based on average weekly loading.
 - .2 Provide a separate bar line for each trade or operation. Identify all tie-ins to Owner's existing facilities.
 - .3 Provide horizontal time scale identifying the first work day of each week.
 - .4 Format in chronological order of the start of each item of Work.
 - .5 Format schedules to allow plotting of actual progress against scheduled progress.
- .2 Update for progress and submit weekly or as requested by Owner.

8.5 **WEEKLY SCHEDULE WITH MANPOWER LOADING**

- .1 For bi-weekly coordination meeting provide a detailed two-week work schedule outlining Work activities and manpower requirements (by trade) planned for that period. Update and submit weekly.
- .2 Identify problems on the past week's operation and submit proposed solutions at coordination meetings.

8.6 **SHOP DRAWINGS AND PRODUCT DATA**

- .1 Contractor's detailed schedule of Work or a separate schedule shall identify the development and submission of Shop Drawings and submission of Product data.
- .2 The Contractor shall provide Shop Drawings in the form specified and in an orderly sequence as directed by the Consultant.
- .3 The Contractor shall provide sufficient information for comprehensive review of Shop Drawings.
- .4 At the start of the Project, review the Contract Documents and compile a submittal schedule which shall include all submittals required by the Contract Documents. Coordinate the submittal schedule with the construction schedule, show all scheduled dates the submittals are to be submitted, and the latest review return date from the Consultant.
- .5 At the time of submission, the Contractor shall notify the Owner in writing of deviations in Shop Drawings from the requirements of the Contract Documents.
- .6 Shop Drawings and all other submittals to be issued to the Consultant via a browser-based contract administration software such as ACC .
 - .1 ACC is a browser Contract Administration software the Consultant is using exclusively for the program.
 - .2 The Consultant will provide access and log information for ACC to the Contractor prior to the start of Work.
- .7 Shop drawings and all other submittals issued in any other form outside of ACC will not be accepted.
- .8 Upon receipt of a Shop Drawing the Consultant will provide a response to the Contractor within ten Business Days. Business days are considered Monday to Friday.

8.7 **DELINEATION**

- .1 The Contractor shall coordinate with other contractors at the facility and arrange for delineation in time and space as required for the completion of construction Work. There could be multiple contractors performing Work at the facility. No additional/overtime charges will be paid if the construction Work is delayed because of coordination with other contractors performing Work at the facility.
- .2 The Contractor shall develop Construction Delineation Plan and implement to ensure that delineation in both time and space is established and maintained among two or more Contractors. Additionally, ensure site coordination during construction Work activities performed at the facility and that there is only one Constructor (Contractor) at the facility at any point in time in the construction Work area.

9 Quality Control

9.1 **INSPECTION AND TESTING BY CONTRACTOR**

- .1 The Contractor shall be responsible for inspection and testing as required by the Contract Documents, statutes, regulations, by-laws, standards or codes or any other jurisdictional authority paid for by the GC included in the be price. Give the Consultant timely notice of the readiness for inspection, date and time for such inspection for attendance by the Consultant.

9.2 **INSPECTION AND TESTING BY INDEPENDENT AGENCIES**

- .1 Independent inspection/testing firms may be engaged for the purpose of inspecting and/or testing portions of Work. The firm will be approved by the Owner and the cost of such services will be included by the Contractor.
- .2 Employment of inspection/testing firms does not relieve the Contractor's responsibility to perform Work in accordance with Contract Documents. Defective materials and/or workmanship may be rejected, regardless of previous inspection, whenever found.
- .3 The Contractor shall provide assistance required for executing inspection and testing by the appointed firms. Allow access and facilities for inspection and testing.
- .4 If defects are revealed during inspection and/or testing, the Owner will request additional inspection and/or testing to ascertain the full degree of the defect. Correct defects and irregularities as advised by Owner at no cost to Owner. Contractor is responsible to pay costs for retesting and re-inspection at their own expense.

9.3 **PROCEDURES**

- .1 The Contractor shall allow inspection/testing agencies access to the Work on the Site, at off-site manufacturing and fabrication plants.
- .2 The Contractor shall notify the appropriate agency and Owner and Consultant in advance of the requirement for tests, in order that attendance arrangements can be made.
- .3 The Contractor shall submit samples and/or materials required for testing. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in the Work.

9.4 **REPORTS**

- .1 Copies of inspection and test reports will be issued to prime Contractor, Owner and Consultant.
- .2 The Contractor shall provide copies to Subcontractor of work being inspected/tested.

9.5 **EQUIPMENT/SYSTEMS**

- .1 The Contractor shall submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

10 Temporary Construction Facilities and Controls

10.1 **INSTALLATION/REMOVAL**

- .1 The Contractor shall provide construction facilities and temporary controls to execute the Work expeditiously.
- .2 The Contractor shall remove from Site all such Work after use.

10.2 **GUARD RAILS, BARRICADES AND TRAFFIC CONTROL**

- .1 The Contractor shall provide secure, rigid guard railings and barricades where required for protection of Work, workers and public.
- .2 The Contractor shall provide flag-persons, traffic signals, flares, lights or lanterns as required to perform the Work and protect the public.
- .3 Provide as required by governing authorities.

10.3 **CONSTRUCTION TRAILERS AND TEMPORARY BUILDINGS**

- .1 Where applicable, Provide temporary facilities, including but not limited to washroom, locker rooms and office space. If required, move existing equipment into the temporary facility to ensure continuity of space use. Provide signage and ensure the path of travel to temporary facilities is kept clean and safe for all building occupants.
- .2 Stay within the working limits defined in the Contract Documents. If the Contractor can prove that there are additional or alternate requirements, the Contractor shall define the extent of space required for construction trailers, laydown areas, storage containers or buildings, construction access roads, etc. and submit a proposal to the Contract Administrator for review and approval.
- .3 Where not available, Provide means of storage and protection of furniture, equipment and existing Work moved or altered to facilitate construction.
- .4 Locate construction trailers, laydown areas, and temporary buildings as arranged with the stakeholders and Contract Administrator.
- .5 When temporary building facilities and/or laydown areas are no longer required, promptly remove all contractor equipment, including all construction waste, unless otherwise specified or directed. Restore all areas to conditions at start of Contract to the satisfaction of the Contract Administrator.

10.4 **HOARDING**

- .1 Contractor shall submit Shop Drawings indicating locations of hoarding, barriers, fencing and dust tight screens prior to commencement of Work. Shop drawings shall illustrate plan for maintaining clear exits during each stage of the Work. Refer to Section 02 41 19 for specific requirements for construction hoarding and dust tight screens.
- .2 Provide hoarding where required to protect the public, workers and private property from injury or damage.
- .3 Provide protection from damage for all existing trees and plants that are not indicated to be removed.

- .4 Install hoarding, fencing, barriers and dust-tight partitions to protect the parts of the building that are not under construction.
- .5 Provide alternative exits when an existing exit is closed off due to construction activities. Alternative exits must be acceptable to both the Owner and to Authorities Having Jurisdiction. All temporary exits must be clearly identified with appropriate signage.
- .6 Provide and maintain, at all times, appropriate protection to fully weatherproof areas of the facility which may become exposed due to demolition, removals, and construction. Prevent ingress of water, snow, etc., into the interior or building components. All costs for clean-up and restoration of damages resulting from failure to comply are the responsibility of the Contractor.
- .7 All Furniture, Equipment and existing Work moved or altered to facilitate construction or movement of material or equipment to be stored and protected with dust-tight covers. Storage space to be provided by the Contractor where not possible to store on site. All Furniture, Equipment and existing Work to be subsequently returned to its original location by the Contractor.
- .8 Contractor is responsible for ensuring at all times any hoarding within a building, and/or outside of a building is not obstructing or impeding any Fire Exiting routes and Emergency access routes.
 - .1 Contractor shall prepare a hoarding schedule for the duration of the Contract prior to start of the Work so as to not impact the Construction Schedule. Hoarding around emergency exits and emergency exit pathways is to be coordinated with the Fire Inspectors for their review and approval prior to commencement of the Work.
- .9 The Contractor shall not use any areas inside or outside of a building for hoarding, storage, or activity unless with the written consent of the building stakeholder

10.5 **DUST TIGHT SCREENS**

- .1 Provide dust tight screens or partitions to localize dust generating activities and for the protection of workers, finished areas of the Work and the public.
- .2 Maintain and relocate protection until such Work is complete.

10.6 **ACCESS AND CONSTRUCTION PARKING**

- .1 Use entrances, exits and on-Site routes as directed by Owner.
- .2 Parking is not permitted on any Site. Contractor to arrange for their own parking. Comply with the Owner's requirements for daily site access.
- .3 Before Contractor enters the Site with his vehicles or equipment, he shall coordinate with the Owner and appropriately barricade, stake off or snow fence the access routes and storage areas and around the construction area in order to prevent damage to buildings, grounds, plantings, turf and surrounding facilities at the Site, and to restrict unauthorized persons from entering the construction area. The Contractor shall be responsible for making good any and all damages caused by his operations on Site. Restoration of such damages shall be to the original condition or better, and to the satisfaction of, and at no extra cost to, the Owner.
- .4 All construction activities must not obstruct the access roadways designated for fire department equipment. If it is necessary that existing access be obstructed or removed, alternative access, acceptable to the fire department, must be pre-planned and provided prior to commencement of construction.

10.7 USE OF THE WORK

- .1 Confine the Work and the operations of employees to limits indicated by the Contract Documents. Do not unreasonably encumber the premises with Products.
- .2 Storage of material shall be outside of the building with exception of material for each day's work requirements.
- .3 Fabrication shops shall not be set up within the building except as directed by the Owner.
- .4 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the Work.
- .5 The Contractor shall be responsible for careful and reasonable use of any Owner-supplied water and power.

10.8 TEMPORARY SIGNAGE

- .1 Ensure that employees and the public are informed of the Work being performed in the work area a minimum of 5 days in advance of Work commencing and that signage is installed noting the nature of Work being performed, anticipated start and end dates and any dangers that may result from the Work.
- .2 Provide temporary wayfinding signage as needed around hoarding, area and room closures, stair closures, exit closures, or otherwise as needed to ensure safe passage and exiting.
- .3 Replace existing signage as it is removed in the course of the Work with temporary signage. Replace with new signage where indicated on Drawings upon completion of the Work.
- .4 Fabricate temporary signage from corrugated plastic. Where required, add grommets for installation.

10.9 SANITARY FACILITIES

- .1 The Contractor shall provide weatherproof sanitary facilities as required portable, trailer type washrooms which consist of flush toilets and wash basins in accordance with local health and other authorities.
- .2 The Contractor shall maintain in clean condition.
- .3 Contractors and Subcontractors are not allowed to use the buildings existing facilities.

10.10 WATER SUPPLY

- .1 For water required for construction, refer to City of Toronto Master Services Agreement.

10.11 TEMPORARY POWER AND LIGHTING

- .1 Refer to the City of Toronto Master Services Agreement.

10.12 EQUIPMENT/TOOL/MATERIALS STORAGE

- .1 The Contractor shall provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials. Locate as directed by Owner.
- .2 The Contractor shall locate materials not required to be stored in weatherproof sheds on Site in a manner to cause the least interference with Work activities, as directed by Owner.

10.13 **SECURITY**

- .1 Be responsible for the security of Work and material supplied, stored and installed until all Work is complete and accepted by Owner.
- .2 Any security guard patrol or service provided by Owner is for the protection of the Owner's interest in the Work on the Site, and shall not relieve the Contractor of his responsibility to protect the Work of the Contract.

10.14 **PROJECT CLEANLINESS**

- .1 The Owner reserves the right to perform clean-up Work not expeditiously completed by the Contractor and deduct such costs from the Contract Price.

10.15 **COVID 19 PROTOCOL**

- .1 The Contractor shall take all necessary precautions to minimize the risk of COVID-19 transmission and illness to themselves, workers and others at the construction site as well as the public sharing common spaces or accessing areas of the project after turn-over.
- .2 The Contractor and Subcontractors shall ensure that individuals assigned to perform the work on this project are fully vaccinated with the COVID-19 vaccine series. This requirement shall be met in addition to any other policies regarding COVID-19 vaccination under regulations, legislation or guidelines applicable to them.
- .3 When directed by the City of Toronto, the Contractor shall provide a written attestation of compliance with the City's COVID-19 Vaccination requirements in accordance with the COVID-19 Vaccination Policy for Contractors, including proof of compliance as required by the City.
 - .1 Refer to the link below for the City of Toronto's COVID-19 Vaccination Policy for Contractors:

<https://www.toronto.ca/city-government/accountability-operations-customer-service/city-administration/corporate-policies/people-equity-policies/covid-19-vaccination-policy-for-contractors/>
- .4 Prior to the start of construction, the Contractor shall develop and submit a written site safety plan. This plan is to be submitted two (2) weeks prior to the start of construction and shall outline the policies and procedures that reflect the recommendations of the Provincial Health Officer and the City of Toronto COVID-19 guidance in force at the time. The written plan shall include, but is not limited to the following:
 - .1 Implementation of a workplace vaccination policy.
 - .2 Cleaning and decontamination procedures for all common areas and surfaces.
 - .3 A preparedness and response plan in the event that someone becomes ill with the symptoms of transmittable illness or disease.
 - .4 A separation plan indicating how the Contractor will provide separation of the plant staff from the Contractor's staff, especially in crowded and congestion area with poor ventilation.
 - .5 Health screening of all personnel on site prior to entry and exit of the worksite.

- .5 The Contractor shall provide the following:
 - .1 Adequate personal protective equipment supplies such as masks and gloves as required.
 - .2 Adequate handwashing and sanitation facilities that are visible and easily accessed on site for all workers and visitors.

10.16 **ROAD CLEAN-UP**

- .1 The Contractor shall take all precautions to avoid depositing materials, debris and mud on the Owner's roadways and parking areas and on roads and streets adjoining the Owner's property from vehicles and equipment operating to and from the construction Site, and be responsible for removal of such deposits by brooming and washing.

11 Fire and Life Safety

11.1 **SAFETY PLAN**

- .1 The Contractor shall submit to the Owner for review, prior to the Commencement date or as directed by the Owner, the following:
 - .1 The Contractor's occupational health and safety policy and procedures.
 - .2 The Contractor's site-specific safety plan and associated procedures.
 - .3 The site-specific emergency response plan listed below:
 - .1 Site-specific emergency response plan guideline.
 - .2 Emergency Response Planning for Construction Projects by the Provincial Labour-Management Health and Safety Committee.
 - .4 The site-specific traffic control plan.
 - .5 The Contractor's site orientation package.
- .2 Depending on the nature of the construction, it may be necessary to modify the fire emergency procedures. Such changes may be temporary to accommodate revised exits, modifications to the fire alarm system operation, etc., in which case the procedures must be returned to the original format at the completion of the Project. In some cases, permanent revisions to the emergency procedures are required when the construction is completed.

11.2 **TRAINING, AWARENESS AND ORIENTATION**

- .1 The Contractor shall provide the Owner, Consultant and visitors to the Site, training, awareness, orientation, or familiarization in advance of Site visit.

11.3 **FIRE PROTECTION**

- .1 The Contractor shall provide and maintain temporary fire protection equipment e.g. portable fire extinguishers, during performance of Work required by authorities having jurisdiction, governing codes, regulations and by-laws, to the satisfaction of the Owner and all local and insurance authorities in order to protect the property of the Owner and the Contractor against fire hazards during construction.
- .2 Bulk storage of flammable liquids and other hazardous materials is not allowed on the Site.

- .3 Flammable liquids must be handled in approved containers.
- .4 The bringing in, use, and disposal of gasoline, benzine or other flammable materials shall be handled with good and safe practice as required by authorities having jurisdiction.
- .5 The Contractor shall provide fire extinguishers of the non-freezing chemical type in each temporary building, enclosure, and trailer.
- .6 The Contractor shall use fire-proofed tarpaulins.
- .7 A technical representative from the fire alarm manufacturer shall be assigned to the Project to coordinate the stages of modifications and/or extensions to the fire alarm system. Whenever there is an outage of at least a portion of the fire alarm system, the Contractor must notify the municipal fire department and the building stakeholders of the temporary shutdown two weeks in advance.
- .8 A fire watch shall be required for each of the following activities regardless of the number, duration, or size of the activity in operation on a single floor:
 - .1 Any open flame activities (e.g. soldering and welding);
 - .2 Shutdown of fire detection system;
 - .3 Shutdown of sprinkler system;
 - .4 Connection to drain line.
- .9 Temporary fire separations of steel studs and gypsum board construction equivalent to a 45 minute fire resistance rating must be erected in existing corridors on occupied floor areas exposed to new corridors under construction. Where access is required, protect the opening with a solid core wood or hollow metal door with self-closing and latching hardware. If temporary fire separations cut off or eliminate the required access to exits, alternative access must be provided.

11.4 **OCCUPATIONAL HEALTH AND SAFETY**

- .1 The Contractor shall conform to safe Work practices in accordance with regulations and authorities having jurisdiction.
- .2 The Contractor shall promptly report to Owner all accidents or if any claim is made by anyone against the Contractor or Subcontractor on account of any accident.
- .3 The Contractor shall provide at the Site, equipment to supply first aid service.
- .4 The Contractor shall enforce proper Work methods and act immediately on directions regarding safety and Work practices given by authorities having jurisdiction or the Owner at no additional cost to Owner.
- .5 Failure of Contractor to comply with verbal or written instructions or orders from the Ministry of Labour inspector or other authorities as well as instructions from the Owner or Consultant regarding safe Work practices or provision of specified requirements under the act shall be considered non-compliance of the Contract.
- .6 The Contractor shall maintain on Site a copy of the latest edition of the "Occupational Health and Safety Act, Construction Projects, issued April 2009", and "Occupational Health and Safety Act, Industrial Establishments, issued October 2006".
- .7 The Contractor shall ensure that all personnel are adequately equipped to comply with safety regulations and that sufficient safety equipment is available.

- .8 Lack of equipment will not be reason for non-compliance.

11.5 **SAFETY SUPERVISOR**

- .1 The Contractor shall designate a senior employee as Contractor's safety supervisor.
 - .1 Duties will include involvement in training, instruction, planning, safety patrols, and enforcement of rules.
 - .2 The Contractor shall provide name and telephone number (site, office and residential) to Owner.
- .2 The Contractor shall ensure that a designated person is certified by IHSA (Infrastructure Health and Safety Association).
- .3 The designated safety supervisor must be familiar with Workplace Hazardous Materials Information System (WHMIS) regulations and be responsible for compliance.
- .4 The Contractor shall ensure that Controlled Products shall be properly labeled.
- .5 The Contractor shall provide proper warning labels and training at the workplace.
- .6 The Contractor shall provide copies of material safety data sheets for any controlled Product in the workplace.
- .7 The Contractor shall be responsible for all other requirements of the regulations as applicable to employers.
- .8 Before commencing any Work on the Site, The Contractor shall attend Owner's safety orientation meeting and provide Owner with a proposal as to how hazardous materials will be stored and dispensed on the Site area, in addition, specifically outline the measures which Contractor will undertake to prevent damage or injury in the event of an accidental spill.
- .9 The Contractor's "Handling Procedure" will be provided no later than ten days following the health and safety orientation meeting.

12 Material and Equipment

12.1 **PRODUCTS - GENERAL**

- .1 The Specifications may contain Product brands that form the basis of some design, and the Specifications will explicitly state so. Such "basis of design" Products are indicated as first listed item in the Product Specifications.
 - .1 Other listed manufacturers' Products are acceptable only on the condition that they comply with, or are modified as necessary, to comply with specified and indicated requirements and conform to quality levels and functional requirements of "basis of design" Product.
 - .2 Inclusion of a manufacturer's model number does not void any specified or indicated requirements.
- .2 When manufacturers' catalogued trade name and model number is specified for a Product, any specified Product will be acceptable.
- .3 When a Product is specified by reference to a standard only, any Product that meets the specified standard may be selected. Products meeting minimum reference standards will be accepted subject to the Consultant's review for compliance with the Specifications.

- .4 When a Product is specified by performance Specification without manufacturers specified, any Product meeting the requirements of the Specification may be accepted subject to Consultant's review.
- .5 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout the Work.
- .6 Where a warranty is not specified in the specification section, the City's construction agreement takes precedence.

12.2 **PRODUCT AND MATERIAL QUALITY**

- .1 Products, materials, equipment, and articles referred to as Products throughout the Specifications incorporated in the Work shall be new, not damaged or defective, and of the best quality compatible with Specifications for the purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.
- .2 Defective Products 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 Unless otherwise indicated in the Specifications, maintain uniformity of manufacturers for any particular or like item.

12.3 **SUBSTITUTIONS**

- .1 Refer to Section 01 62 01 Substitution Request Form.

12.4 **EXPEDITING**

- .1 Immediately after award of Contract, The Contractor shall review Product delivery requirements and anticipate foreseeable supply delays for any item. If delays in supply of Products are foreseeable, notify the Owner of such, in order that substitutions or other remedial action may be authorized in sufficient time to prevent delay in performance of Work.
- .2 In the event of failure to notify the Owner at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Owner reserves the right to substitute more readily available Products of similar character at no increase in Contract Price.
- .3 The Contractor shall utilize Canadian materials and Products if available and equivalent in price and quality.
- .4 The Contractor shall submit, when requested by Owner, an updated material procurement/expediting record clearly indicating the status of material delivery and fabrication. Particulars to be covered by this record shall include the item identification, sub-vendor, order date, order number, Shop Drawing submission date(s) and review date(s), required delivery date, promised delivery date, date received, date checked and general remarks.
- .5 The Contractor shall accumulate and submit similar records from (assigned) Subcontractors and ensure that Subcontractors are properly and frequently expediting all equipment and material to meet delivery deadlines to suit installation schedule.
- .6 Allow the Owner or their Representative free access to the Contractor's plant and to Subcontractor's plants for visual inspection of allotted material and/or progress of the Work.

12.5 **TRANSPORTATION**

- .1 The Contractor shall pay transportation costs to Site of Products required in the performance of Work.

12.6 **STORAGE, HANDLING AND PROTECTION**

- .1 The Contractor shall handle and store Products in a manner to prevent damage and deterioration.
- .2 The Contractor shall remove and replace damaged Products at own expense and to the satisfaction of Owner.

12.7 **WORKMANSHIP**

- .1 Workmanship shall be the best quality, executed by workers experienced and skilled in the respective duties for which they are employed.
- .2 The Contractor shall immediately notify the Owner if required Work is such as to make it impractical to produce required results.
- .3 Do not employ any unfit person or anyone unskilled in their required duties. The Owner reserves the right to require the dismissal from the Site of workers deemed incompetent, careless, insubordinate, or otherwise objectionable.

12.8 **CUTTING AND REMEDIAL WORK**

- .1 Refer to article - Cutting and Patching.

12.9 **FASTENINGS**

- .1 The Contractor shall provide metal fastenings and accessories in same texture, colour and finish as adjacent material unless indicated otherwise.
- .2 The Contractor shall prevent electrolytic action between dissimilar metals and materials.
- .3 The Contractor shall use non-corrosive hot dipped galvanized steel fasteners and anchors for securing exterior Work, unless stainless steel or other material is specifically requested in the affected Specification section.
- .4 Space anchors within their load limit or shear capacity and ensure that they provide positive permanent anchorage. Wood or any other organic material plugs are not acceptable.
- .5 The Contractor shall keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

12.10 **PROTECTION OF WORK**

- .1 The Contractor shall adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Owner, at no increase in Contract Price.
- .2 The Contractor shall prevent overloading of any part of the Work or building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of the Owner.

- .3 The Contractor shall maintain and monitor protection of roofing membrane when Work is done on or above finished roofing system.

12.11 **EXISTING UTILITIES**

- .1 Connect to existing services or utilities at times directed by Owner or local governing authorities, with a minimum of disturbance to Work, building occupants, pedestrian and vehicular traffic.
- .2 The Contractor shall protect and 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.

13 Systems Demonstrations

13.1 **NOT USED**

14 Contract Closeout

14.1 **FINAL CLEANING**

- .1 When the Work is substantially performed, the Contractor shall remove surplus Products, tools, construction machinery and equipment not required for the performance of the remaining Work. Final cleaning shall include, but are not limited to the following:
 - .1 Remove waste materials and debris from the Site at regularly scheduled times or dispose of as directed by the Owner. Do not burn waste materials on Site, unless approved by the Owner.
 - .2 Use professional cleaners for final cleaning. Use only cleaning material recommended by manufacturer of surface to be cleaned.
 - .3 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation system is not permitted for this purpose.
 - .4 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on previously cleaned surfaces
 - .5 Remove dirt and broom clean, wash and sweep exterior walks, steps and paved surfaces. Leave exterior Work broom clean before the inspection process commences.
 - .6 Remove dust, dirt and other foreign disfigurements from exposed surfaces.
 - .7 Vacuum clean and dust building interiors, behind grilles, louvers and screens. Leave Work vacuum-clean before the inspection process commences.
 - .8 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, mechanical and electrical fixtures and equipment. Replace broken, scratched or disfigured items at no extra cost to the Owner.
 - .9 Remove grease, stains, spots, marks, dust and dirt from decorative Work, electrical and mechanical fixtures, furniture, fittings, and walls and floors.
 - .10 Remove from building and site, snow and ice that would prevent operation and activities of the facility.

14.2 **WARRANTY**

- .1 Refer to Division 00 for Warranty information.

14.3 **DOCUMENTS**

- .1 The Contractor shall submit close-out documents to the Consultant and the City of Toronto in electronic and printed copy formats within 45 days of the issuance of Substantial Performance. Provide electronic copies and printed in 3-ring binders of close-out documents to the Consultant for prior review. Closeout documents submissions includes, but is not limited to:

- .1 As-Built Drawings in electronic (USB) AUTOCAD live files as per the latest drawing standard.
- .2 Notice of Project
- .3 Health & Safety Pre-start report and Policy.
- .4 Project Schedules
- .5 Warranties and bonds, including the Two-Year Warranty Certification for all Work.
- .6 Section 01 33 00 Submittal Procedures: Shop Drawings, As-Built Drawings, Building Manuals, Operation and Maintenance Manuals, Samples.
- .7 Change Orders and Change Directives
- .8 Testing and inspection certificates required by municipal, provincial and other authorities having jurisdiction.
- .9 Final adjustment in cash allowances.
- .10 Product data, materials and finishes and related information.
- .11 Commissioning reports.
- .12 Individual Specifications sections: Specific requirements for operation and maintenance data.
- .13 Substantial Performance Certificate and Advertisement
- .14 Contact List for Design and Construction Teams
- .15 Prime Consultant Final Completion Certificate.
- .16 New Asset & Equipment PM Details Form
 - .1 Refer to Section 01 10 00.3 for sample sheet
 - .2 Contractor to request digital form from the Consultant and/or Owner
- .17 Access Database
 - .1 As part of the Closeout documents, the Contractor shall provide a breakdown of tasks under each specification division and fill out pricing and quantities.
 - .2 Access Database to be submitted to the Consultant as an excel file. Template to be provided to the General Contractor at a later date.

- .2 Collect reviewed submittals and assemble documents executed by Subcontractors, Suppliers, and manufacturers.
- .3 Submit material in a neatly indexed package, prior to final application for payment.
- .4 All Warranties shall commence from date of Certificate of Substantial Performance unless indicated otherwise.
- .5 Contractor shall be responsible for obtaining and enforcing all required warranties.
- .6 Examine all sections of the Specification to ensure inclusion of all warranties specified.

14.4 **INSPECTION/TAKEOVER PROCEDURES**

- .1 Prior to application for certificate of Substantial Performance, The Contractor shall carefully inspect the Work and ensure it is complete, that major and minor construction deficiencies are complete, defects are corrected and the building is clean and in condition for occupancy. Notify the Owner in writing of satisfactory completion of the Work and request an inspection.
- .2 The Contractor shall conform to OAA/OGCA document No.100 for takeover procedures.
- .3 Consultant will allow a maximum of two final inspections for each discipline for rectifying all defects. Beyond this all additional visits will be charged to the General Contractor at a rate of \$1000.00 per visit/report per person.
- .4 During inspection by the Owner and Consultant, a list of deficiencies and defects will be tabulated. Correct within agreed time schedules.

14.5 **EQUIPMENT HANDOVER LIST**

- .1 The Contractor shall submit Equipment Handover List in accordance with Section 01 33 00, containing specific technical data for each equipment which has, or shall have, an Asset Tag number allocated. List shall include but not limited to the equipment name, quantity and equipment model.
- .2 The template format will be provided by the Owner.

End of Section

City of Toronto

Method of Procedure (MOP) Template



Detailed Technical Method of Procedure
Isolation of Switchboard EB

Title: Isolation of Switchboard EB
Version: 2
Project:
Site Address:
Revision Date:

Activity Date:
Estimated Duration: 4:30
Start Time: 7:30
End Time: 11:30
Required Tech 1:
Required Tech 2:

Approved by:

Technical Details Approval by:	<input type="checkbox"/> -	<input type="checkbox"/> -	<input type="checkbox"/> COT - FM	<input type="checkbox"/> COT - Site Operations				
Impact/Schedule Approval by:	<input type="checkbox"/> T.P.S	<input type="checkbox"/> TPS - COMM	<input type="checkbox"/> PARAMEDICS	<input type="checkbox"/> COT - transportation	<input type="checkbox"/> COT - OEM	<input type="checkbox"/> COT – I & T	<input type="checkbox"/> COT – Security	<input type="checkbox"/> T.F.S

Overview: MOP 60 pertains to the isolation of Switchboard EB and the downstream loads in order to remove panel CDP and connect new UPS-2 feeders.

Blackout: In the event of an utility outage during the activity, the work shall continue as the building is being carried under the generator plant in a controlled condition.



Detailed Technical Method of Procedure
Isolation of Switchboard EB

Risk Assessment Summary				
Floor	Tenant	Building Level Impact	Risk Level	Duration (hrs)
Full Building	All	Isolation of Switchboard EB. The Blue Side loads will be carried by UPS-1 while UPS-2 is isolated. Momentary loss of emergency power identical to monthly generator testing.	High	4.5
Floor	Tenant	Floor Level Impact	Risk Level	Duration (hrs)
9th	T.P.S.	Loss of B feed at critical load TPS Radio Equipment Room.	High	4.5
8th	Paramedics	No stakeholder specific impacts.	N/A	0
	T.P.S. - COMM	No stakeholder specific impacts.	N/A	0
7th	T.P.S - I&T	Loss of B feed at critical load TPS TRIP Room.	High	4.5
	Paramedics			
	T.F.S - I&T			
6th	O.E.M.	No stakeholder specific impacts.	N/A	0
	T.F.S.	No stakeholder specific impacts.	N/A	0
5th	COT - Transportation	No stakeholder specific impacts.	N/A	0
4th	Paramedics	No stakeholder specific impacts.	N/A	0
3rd	COT - I&T	No stakeholder specific impacts.	N/A	0
2nd	COT - I&T	No stakeholder specific impacts.	N/A	0
1st	COT - I&T	No stakeholder specific impacts.	N/A	0
	COT - Security	No stakeholder specific impacts.	N/A	0
	Trans - RLC	No stakeholder specific impacts.	N/A	0
Basement	COT - I&T	No stakeholder specific impacts.	N/A	0
	COT - FM	No stakeholder specific impacts.	N/A	0

Low Risk - minimal to no impact to critical system redundancy
Medium Risk - work that has an impact to system redundancy (typical to normal maintenance)
High Risk - work that has an impact to system redundancy (above normal maintenance, e.g. loss of A or B feed at critical load, or limited cooling capacity)



Detailed Technical Method of Procedure
Isolation of Switchboard EB

Emergency Contacts				
Company	Title		Phone	Email
-	Construction Manager			
-	Project Manager			
-	Mechanical Foreman			
-	Project Foreman			
-	Mechanical Project Manager			
COT - FM	Project Manager			
COT - FM	Construction Coordinator			
COT - Site Operations	Operations Supervisor			
COT - Site Operations	Electrician			
-	Project Lead			
-	Electrical Enginner, E.I.T.			
-	Mechanical Lead			
-	Mechanical Engineer			
COT - FM				
COT - I&T				
COT - I&T				
COT - I&T				
COT - OEM				
COT - OEM				
COT - Transportations				
COT - Transportations				
COT - Security				
Paramedics				
T.F.S				
T.F.S				
T.P.S.				
T.P.S.				
T.P.S.				
T.P.S.				
T.P.S.				
T.P.S.				
Technician				
Technician				
Technician				
Technician				



Detailed Technical Method of Procedure
Isolation of Switchboard EB

Step	Description	Action By	Verified
0.0	Preliminary Steps		
0.01	At Switchboard 'EC' Blue Side, adjust the tie breaker settings and perform secondary injection.	FS	
0.02	At 'MTS A/C Riser 1', confirm the MTS is fed from DP-P-EB1.	Ops	
0.03	At 'MTS A/C Riser 2', confirm the MTS is fed from DP-P-EB1.	Ops	
0.04	At 'MTS-P-E1', confirm the MTS is fed from DP-P-EB1.	Ops	
0.05	At 'MCC-1EA', confirm the MCC is fed from Switchboard 'EA'.	Ops	
0.06	At 'MCC-2EA', confirm the MCC is fed from Switchboard 'EA'.	Ops	
0.07	At 'DP-P-EB5', confirm the panel is fed from Switchboard 'EA'.	Ops	
0.08	Confirm the building is being supported by Chiller 1 and Chiller 2.	Ops	
0.09	Confirm all UPSs are online with no alarms.	-	
0.10	Review generator fuel levels and confirm there are no alarms.	Ops	
0.11	Confirm PPE is prepared. Proper PPE must be worn for every switching steps and when confirming 0 voltage.	Ops	
0.12	Operations to notify security and the stakeholders that the work is about to begin.	Ops	

Step	Description	Duration	Start	End	Actual End	Action By	Verified
1.0	Start Generator Plant						
1.01	At Switchboard 'EA', turn the 'SELECT EMERGENCY AS PREFERRED SOURCE' switch.	1 min	7:00	7:01		-	-
1.02	At Switchboard 'EA', verify 'LOAD CONNECTED TO EMERGENCY' light is on.	1 min	7:01	7:02		-	-
1.03	At Switchboard 'EB', turn the 'SELECT EMERGENCY AS PREFERRED SOURCE' switch.	1 min	7:02	7:03		-	-
1.04	At Switchboard 'EB', verify 'LOAD CONNECTED TO EMERGENCY' light is on.	1 min	7:03	7:04		-	-
Step Sign Off (Initial):							-
Contingency Plan/Comments:							
2.0	Transfer Switchboard EC Blue side loads to Red side						
2.01	At UPS-1, confirm module is online with no alarms. Record load.	1 min	7:04	7:05		-	-
2.02	At UPS-2, confirm module is online with no alarms. Record load.	1 min	7:05	7:06		-	-
2.03	At UPS-1, turn the System Mode key to the 'BYPASS' position for three seconds.	1 min	7:06	7:07		-	-
2.04	At UPS-1, confirm the UPS is on Static Bypass.	1 min	7:07	7:08		-	-
2.05	At UPS-2, turn the System Mode key to the 'BYPASS' position for three seconds.	1 min	7:08	7:09		-	-
2.06	At UPS-2, confirm the UPS is on Static Bypass.	1 min	7:09	7:10		-	-
2.07	Obtain 2 Kirk Keys #17096 from key cabinet, insert into breakers 'EC-T1' and 'EC-T2' of Switchboard 'EC'.	1 min	7:10	7:11		-	-
2.08	At Switchboard 'EC', CLOSE breaker 'EC-T1'.	1 min	7:11	7:12		-	-
2.09	At Switchboard 'EC', remove the panel cover wearing proper PPE. At the tie breaker labelled 'EC-T2', test the following voltages: Phase A Line Terminal to Phase A Load Terminal (confirm voltage is less than +/-5V). Phase B Line Terminal to Phase B Load Terminal (confirm voltage is less than +/-5V). Phase C Line Terminal to Phase C Load Terminal (confirm voltage is less than +/-5V)	1 min	7:12	7:13		-	-
2.10	At Switchboard 'EC', CLOSE breaker 'EC-T2'.	1 min	7:13	7:14		-	-
2.11	At Switchboard 'EC', OPEN main breaker 'EC-A', remove Kirk Key and secure it.	1 min	7:14	7:15		-	-
2.12	At UPS-1, confirm the UPS is carrying all of the EC loads.	1 min	7:15	7:16		-	-
2.13	At UPS-1, turn the System Mode key to the 'NORMAL' position for three seconds.	1 min	7:16	7:17		-	-
2.14	At UPS-1, confirm module is online with no alarms. Record load.	1 min	7:17	7:18		-	-



	2.15	At UPS-2, shutdown the UPS.	1 min	7:18	7:19		-	-		-	
	2.16	At HMI, OPEN Switchboard 'EB' cell EB-4b breaker 'UPS-2 Input'.	1 min	7:19	7:20		-	-		-	
	2.17	At HMI, OPEN Switchboard 'EB' cell EB-2c breaker 'UPS-2 Bypass'.	1 min	7:20	7:21		-	-		-	
Step Sign Off (Initial):							-				
Contingency Plan/Comments:											
3.0 Isolation of UPS-P-4 Loads											
	3.01	At 'PP-9-UB1', OPEN all feeder breakers. (record the ones originally open)	1 min	7:21	7:22		-	-		-	
	3.02	At 'PP-7-UB1', OPEN all feeder breakers. (record the ones originally open)	1 min	7:22	7:23		-	-		-	
	3.03	Operations to return to 'PP-7-UB1' while all other loads are isolated and disconnect TP-UPS Panel 1 temporary feeders.	0 min	7:23	7:23		-	-		-	
	3.04	Verify with the associated stakeholders that all equipment are running satisfactorily.	1 min	7:23	7:24		-	-		-	
Step Sign Off (Initial):							-				
Contingency Plan/Comments:											
4.0 Isolation of UPS-P-4											
	4.01	At 'UPS-P-3', verify there is no alarm.	1 min	7:24	7:25		-	-		-	
	4.02	At 'UPS-P-4', verify there is no alarm and no load.	1 min	7:25	7:26		-	-		-	
	4.03	At 'UPS-P-4', shutdown UPS-P-4 module.	1 min	7:26	7:27		-	-		-	
Step Sign Off (Initial):							-				
Contingency Plan/Comments:											
5.0 Isolation of DP-P-EB4											
	5.01	At 'DP-P-EB4', OPEN breaker 'AC-PH-1'.	1 min	7:27	7:28		-	-		-	
	5.02	At 'DP-P-EB4', OPEN breaker 'UPS-P-4 Module'.	1 min	7:28	7:29		-	-		-	
	5.03	At 'DP-P-EB4', OPEN breaker 'UPS-P-4 Bypass'.	1 min	7:29	7:30		-	-		-	
	5.04	At BAS control system, acknowledge alarms and confirm system is running satisfactorily.	1 min	7:30	7:31		-	-		-	
Step Sign Off (Initial):							-				
Contingency Plan/Comments:											
6.0 Isolation of DP-P-EB2											
	6.01	At 'DP-P-EB2', OPEN breaker 'MTS-P-E1'.	1 min	7:31	7:32		-	-		-	
	6.02	At 'DP-P-EB2', OPEN breaker 'TX-P-B2'.	1 min	7:32	7:33		-	-		-	
	6.03	At 'DP-P-EB2', OPEN breaker 'MTS-A/C RISER 1'.	1 min	7:33	7:34		-	-		-	
	6.04	At 'DP-P-EB2', OPEN breaker 'MTS-A/C RISER 2'.	1 min	7:34	7:35		-	-		-	
	6.05	At 'DP-P-EB2', OPEN breaker 'DP-P-EM'.	1 min	7:35	7:36		-	-		-	
	6.06	At 'DP-P-EB2', confirm the 3 spare breakers are OPEN.	1 min	7:36	7:37		-	-		-	
	6.07	At HMI, OPEN Switchboard 'EB' cell EB-6c breaker 'DP-P-EB2'.	1 min	7:37	7:38		-	-		-	
Step Sign Off (Initial):							-				
Contingency Plan/Comments:											
7.0 Isolate Switchboard EB											
	7.01	At Switchboard 'EB', insert key and enable MAINTENANCE MODE.	1 min	7:38	7:39		-	-		-	
	7.02	At Switchboard 'C', OPEN, rack out and lock off breaker 'C-8 SWBD EB'.	1 min	7:39	7:40		-	-		-	
	7.03	At Switchboard 'EG-B', OPEN, rack out and lock off breaker 'EG-B-4b SWBD EB'.	1 min	7:40	7:41		-	-		-	
Step Sign Off (Initial):							-				
Contingency Plan/Comments:											
8.0 Disconnect Panel CDP and Connect New Feeders											
	8.01	At Switchboard 'EB', confirm 0 voltage.	1 min	7:41	7:42		-	-		-	
	8.02	At Switchboard 'EC', main breaker 'EC-A', adjust trip settings and perform secondary injection.	0 min	7:42	7:42		-	-		-	
	8.03	At Switchboard 'EB' cell EB-4c, disconnect existing panel CDP feeders.	45 min	7:42	8:27		-	-		-	
	8.04	At Switchboard 'EB' cell EB-4c, connect new UPS-2 Input Panel feeders.	120 min	8:27	10:27		-	-		-	
	8.05	At Switchboard 'EB' cell EB-4c, confirm torquing and meggering of new feeders	15 min	10:27	10:42		-	-		-	
Step Sign Off (Initial):							-				
Contingency Plan/Comments:											



9.0 Energize Switchboard EB											
	9.01	At Switchboard 'C', remove lock, rack in and CLOSE breaker 'C-8 SWBD EB'.	1 min	10:42	10:43		-	-		-	
	9.02	At Switchboard 'EG-B', remove lock, rack in and CLOSE breaker 'EG-B-4b SWBD EB'.	1 min	10:43	10:44		-	-		-	
	9.03	At Switchboard 'EB', insert key and enable AUTO MODE.	1 min	10:44	10:45		-	-		-	
Step Sign Off (Initial):								-			
Contingency Plan/Comments:											
10.0 Transfer Switchboard EC back to normal configuration											
	10.01	At HMI, CLOSE Switchboard 'EB' cell EB-4b breaker 'UPS-2 Input'.	1 min	10:45	10:46		-	-		-	
	10.02	At HMI, CLOSE Switchboard 'EB' cell EB-2c breaker 'UPS-2 Bypass'.	1 min	10:46	10:47		-	-		-	
	10.03	At UPS-2, startup the UPS.	1 min	10:47	10:48		-	-		-	
	10.04	At UPS-2, confirm module is online with no alarms.	1 min	10:48	10:49		-	-		-	
	10.05	At UPS-2, turn the System Mode key to the 'BYPASS' position for three seconds.	1 min	10:49	10:50		-	-		-	
	10.06	At UPS-2, confirm the UPS is on Static Bypass.	1 min	10:50	10:51		-	-		-	
	10.07	At UPS-1, turn the System Mode key to the 'BYPASS' position for three seconds.	1 min	10:51	10:52		-	-		-	
	10.08	At UPS-1, confirm the UPS is on Static Bypass.	1 min	10:52	10:53		-	-		-	
	10.09	At Switchboard 'EC', insert key and CLOSE main breaker 'EC-A'.	1 min	10:53	10:54		-	-		-	
	10.10	At Switchboard 'EC', OPEN breakers 'EC-T1' and 'EC-T2', remove Kirk Keys #17906.	1 min	10:54	10:55		-	-		-	
	10.11	Return 2 Kirk Keys #17096 to key cabinet.	1 min	10:55	10:56		-	-		-	
	10.12	At UPS-1, turn the System Mode key to the 'NORMAL' position for three seconds.	1 min	10:56	10:57		-	-		-	
	10.13	At UPS-1, confirm module is online with no alarms. Record load.	1 min	10:57	10:58		-	-		-	
	10.14	At UPS-2, turn the System Mode key to the 'NORMAL' position for three seconds.	1 min	10:58	10:59		-	-		-	
	10.15	At UPS-2, confirm module is online with no alarms. Record load.	1 min	10:59	11:00		-	-		-	
Step Sign Off (Initial):								-			
Contingency Plan/Comments:											
11.0 Energize DP-P-EB2											
	11.01	At HMI, CLOSE Switchboard 'EB' cell EB-6c breaker 'DP-P-EB2'.	1 min	11:00	11:01		-	-		-	
	11.02	At 'DP-P-EB2', CLOSE breaker 'MTS-A/C RISER 1'.	1 min	11:01	11:02		-	-		-	
	11.03	At 'DP-P-EB2', CLOSE breaker 'MTS-A/C RISER 2'.	1 min	11:02	11:03		-	-		-	
	11.04	At 'DP-P-EB2', CLOSE breaker 'DP-P-EM'.	1 min	11:03	11:04		-	-		-	
	11.05	At 'DP-P-EB2', CLOSE breaker 'MTS-P-E1'.	1 min	11:04	11:05		-	-		-	
	11.06	At 'DP-P-EB2', CLOSE breaker 'TX-P-B2'.	1 min	11:05	11:06		-	-		-	
	11.07	At 'DP-P-EB2', confirm the 3 spare breakers are left OPEN.	1 min	11:06	11:07		-	-		-	
Step Sign Off (Initial):								-			
Contingency Plan/Comments:											
12.0 Energize DP-P-EB4											
	12.01	At 'DP-P-EB4', CLOSE breaker 'AC-PH-1'.	1 min	11:07	11:08		-	-		-	
	12.02	At 'DP-P-EB4', CLOSE breaker 'UPS-P-4 Module'.	1 min	11:08	11:09		-	-		-	
	12.03	At 'DP-P-EB4', CLOSE breaker 'UPS-P-4 Bypass'.	1 min	11:09	11:10		-	-		-	
	12.04	At BAS control system, confirm system is running satisfactorily.	1 min	11:10	11:11		-	-		-	
Step Sign Off (Initial):								-			
Contingency Plan/Comments:											
13.0 Energize UPS-P-4											
	13.01	At 'UPS-P-4', startup UPS-P-4 module.	1 min	11:11	11:12		-	-		-	
	13.02	At 'UPS-P-3', verify there is no alarm.	1 min	11:12	11:13		-	-		-	
	13.03	At 'UPS-P-4', verify there is no alarm.	1 min	11:13	11:14		-	-		-	
Step Sign Off (Initial):								-			
Contingency Plan/Comments:											



Detailed Technical Method of Procedure

Isolation of Switchboard EB

14.0		Energize UPS-P-4 Loads									
	14.01	At 'PP-9-UB1', CLOSE all feeder breakers. (keep the ones originally open OPENED, see step 2)	1 min	11:14	11:15		-	-		-	
	14.02	At 'PP-7-UB1', CLOSE all feeder breakers. (keep the ones originally open OPENED, see step 2)	1 min	11:15	11:16		-	-		-	
	14.03	Verify with the associated stakeholders that all equipment are running satisfactorily.	1 min	11:16	11:17		-	-		-	
Step Sign Off (Initial):								-			
15.0		Shutdown Generator Plant									
	15.01	At Switchboard 'EA', turn the 'SELECT NORMAL AS PREFERRED SOURCE' switch.	1 min	11:17	11:18		-	-		-	
	15.02	At Switchboard 'EA', verify 'LOAD CONNECTED TO NORMAL' light is on.	1 min	11:18	11:19		-	-		-	
	15.03	At Switchboard 'EB', turn the 'SELECT NORMAL AS PREFERRED SOURCE' switch.	1 min	11:19	11:20		-	-		-	
	15.03	At Switchboard 'EB', turn the 'SELECT NORMAL AS PREFERRED SOURCE' switch.	1 min	11:19	11:20		-	-		-	
	15.04	At Switchboard 'EB', verify 'LOAD CONNECTED TO NORMAL' light is on.	1 min	11:20	11:21		-	-		-	
	15.05	Wait for generator cool down period.	5 min	11:21	11:26		-	-		-	
Step Sign Off (Initial):								-			
16.0		Closeout									
	16.01	Confirm building is back in normal conditions and no alarms.	3 min	11:26	11:29		-	-		-	
	16.02	Operations to notify security and the stakeholders that the work is completed.	1 min	11:29	11:30		-	-		-	
Step Sign Off (Initial):								-			
End of Technical Portion of the MOP											

City of Toronto

New Asset & Equipment PM Details Form

Automatic from Column F

[illegible]

[illegible]

[illegible]

[illegible]

Recommended PM TAG List Canada/U.S	
Equipment Code	Equipment Type
ACU	Air Conditioning Unit
AHU	Air Handling Unit
AMS	Alarm Monitoring System
ATS	Automatic Transfer Switch
BAS	Building Automation System
BAT	Batteries
BFP	Back Flow Preventor
BOI	Boiler
CDH	Cabinet Display Heated
CHLR	Chiller
CO/NO	CO/NO Detection Systems
CND	Condensing Unit
CT	Cooling Tower
DST	Diesel Storage Tank
ELEV	Elevator
EVP	Evaporator Unit
EXH	Exhaust Fans
EXTL	Exit Lighting
FAS	Fire Alarm System
FSS	Fire Suppression System
GEN	Emergency Generator
GHTR	Gas Heater
HP	Heat Pump
HCAB	Heated Cabinets/Warmers
HEX	Heat Exchangers
HWH	Hot Water Heater
REFRI	Refrigeration/Brine System
RHS	Ramp Heating System
RTU	Roof Top Unit
ROOF	Roofing System
SS	Split System
SUP	Sump Pump
SURPS	Suppression System
SWG	Switch Gear
UPS	Uninterruptible Power Supply
WTRT	Water Treatment System

1 General

1.1 **GENERAL**

- .1 This Section is intended to provide basic identification of the Work, for the Contractor (Manufacturer) to determine upfront, the nature of the Work involved in this Contract. In no way shall this section be interpreted as being a full representation of the Work of this Contract.
- .2 It is the Contractor's (Manufacturer's) sole responsibility to examine the Commercial Documents, Specifications and Drawings issued to establish/determine total scope of Work.

1.2 **PROJECT DESCRIPTION**

- .1 The City of Toronto is undertaking upgrades to convert Buildings 8 and 9 at 1116 King Street West into a fully functional fleet maintenance facility for Toronto Paramedic Services. The project includes comprehensive interior and structural renovations, installation of mechanical and electrical systems such as HVAC, vehicle exhaust, hoists, and air compressors, as well as accessibility improvements in compliance with AODA and sustainability measures aligned with the City's Transform TO Net Zero Strategy. Work will be delivered in phases, beginning with site investigation and schematic design, followed by detailed design and tender preparation, and concluding with construction and commissioning, ensuring critical upgrades are completed before FIFA 2026 and remaining enhancements finalized thereafter.

1.3 **PROJECT PHASING**

- .1 The Contractor shall coordinate the stages of Work to accommodate Project requirements during construction; and the sequence and direction of execution to meet Project schedule. The work is split into 2 parts:
 - .1 Part I: Pre-FIFA – Period starting from PO issuance date until May 15, 2026, which will include:
 - .1 Slab/excavation/fill for Building 8
 - .2 Slab/excavation/fill for Building 9
 - .3 All mechanical embedded items (slab/floor and walls) in Building 8 – Level 1
 - .4 All mechanical embedded items (slab/floor and walls) in Building 9 – Level 1
 - .5 Hoists (Building 9)
 - .6 Air compressors (both buildings)
 - .7 Washrooms (both buildings)
 - .8 Vehicle exhaust system (both buildings)
 - .2 Part II: Post-FIFA: Remaining works, starting August 2026 onwards.

1.4 **PROJECT OVERVIEW**

- .1 The Contract comprises the building modifications Work which consists of, but is not limited to, the following:
 - .1 Localized removal and reinstatement of damaged asphalt surface at the west face of the building 8
 - .2 Line markings for parking spaces including relevant signage for accessible parking
 - .3 Cleanup and removal of items as indicated within the building to prepare for new works
 - .4 Construction of new interior partitions and ceilings (lids)
 - .5 Provision and installation of new doors, O/H doors and windows
 - .6 New door hardware and paint for existing doors
 - .7 Installation of new guardrails, wall rails and tactile indicators for stairs A and B
 - .8 New millwork for 1st floor lunch room and 2nd floor kitchenette
 - .9 Renovation of first floor washrooms with new finishes (floor, ceiling, walls), new fixtures and accessories
 - .10 Modifications to the water closet stalls in 2nd floor washroom including new fixtures and accessories
 - .11 Provision and installation of vehicle hoists as indicated
 - .12 Provision and installation of alignment rack as indicated
 - .13 Coordination and installation of furniture and fixtures as indicated
 - .14 Interior paint
 - .15 Provision and installation of wayfinding signage
 - .16 Construction of new ground floor slab
 - .17 Addition of structural steel and metal decks for interior rooms
 - .18 Addition of new block walls for interior rooms
 - .19 Exterior wall openings
 - .20 Wood joists reinforcing at roof openings
 - .21 Fire alarm system
 - .22 Plumbing and drainage including:
 - .1 Storm and sanitary drainage systems
 - .2 Potable hot and cold water piping
 - .3 Plumbing fixtures
 - .4 Electric storage water heater

- .5 Oil interceptor
- .6 Sump pump
- .23 Heating, ventilating and air conditioning systems
- .24 Performance testing and balancing of air and water systems
- .25 Mechanical thermal insulation
- .26 Power distribution
- .27 Grounding
- .28 Lighting
- .29 Security system
- .30 Communications
- .31 Empty conduit system and outlets for data

End of Section

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1 General

1.1 **GENERAL**

- .1 Provide Work of this section in accordance with the Contract Documents.
- .2 This section applies on projects where commissioning is performed by the General Contractor.

1.2 **DESCRIPTION**

- .1 The commissioning process provides the Owner of the facility with a high level of assurance that the systems to be commissioned, 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 Design Consultants or Installing Contractors 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 Design Consultant and the Installation Contractor to the Owner.
- .3 The General Contractor has primary responsibilities for coordinating all commissioning activities with the Consultant, Subcontractors, manufacturers and equipment Suppliers.
- .4 The Consultant will witness and confirm that all startup commissioning and training are in general conformance with the Contract Documents.

1.3 **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
 - .4 Part 4: Operator Training

1.4 **SUBSTANTIAL COMPLETION**

- .1 Substantial Completion of the trades 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 months minimum after Substantial Completion, based on seasonal conditions required to obtain test load conditions.

1.5 **ROLES AND RESPONSIBILITIES**

- .1 Owner
 - .1 Assign maintenance and operations personnel and schedule them to participate in meetings, witnessing of demonstrations, and training.
 - .2 Designate a person(s) as an authorized acceptance authority, to sign-off and accept test reports.

- .3 Authorize the use of Owner's utilities for the commissioning process.
- .2 General Contractor
 - .1 Responsibility: primary point of responsibility to inform the Owner on the status, integration, and performance of the systems within the facility. Lead the coordination and scheduling of installation Work and commissioning Work. Ensure deficiencies are corrected.
 - .2 Scheduling: develop a coordinated commissioning schedule, including the scheduling requirements from the trade contractors conducting the commissioning. Coordinate Owner's commissioning personnel to be available at appropriate times for witnessing of tests.
 - .3 Information: collate and disseminate information to all construction team parties, including progress reports, meeting minutes, etc.
 - .4 Observation of tests: observe testing of installation and equipment and make recommendations for acceptance.
 - .5 Documentation of tests: document results of tests directly or ensure documentation is completed by trade contractors. Provide template format for tests to applicable trade contractors.
 - .6 Acceptance: determine and advise the Owner of the date of acceptance for each system and sub-system for start of the Warranty Period.
 - .7 Coordinate the Commissioning Plan with Consultant's Commissioning Agent.
- .3 Acceptance Authority
 - .1 Witness demonstration tests of equipment and systems, and have the authority to sign-off on the test forms to accept the test results.
 - .2 Coordinate and schedule additional operations and maintenance personnel to witness the test if required.
- .4 Consultant and Consultant's Commissioning Agent
 - .1 Conduct periodic construction site 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 and participate in the systems training sessions. Provide hand-out literature to be reviewed by operations personnel as part of these 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 Installation Contractors.
 - .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.
- .5 Installation Contractor
 - .1 Include requirements for submittal data, start-up and testing, O&M data, and training in each Purchase Order or Subcontract written.
 - .2 Ensure cooperation and participation of Subcontractors.
 - .3 Ensure participation of major equipment manufacturers in appropriate training and testing activities. Provide and pay for power, fuel, oil and all other necessities to perform testing and commissioning. Provide qualified personnel for video recording and editing of training sessions.
 - .4 Attend construction/commissioning coordination meetings scheduled by the General Contractor.
 - .5 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, for integration into the master commissioning schedule prepared by the General Contractor.
 - .6 Provide detailed schedule and notification to the General Contractor for upcoming tests, a minimum of two weeks before the anticipated test date.
 - .7 Conduct system orientation and inspection at the equipment placement completion stage. Do not make connections to equipment until acceptance has been given by the Owner.
 - .8 Participate in, and schedule Vendors and Subcontractors to participate in the training sessions.
 - .9 Gather O&M Manuals and data on all equipment, and assemble in binders as specified.
 - .10 Shop Drawings which are to be included in the O&M Manuals, which are marked as "Reviewed" (or similar) by the Consultant or Owner, are to be marked on the front page as "ISSUED FOR MANUALS".
 - .11 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 Owner, are to be revised by the manufacturer to incorporate comments and marked on the front page as "REVISED FOR MANUALS".
 - .12 Shop Drawings which are marked as "Revised and Resubmit" (or similar) shall not be included in the O&M Manuals.
 - .13 Provide a final commissioning report as described below.
- .6 Equipment Suppliers and Miscellaneous Contractors
 - .1 Provide submittals and appropriate O&M Manuals.
 - .2 Attend initial commissioning coordination meetings scheduled by the General Contractor.
 - .3 Participate in training sessions as scheduled by the Installation Contractor.

- .4 Demonstrate performance of equipment as applicable. This includes in-season and out-of season testing depending on time of year of Substantial Completion.
- .5 Provide written and signed start-up reports and submit to the Installation Contractor.

2 Products

2.1 **GENERAL**

- .1 Refer to commissioning Specifications for affected division of the Work.

3 Execution

3.1 **COMMISSIONING PLAN AND SCHEDULE**

- .1 The General Contractor shall coordinate, develop and submit an integrated construction and commissioning schedule. Commissioning schedule and commissioning activities are to be coordinated with the Consultant and the Consultant's Commissioning Agent. Any additional site visits required by the Consultant and/or Consultant's Commissioning Agent resulting from incomplete work or corrections regarding commissioning shall be paid for by the General Contractor.
- .2 The Consultant and the Consultant's Commissioning Agent will provide a Commissioning Plan for the Contractor's use and coordination. Installation Contractors shall assist in the development and coordination of the overall commissioning schedule and plan.
 - .1 Commissioning Plan checklists and inputs for installers and sub-contractors may be hardcopy, software, app, or browser based.
 - .1 Login information for General Contractor and sub-contractors will be provided as needed.

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 Owner 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.

- .4 As a result of initial testing results, testing plans and procedures may need to be adjusted to suit

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, Section 01 10 00 General Requirements, and the General Contract requirements.
- .2 Submit the O&M Manuals for review at least two 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 The General Contractor shall coordinate with the Owner and the Installation Contractor to schedule each training session.
 - .2 The Installation Contractor shall schedule training sessions with their Sub-contractors and equipment manufacturer service representatives.
- .2 Training is to be conducted in a classroom setting with the appropriate system schematics, handouts, and any audio/visual training aids on-site with the equipment. Video record the training sessions in full and submit two USB flash drives to the Design Consultant for turning over to the Owner.
- .3 The Consultant will assist the Installation Contractor with the development of training hand-outs, and in conducting training sessions with regards to system operation.
- .4 Equipment Vendors shall provide training on the specifics of each major equipment item including design intent, troubleshooting, and repair techniques.
- .5 Refer to the technical sections for specific commissioning requirements and Commissioning Plan for training details.

3.5 **RECORD DRAWINGS**

- .1 The Installation Contractor shall maintain and provide As-Built Drawings in accordance with the General Conditions of the Contract.
- .2 The General Contractor and Design 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 Commissioning Authority and the Owner, and will include but not be limited to the following:
 - .1 Demonstration and acceptance of systems in full automatic control.
 - .2 All I/O points individually verified for proper function, calibration, and operation. The General Contractor 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.
 - .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 Installation 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 acceptance authority prevents the safe operation of the equipment or system, the test shall be abandoned. The Installation Contractor shall then correct the deficiency and reschedule the test(s).

3.7 **DEFICIENCY REVIEW AND REMEDIATION**

- .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 Contractor shall correct, remedy, mitigate, or otherwise make good any and all deficient work immediately.

3.8 **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.

3.9 **EXCLUSIONS**

- .1 Responsibility for Construction Means and Methods
 - .1 The Installation 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 Owner. Once accepted by the Owner, the Owner may require the Installation Contractor to maintain and operate the system until such time as the Owner is prepared to operate the facility, and such Work will be paid for by the Owner as a separate Contract.

.2 Hands-On Work

- .1 The Installation 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 General Contractor shall coordinate and observe these procedures (and may make minor adjustments as necessary).

End of Section

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1 General

1.1 **SECTION INCLUDES**

.1 Items to be submitted for review

- .1 Shop Drawings
- .2 Samples
- .3 Operating and Maintenance Manuals
- .4 "As-Built" Drawings
- .5 Certificates and transcripts
- .6 Progress photographs

.2 Submittals **MUST** be accompanied by "Standard Submittal Form" with all blank spaces filled in. A copy of the form is bound into the Specifications following this section.

.3 Submit with reasonable promptness and in an orderly sequence so as not to cause delay in the Work. Failure to submit in adequate time is not considered sufficient reason for an extension of Contract Time and no claim for an extension by reason of such default will be allowed.

.4 Work affected by the submittal shall not proceed until review is complete.

.5 Contractor shall retain one reviewed and stamped copy of each submission on Site. Only the stamped copies shall be used on the Work.

2 Shop Drawings

2.1 **GENERAL**

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

.2 The Contractor shall arrange for the preparation of clearly identified Shop Drawings as called for by the Contract Documents or as the Consultant may reasonably request.

.3 Prior to submission to the Consultant, the Contractor shall review and stamp all Shop Drawings. By this review the Contractor represents that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data and that he has checked and coordinated each Shop Drawing with the requirements of the Work and of the Contract Documents. The Contractor's review of each Shop Drawing shall be indicated by stamp, date, and signature of a responsible person.

.4 Submittals not stamped, signed, dated and identified as to the specific Contract requirements may be returned without being examined and shall be considered rejected.

.5 The Contractor shall submit Shop Drawings to the Consultant for his review with reasonable promptness and in orderly sequence so as to cause no delay in the Work or in the work of other Contractors. If either the Contractor or the Consultant so requests they shall jointly prepare a schedule fixing the dates for submission and return of Shop Drawings. At the time of submission the Contractor shall notify the Consultant in writing of any deviations in the Shop Drawings from the requirements of the Contract Documents.

- .6 The Consultant will review and return Shop Drawings in accordance with schedule agreed upon, or otherwise with reasonable promptness so as to cause no delay. The Consultant's review will be for conformity to the design concept and for general arrangement only and such review shall not relieve the Contractor of responsibility for errors or omissions in the Shop Drawings or of responsibility for meeting all requirements of the Contract Documents unless a deviation on the Shop Drawings has been approved in writing by the Consultant.
- .7 The Contractor shall make any 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 revisions other than those requested by the Consultant.
- .8 The Contractor shall secure from all his Subcontractors and material Suppliers, uniform size Shop Drawings showing the construction materials, etc., or as required and upon which the respective Bids have been based.
- .9 Shop Drawings shall define the division of responsibility between the trades, and all items shown on the Shop Drawings shall be supplied as part of the Contract unless it is specifically noted that certain items are not part of the Contract.
- .10 Any work done before receiving the Consultant's final review of the Shop Drawings shall be at the Contractor's risk.

2.2 SHOP DRAWINGS IDENTIFICATION

- .1 An electronic stamp will be sized and placed to fit on each Shop Drawing:



<p>The review of this Shop Drawing is solely for the limited purpose of checking general conformance with the general design concept and general arrangement only. This review does not constitute approval or verification of the design inherent in the Shop Drawings, and any omissions or errors therein remain the responsibility of the Contractor. The Contractor remains entirely responsible for complying with the Contract Documents, confirming all field dimensions and site conditions, for information that pertains to fabrication, techniques of construction and installation, and coordination of the Work.</p>			
Reviewed	Reviewed As Noted	Revise & Resubmit	Not Reviewed
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reviewed By:		Date:	

2.3 REPRODUCTION OF ENGINEERING DRAWINGS

- .1 Reproduction of the engineering Drawings, to serve as background or reference for Shop Drawings, will be permitted. Cost of reproduction shall be based on the number of electronic Drawing files as indicated below, and shall be paid for by the Contractor in accordance with rates indicated below. Rates are exclusive of HST. The Consultant will prepare the files by removing logos, seals and other identification or reference to the Owner or Consultant, checking all reference files and removing unnecessary external references, and packaging files for release. Any identification or reference to the Owner or Consultant is to be removed from all Drawings that are used by the Contractor for this Contract. Costs incurred for the reproduction of engineering Drawings shall be paid by the Contractor directly to the Consultant.
- .1 One to ten files: \$1,000.00
- .2 Eleven to twenty files: \$1,900.00

- .3 Twenty-one to fifty files: \$4,500.00
- .4 Fifty-one to one hundred files: \$8,000.00
- .5 More than one hundred files: \$75 rate per file, plus \$500.00 administration fee
- .6 The submission of a copy of the Consultant's Drawings as a Shop Drawing without additional detailed installation, fabrication or Product information added is not an acceptable form of submittal and is grounds for automatic rejection.
- .2 Prior to the release of digital or electronic files, the Consultant will issue to the Contractor the Digital Transfer Agreement form attached to the end of this section.
 - .1 The Contractor shall review and return to the Consultant an electronic copy of the agreement with the Contractor's signature.
 - .2 By this review and signing of the agreement, the Contractor has acknowledged and agreed to the terms contained within the Digital Transfer Agreement.
 - .3 The Consultant will not release digital files to the Contractor until the agreement is signed and executed. The Consultant will retain an executed copy of the Digital Transfer Agreement.

2.4 SUBMITTAL SYSTEM - GENERAL

- .1 Submit Portable Data Files (PDF's) of fully detailed and dimensioned Shop Drawings of the Work.
- .2 Shop Drawings will be returned to the Contractor stamped and marked "REVIEWED", or "REVIEWED AS NOTED", or "REVISE & RESUBMIT" or "NOT REVIEWED". These stamps are defined as follows:

Stamp	Meaning
REVIEWED	Drawings reviewed without comments. Proceed with construction
REVIEWED AS NOTED	Incorporate corrections or comments and proceed with construction. No other alterations are to be made to the Drawings by the Contractor subsequent to receipt of Drawings stamped and marked as above. If further changes are made in addition to the Consultant's notations, then the Drawings must be resubmitted for further review.
REVISE & RESUBMIT	Revise Drawing in accordance with corrections or comments and re-submit to the Engineer for further review
NOT REVIEWED	Drawing does not require Engineer's review

- .3 Shop Drawing numbering shall be in numerical sequence beginning with the specification Section number followed by "001". If a revision is submitted it shall be followed up in sequence beginning with ".R1". See below table for example:

Section 02 41 19	Selective Structure Demolition
02 41 19.001	Demolition Plan
02 41 19.001.R1	Demolition Plan
02 41 19.002	Conflict with Buried Fiber Cable

- .4 Coordinate Shop Drawing file sizes with Consultant in advance of submittal. Generally, submit up to 10 megabytes file size only.
- .5 Drawings shall be blackline as much as possible to obtain good resolution when printed.
- .6 Consultant may mark up the Shop Drawings electronically or may print and mark up manually.
- .7 A copy of Shop Drawings with Consultant's comments in colour and shall be emailed back to the Contractor or posted on a File Transfer Protocol (ftp) site or project website, if such site exists. The Consultant will retain on its electronic folder, a PDF copy of Shop Drawings returned to the Contractor. Original marked up hardcopy if applicable will also be retained by the Consultant.

2.5 **SUBMITTAL SYSTEM**

- .1 Shop Drawings shall be submitted in electronic format for obtaining reviews from the Consultant.
- .2 Electronic submittals shall be uploaded by the Contractor in PDF format. Any other format will result in delays in the review of submittals.
- .3 Contractor shall electronically notify various people of each submittal according to a communications plan determined at the beginning of the Work.
- .4 Consultant will apply the review stamp to the submittals and upload a PDF version of the reviewed Drawings complete with comments. Consultant will return submittals and will be named to align as closely as possible.
- .5 Consultant will electronically notify the various parties of a reviewed submittal as determined at the beginning of the Work in the communications plan.
- .6 Contractor shall download "Reviewed" submittal and print out the files in order to obtain the Consultant's review comments.
- .7 Contractor is responsible for opening and checking all documents and shall confirm the following and if there are any discrepancies, the Contractor shall contact the Consultant immediately.
 - .1 That the files contained have been correctly transmitted.
 - .2 That the transmittal sheet accurately lists the files that were sent.
 - .3 That the files match-up with files previously submitted by the Contractor to the Consultant.

2.6 **SUBMITTAL SYSTEM – ACC**

- .1 The Consultant will be utilizing a web based construction contract administration control software such as ACC to manage requests for information, submittal construction communications, and change management documents for the Project.
- .2 The Contractor and requested sub-contractors will be provided with access to this web-based software and project database following Contract award by the Owner.

2.7 INFORMATION REQUIRED

- .1 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information requested in the individual Specification sections or as necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross references to design Drawings and Specifications.
- .2 Where a submittal relates to door schedule(s), submittal **MUST** be cross referenced to the door schedule(s) indicating door number and type. Non-compliance will result in the rejection of Shop Drawing.
- .3 All submittals shall be clearly drawn with CAD or typewritten to be legible.

2.8 ENGINEER'S STAMP AND SIGNATURE

- .1 Shop Drawings of components, apparatus and equipment which are designed by the Contractor shall bear the stamp and signature of an Engineer licensed to practice in the Province of Ontario in accordance with the Ontario Building Code and the Professional Engineer's Act.

2.9 CHANGES

- .1 Adjustments made on Shop Drawings by the Consultant are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to the Consultant prior to proceeding with the Work.
- .2 Make changes in Shop Drawings as the Consultant may require and which are consistent with Contract Documents. When resubmitting, notify the Consultant in writing of any revisions other than those requested by the latter.

2.10 UNITS OF MEASUREMENT

- .1 Shop Drawings shall show weights and dimensions in either metric (S.I. units) or Imperial units, consistent with the Consultant's Drawings and Specifications.

2.11 MISCELLANEOUS

- .1 Fabrication shall not proceed until Drawings have been reviewed, unless other authorization is granted in writing by the Consultant.
- .2 The Contractor and each Subcontractor is expected to operate as an expert in his respective field. The Contractor shall save Owner and Consultant harmless from any defect resulting from failure in this regard including cost of remedial action necessary before or after completion of the Work.
- .3 Drawings shall be prepared specifically for the Work.

2.12 RECORD SUBMISSIONS

- .1 Record purpose submissions for:
 - .1 Piping specialties.
 - .2 Valves.

- .3 Any inspection certificate/report submitted by authorities shall be stamped "FOR RECORD PURPOSES ONLY".
- .4 For each size or model as applicable for equipment, submit two copies or one copy on a USB drive, scanned file copies in Adobe Acrobat Version 9 or later.

2.13 **SUBMISSIONS TO AUTHORITIES HAVING JURISDICTION**

- .1 Contact authorities having jurisdiction over the Place of Work for required list of submissions for their review.
- .2 All detailed design Drawings or other submittals required to be submitted to the authority for approval shall be prepared, submitted, and paid for by the Contractor.

2.14 **BROCHURES**

- .1 Submit two copies of Product data sheets or brochures, or one copy on a USB drive, scanned file copies in Adobe Acrobat Version 9 or later. Data sheets or brochures are for requirements requested in Specification sections and as the Consultant may reasonably request where customized Shop Drawings will not be prepared due to standardized manufacture of Product.
- .2 Brochures or Drawings of standard production equipment shall be for one size or model and include all performance data and characteristic curves for such equipment.
- .3 Wiring diagrams and schematics shall accompany Shop Drawings for all equipment which have electrical controls furnished with the equipment.

3 **Samples**

3.1 **SAMPLES**

- .1 Submit for review all samples as requested in the respective Specification sections. Label samples as to origin and intended use in the Work.
- .2 Deliver samples prepaid to Consultant's business address, unless otherwise approved by Consultant. Large, heavy items such as concrete block samples may be reviewed on site if arranged in advance with the Consultant.
- .3 Notify the Consultant in writing at the time of submission, of deviations in samples from requirements of Contract Documents.
- .4 Adjustments made on samples by the Consultant are not intended to change the Contract Price. If such adjustments affect the value of Work, state such in writing to the Consultant prior to proceeding with the Work.
- .5 Make changes in samples which the Consultant may require consistent with the Contract Documents.

4 **Building, Operating and Maintenance Manuals**

4.1 **BINDERS**

- .1 Binders: Commercial quality, 260 mm x 295 mm; hard covered, jacketed, "D" ring style with 3 rings in size to suit binder thickness.
- .2 Covers: Identify each binder with typed or printed title "Building, Operating and Maintenance Manuals"; list title of Project, Owner, and date of manual submission.

- .3 Organize contents into applicable categories of Work, parallel to Specification sections. When only one volume is required, include a complete index. Where more than one volume is required, include a complete index of all volumes and each succeeding volume shall contain an index of its own contents.
 - .1 Provide tabbed fly leaf for each category of Work, with typed description of Product and major component parts of equipment.
 - .2 Include names, addresses, telephone number and general email address of Contractor with names of responsible parties; schedule of Products and systems, indexed to content of the volume.
 - .3 For each Product or system, list names, addresses, telephone numbers and general email address of Subcontractors and Suppliers who can effect repair or maintenance on equipment, including local source of supplies and replacement parts.
 - .4 Product data: organize to parallel Project Manual breakdown. Mark each sheet to clearly identify specific Products and component parts and data applicable to installation; delete inapplicable information. Supplement Product data to illustrate relationships of component parts of equipment and systems to show control and flow diagrams
 - .5 Typed text information: Provide as required to supplement Product data. Provide logical sequence of instructions for each procedure incorporating manufacturer's instructions.
 - .6 For test information, manufacturer's printed data or typewritten data is required.
 - .7 For Drawings, provide appropriate reinforced binder tabs and bind in with text; fold larger sheets.

4.2 **BUILDING MANUALS**

- .1 For building Products, applied materials and finishes include:
 - .1 Product data with catalogue number, size, composition and colour and texture designations.
 - .2 Maintenance instructions for finished surfaces and materials.
 - .3 Copy of finish hardware and paint schedules.
 - .4 Spare materials for maintenance purposes as listed in various technical sections.
 - .5 Provide information for reordering custom manufactured Products.
- .2 Include instructions for cleaning agents methods and recommended schedule for cleaning and maintenance, include precautionary information against detrimental agents and proper methods.
- .3 Additional requirements: Include as specified in individual Specification sections.

4.3 **OPERATING AND MAINTENANCE MANUALS**

- .1 Manuals are to contain operational information on equipment, cleaning and lubrication schedules e.g. filters, overhaul and adjustment schedules and similar maintenance information. Give equipment function, normal operation characteristics and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

- .2 Instructions shall be in such form and language so as to facilitate the Owner in the proper operation and maintenance of building systems.
- .3 In addition to information specified, include the following:
 - .1 Final Shop Drawings and Product data of equipment.
 - .2 Record Drawings of mechanical and electrical installations.
 - .3 Full description of building systems and operations.
 - .4 Operating procedure: include start up, break-in, and routing normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter and any special operating instructions.
 - .5 Controls and operating sequences; wiring diagram of control panels.
 - .6 Schematic diagram of pneumatic, electrical, oil and/or gas systems.
 - .7 Non-dimensional layout showing locations of all electrical devices on mechanical equipment.
 - .8 Complete parts list of assemblies showing manufacturer's names, addresses, nearest replacement sources and telephone numbers.
 - .9 List of recommended spare parts and quantity of each item to be stocked.
 - .10 Maintenance requirements: include preventative requirements; routine procedures and guide for troubleshooting; disassembly, repair, and reassembly instructions and alignment, balancing and checking instructions.
 - .11 Manufacturer's warranties.
 - .12 Lubricating instructions, list of lubricants and recommended cycle of lubrication.
 - .13 Manufacturer's certified reports.
 - .14 Field testing and commissioning reports.
 - .15 Factory test reports.
 - .16 Sequence of controls operation and control diagrams.
 - .17 Contractor's coordination Drawings with installed colour coded piping diagrams.
 - .18 Original manufacturer's parts list, illustrations, assembly Drawings and diagrams required for maintenance.
 - .19 List of original manufacturer's spare parts, current prices and recommended quantities to be maintained in storage.
 - .20 Additional requirements: Provide as specified in individual Specifications sections.
- .4 Requirements specified apply to component parts of equipment whether they are manufactured by Supplier of equipment or are supplied as a component part of an item of equipment.

4.4 SUBMITTAL OF MANUALS

- .1 Two weeks prior to anticipated date of Substantial Performance, submit to Consultant one hardcopy and one USB drive of completed manuals in final form.
 - .1 Copy will be returned with Consultant's comments.
 - .2 Revise contents of manuals as required prior to final submittal.
 - .3 Submit two copies of revised manuals in final form within 14 days before Substantial Performance.
 - .4 USB shall contain PDF file copies in Adobe Acrobat Version 9 or later version, of all Building, Operating and Maintenance Manuals. Provide a file for each document, with bookmarking reference for each chapter or section in the document.

5 As-Built

5.1 AS-BUILT DRAWINGS

- .1 Provide at own cost, additional sets of Drawing prints for use in maintaining "As-Built" information.
- .2 Prepare and submit As-built Drawings in hard copy format and electronic format. Electronic submission shall in PDF and AutoCAD format using the most recent or immediately prior version.
- .3 Be responsible for creating "As-Built" from field data collected during the course of the Project. Neatly record complete with legible dimensions and notes.
- .4 "As-Built" Drawings are those prepared by the Contractor as it constructs the Project and upon which it documents the actual locations of the building components and changes to the original Contract Documents.
- .5 Field data is defined as information that is not available from the Contract Documents, addenda, Change Orders, or Site instructions. It is of importance that the Contractor record on the "As-Built" all field information relating to concealed conditions.
- .6 "As-Built" information MUST have a high degree of accuracy in all respects.
- .7 Recording must be done on the same day that deviation is made to ensure that important information is not missed from the "As-Built".
- .8 Hand-mark all recording using red ink. "Clouded" method is unacceptable and "As-Built" showing such method will be returned to the Contractor.
- .9 Identify as "Project As-Built Copy". Maintain in good condition; clean, dry and legible, and make available for inspection on Site by Consultant at all times.
- .10 Upon completion of the Work and prior to final inspection, submit a clean and legible copy of "As-Built" Drawings to Consultant.

5.2 PROGRESS PHOTOGRAPHS

- .1 On commencement of the Work and at every two-week interval thereafter, supply the Consultant with minimum twelve digital colour photographs, taken from different views, indicating status and progress of the Work by each section of Work. Indicate date photograph was taken with appropriate description and email to the Consultant or upload to FTP site or project website, where the latter exists.

- .2 The Contractor shall submit monthly photographic site review reports.
- .3 Maintain a binder on site with 4 x 6 photographs for easy reference.

End of Section

Digital Transfer Agreement

This Digital Transfer Agreement (the “**Agreement**”) is made as of **[Month, Day, Year]**, between **[Insert Client Name]** and **[Insert correct Arcadis entity legal name]** as provided below:

**[Insert Recipient Name
Office Address
City, Province/State, Country
Postal/ZIP Code]**

and

[Insert correct Arcadis entity name and address.]

the “**Recipient**”

the “**Consultant**”

The Consultant and the Recipient are providing services for the **[insert project name and brief description]** (the “**Project**”). The Recipient and Consultant wish to enter into this Agreement whereby the Consultant will provide digital documents to the Recipient to assist the Recipient in carrying out its Project-related services.

NOW THEREFORE, in consideration for being given access to information that is confidential and proprietary, and for other good and valuable consideration the receipt and sufficiency of which are hereby acknowledged, the parties hereby agree and covenant as follows:

Section 1 – Transfer of Files

- 1.01 The Consultant will, following execution of this Agreement **[and payment to Consultant by the Recipient of \$X]**, transfer to the Recipient the digital files listed at *Schedule 1 – Digital Files* (the “**Files**”). By separate amendment executed by both parties hereto, the parties may agree to transfer additional Files to be included in additional schedules in the form attached hereto at Schedule 2.
- 1.02 The Recipient acknowledges and agrees that it:
 - (a) may use the Files, and any portion or component thereof, only for its own use in relation to the Project, and only for the following express purposes:
 - (i) **[background on which to prepare design, shop or other drawings and other submittals]**
 - (ii) **[3D coordination / clash detection / schedule simulation (4D)]**
 - (iii) **[take offs / quantity estimates of specific items (list)]**
 - (iv) **[fabrication / procurement of components]**
 - (v) **[integration with Geographic Information System (GIS) or Asset Management System]**
 - (vi) **[insert other]**
 - (b) may not transfer, forward, sell, trade, distribute, or permit access to, the Files, to any third party, including without limitation Project contractors, subcontractors, consultants and sub consultants, unless the Consultant has expressly agreed to such transfer in writing, it being understood that such agreement will not be forthcoming from the Consultant unless and until such proposed third party has executed a digital transfer agreement similar to the terms contained herein in favour of the Consultant; and
 - (c) may not alter, modify, amend or change in any manner the contents of Files, or separate any content, schedules, materials, wall types or legends which are included as elements within the Files, or in any portion of the Files.

Section 2 – Liability of Consultant and Recipient Indemnity

- 2.01 The parties agree that the Consultant is not responsible for, and does not warrant or guarantee the accuracy, correctness or completeness of, the Files or the data contained therein, including without limitation any reference notes to “as-built” or similar. The Consultant offers no assurances that the information in the Files is reflective of previous contract or as-built conditions, and disclaims all responsibility for the accuracy or use of the data contained within the Files.
- 2.02 The Recipient agrees to verify and check all information contained within the Files and acknowledges it is solely responsible for fully ascertaining all site conditions and measurements relevant to its Project deliverables..
- 2.03 The Recipient agrees to waive any and all actions, claims, demands, proceedings, charges, fines, sanctions, penalties, damages, losses, consequential losses, damages related to loss of use, loss of profit, loss of opportunity, loss income or diminution of property value and the like, and costs and expenses (including legal and other professional fees) of whatsoever nature or kind (together “Claims and Damages”), that the Recipient, the entity procuring the Project and any third party involved in the Project, and each of their respective employees and agents (together “Project Parties”) may suffer, on any theory of liability, whether in contract, strict liability, tort, negligence, or otherwise (as against the Consultant), which arise out of or result from the Recipient’s use of or reliance on the Files or use of or reliance of the Files by the Recipient’s third party recipient, whether or not authorized as permitted hereunder.
- 2.03 The Recipient agrees to indemnify, defend and hold harmless the Consultant, and each of its related and affiliated companies, their officers, directors, unit holders, partners, associates, and employees (together “Consultant Indemnified Parties”) from and against any and all Claims and Damages suffered by any Consultant Indemnified Party, arising out of, in connection with, or result from use of the Files by the Recipient or its representatives.

Section 3 – Consultant Retention of Rights

- 3.01 The Consultant retains all common law, statutory law and other intellectual property rights relating to the Files and the data contained therein, including, but not limited to, title, copyright, industrial design rights and moral rights.
- 3.02 The Recipient hereby assigns to the Consultant all copyrights in all materials produced from the Files and except with the Consultant prior written consent, the Recipient shall not use the Files or any part thereof to produce any materials not expressly required for the Project, including without limitation views, graphics, renderings, physical models or marketing materials, nor may the Recipient use those materials for any purpose other than the Project. If, in its sole discretion, Consultant does consent to any other use, such consent will be conditioned, at a minimum, to the Consultant receiving credit as the producer and (to the extent applicable) copyright holder.

Section 4 – Recipient Acknowledgments

- 4.01 While the Consultant has taken reasonable precaution to ensure that Files are “virus-free”, the Recipient takes full responsibility of assuring that this is the case, and that the Recipient shall have no entitlement to any Claims and Damages connected to damages to its computing systems and/or files in the transfer or use of the Files.
- 4.02 The Recipient acknowledges that:
- (a) the Files provide a representation of then dated design, are not construction documents, nor do the Files reflect construction or contract documents, and that there may be differences

between the Files and any corresponding construction or contract documents, including but not limited to previously prepared construction or contract documents;

- (b) the Files do not represent or confirm specific Project elements, including without limitation those relating to fire and life safety, assembly details, systems, building envelope assemblies or details and the like; and
 - (c) data contained in the Files may change subsequent to the issue of Files to the Recipient due to changes or additions, however the Consultant is under no requirement to advise the Recipient of any such changes or additions and no liability accrues to the Consultant for not advising the Recipient of any changes or additions.
- 4.03 The Recipient shall, at its sole expense, remove all references to the name and logo of the Consultant, the name and logo of any other consultant, and all professional seals, in the use of the Files. Furthermore, the Consultant reserves the right to remove all references to the name and logo of the Consultant, the name and logo of any other consultant, and all professional seals, in the Files provided to the Recipient.
- 4.04 If the Files are provided as linked components, the Recipient takes full responsibility for any 'binding' which may be required by the Recipient. The Recipient acknowledges that in some cases Files are linked because of size constraints, and agrees that file corruption which may be a consequence thereof is at the Recipient's sole cost, risk and expense.

Section 5 – Term and Termination

- 5.01 Unless extended by mutual agreement of the Recipient and the Consultant, this Agreement will terminate on the earliest of: (a) [DATE]; and (b) the date of termination in accordance with this Section 5.
- 5.02 If the Recipient fails to comply with any of the terms or conditions of this Agreement, the Consultant may terminate this Agreement and all rights of the Recipient created herein.
- 5.03 Upon completion of the Project, or upon termination of this Agreement for whatever cause, all rights and privileges granted to the Recipient hereunder will immediately terminate and the Recipient shall immediately return to Consultant, or destroy, the Files and all related copies and materials. The Consultant reserves the right to require a certificate of a Director of the Recipient attesting to the return or destruction of the Files and all related copies and materials.

Section 6 – Confidentiality

- 6.01 Recipient shall not divulge any specific information identified as confidential, communicated to or acquired, or disclosed by the Consultant. No such information shall be used by Recipient on any other project without the written approval of the Consultant. These obligations of confidentiality shall not apply to information which is in the public domain; which is provided to Recipient by a third party without obligation of confidentiality; which is independently developed by Recipient without use of the Consultant's information; or which is required to be disclosed by law or by court order.

Section 7 – Miscellaneous

- 7.01 The express rights and remedies of the parties set out in this Agreement are in addition to and will not limit any other rights and remedies available to the Recipient or the Consultant at law or in equity. Any failure by either party to insist on strict performance and compliance by the other of any term, right or remedy under this Agreement will not be construed as a waiver by such party its right to require strict performance of any such term, right or remedy, and the duties of the party with respect to such contractual performance will continue in full force and effect.

- 7.02 Neither party will transfer, sublet or assign any rights or duties under, or interest in, this Agreement, without the prior written consent of the other party.
- 7.03 If any term, condition or obligation of this Agreement, or the application of any term, condition or obligation to the parties or to any other persons (including firms, partnerships, corporations or any combination), is to any extent held invalid or unenforceable under any applicable legislation or rule of law, such holding will be applied only to that provision(s), with the remainder of this Agreement remaining in full legal force and effect.
- 7.04 The parties agree that this Agreement and legal actions concerning its validity, interpretation and performance will be governed and interpreted in accordance with **[INSERT JURISDICTION OF CONSULTANT ENTITY]**; and it is further agreed by the parties that any legal action arising under this Agreement will be brought in a court of competent jurisdiction in that jurisdiction.
- 7.05 This Agreement constitutes the entire agreement between the Recipient and the Consultant regarding the transfer of Files and cancels and supersedes any prior understandings and agreements, whether written or oral in respect of the same. Except as expressly provided in this Agreement, no other terms, conditions or warranties, express or implied, form a part of this Agreement. Amendments to this Agreement must be in writing and signed by both parties.
- 7.06 Notwithstanding any amendment, completion or termination of this Agreement, all indemnifications in favour of the Consultant will survive and will remain in full legal force and effect.
- 7.07 The Recipient and the Consultant agree to be bound, as are their respective successors, executors, administrators and legal representatives, in respect of all terms, conditions and obligations pursuant to this Agreement.
- 7.08 This Agreement may be signed in counterparts and each such counterpart will constitute an original document and such counterparts, taken together, will constitute one and the same instrument. This Agreement may be executed and delivered by electronic transmission and the Recipient and the Consultant may rely on such electronic signature as though such were an original signature.

This Agreement is executed with effect as of the date set out on the first page of this Agreement.

[Recipient]

Name: _____
Title: _____

Name: _____
Title: _____

[insert correct Arcadis entity legal name]

Name: _____
Title: _____

Name: _____
Title: _____

Schedule 1 – DIGITAL FILES

[NTD: Insert Description of Digital Files including format (use a screen capture to include Name, Date and Size of the files. Extensions should be listed.)]

Schedule 2 – ADDITIONAL DIGITAL FILES

The defined terms used in Schedule 2 have the meaning ascribed to them in the Agreement.

For and in consideration of good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the parties hereto agree that except for the addition of Files as described below, the provisions of Agreement shall remain in full force and effect and the Files described below shall be subject to the terms and conditions of the Agreement in full.

The Consultant will, following execution of this Agreement **[and payment to Consultant by recipient of \$X]**, transfer to the Recipient the digital files listed at *Schedule 2 – Additional Digital Files* (the “Files”). By separate amendment executed by both parties hereto, the parties may agree to transfer additional Files to be included in additional schedules in the form attached hereto at Schedule 2.

[Recipient]

	_____		_____
Name:	_____	Name:	_____
Title:	_____	Title:	_____

[insert correct Arcadis Entity legal name]

	_____		_____
Name:	_____	Name:	_____
Title:	_____	Title:	_____

[NTD: Insert Description of Additional Digital Files including format (use a screen capture to include Name, Date and Size of the files. Extensions should be listed.)]

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**Attachment "A" to Specification Section 01 33 00
Standard Submittal Form**

Page 1

1. Submittal Title:														
2. To:			3. From:			4. Project Title & Location:			5. Submittal Date		6. New Resubmittal <input type="checkbox"/>			
									7. Submittal No.					
						ATTN:			ATTN:			8. Specification Section No:		
11. Contract						12. Project No:				Arcadis/Owner Use Contract No:				
13. Page No.	14. Mfr/Contractor		15. Item I.D.		Description	16. Electronic Copy (Yes) (No)		17. No. of Hard Copies				Date:		
								Print	Cat.	Samp	Other	Received:		
												Action Code #	Dept. File	
18. Contractor's Remarks:						<p>The undersigned certifies that the above submitted items have been reviewed in detail and are correct and in strict conformance with all requirements of the Contract Documents, except as otherwise noted. Note: Approval of items submitted does not relieve Contractor from complying with all requirements of the Contract Documents.</p> <p>Name of Contractor _____</p> <p>Signature _____</p>						Action Codes: Refer to Section 01 33 00 for full text of codes below		
												1. Revise & Resubmit		Revise and resubmit to the Consultant for further review <input type="checkbox"/>
												2. Reviewed as Noted		Incorporate corrections or comments and proceed with construction <input type="checkbox"/>
												3. Reviewed		Drawings reviewed without comments. Proceed with construction <input type="checkbox"/>
Consultant Comment:						Route		Dept.	Ck'd by	Date	Action	Received		
							Civil							
							Arch.							
							Struc.							
							Mech.							
							Elect.							
							I &C							
							Process							
	PM													
Copies to:						Primary Dept. Checker				Review completed on		By Date		
						Control Administrator				Returned to Contractor on				
														Arcadis

Attachment "A" to Specification Section 01 33 00
Standard Submittal Form

Page 2

Instructions for Use of Standard Submittal Form

1. Use an individual copy of this form for each and every required Project submittal.
2. Contractor shall fill in all blank spaces above the "Owner Comment" box and to the left of the "Action Codes", including the following:
 - Box 1 - Indicate generically what is being submitted i.e. "structural steel", "overhead doors", "plumbing fixtures", "wiring diagrams", etc.
 - Box 3 - Contractor's return address
 - Box 5 - Submittal date
 - Box 6 - Indicate "New" or "Resubmittal"
 - Box 7 - Submittal number
 - Box 8 - Specification section number submittal is in response to
 - Box 9 - Indicate if this is a partial submittal by using root number with part number (A5-00-01 – Part A, A5-00-01 – Part B, etc.)
 - Box 10 - Indicate if this is a resubmittal by using original root number with revision number
 - Box 11 - Indicate appropriate Contract name
 - Box 13 - Indicate Specification page number
 - Box 14 - Identify the manufacturer/Vendor/Subcontractor
 - Box 15 - Describe the submitted item
 - Box 16 - Indicate if electronic submittal
 - Box 17 - Indicate the quantity of submittal copies
 - Box 18 - Include appropriate remarks as required and sign the certification
3. The remainder of the submittal form will be completed by the Consultant, and returned to the Contractor with the submittal.

End of Attachment

- 1 Description
 - .1 This section covers Work for protection of environment as applicable to this Project.
 - .2 Provisions of this section supplement requirements of Contract Documents.
- 2 Environmental Practices
 - .1 Implement environmentally sound practices in this Project by incorporating Products that lessen burden on environment in production, use and final disposition. Support implementation of reduction, reuse and recycling strategies and use of environmentally sound Products. Promote use of environmentally responsible packaging practices by reducing and/or eliminating Products with excessive packaging in this Project where these practices do not negatively affect the proper protection of materials from inclement weather, especially water damage.
 - .2 Employ environmentally sound Products which are made, used and disposed of in a manner that significantly reduces harm to environment.
- 3 Surface Drainage and Watercourses
 - .1 Maintain ditches and watercourses for surface water drainage of Site and external properties during construction. Be responsible for damage due to negligence.
 - .2 Incorporate appropriate retention, detention and settling ponds, or similar methods, reviewed by Consultant, to control surface water run-off to adjacent ditches or other watercourses and to prevent oil, sediment or de-icing materials being carried into such ditches and/or watercourses. Tested quality of water discharged to ditches and/or watercourses shall not be of worse quality than that present in ditches and/or watercourses prior to any discharge of Site surface water. Monitor and test discharge water at least weekly and provide copies of test result to Consultant.
 - .3 Locate and protect stockpiles of semi-permanent nature to satisfaction of authorities having jurisdiction to ensure minimum environmental interference.
- 4 Noise Control
 - .1 Adhere to local noise bylaws.
 - .2 Equip vehicles and equipment with efficient noise attenuation devices (mufflers) to minimize noise levels in vicinity of Site.
 - .3 Where necessary place noise attenuation devices (barriers) around stationery pumps and compressors.
- 5 Dust Control
 - .1 Undertake control measures to prevent nuisances due to dust in any phase of construction.
 - .2 Application of calcium chloride shall be kept to a minimum and shall be restricted to vehicle right-of-way. In close proximity to watercourses, frequent application of water is preferred method. Obtain Consultant's approval before chemicals for dust control are used.
 - .3 Transport dusty materials in covered haulage vehicles.
 - .4 Transport wet materials in suitable watertight haulage vehicles.
- 6 Waste Management Practices

- .1 Refer to Section 01 74 19.
- 7 Equipment Fuelling, Maintenance and Storage
 - .1 Obtain Consultant's acceptance of refueling areas.
 - .2 Procedures for interception and rapid clean-up and disposal of fuel spillages shall be submitted to Consultant for review prior to starting Work.
 - .3 Ensure that materials required for clean-up of fuel spillages are readily accessible on Site at all times.
 - .4 Carry out refueling of equipment at acceptable refueling areas.
 - .5 Ensure that water used for cleaning of equipment does not drain into streams, lakes or watercourses. Do not empty fuel, lubricants and/or pesticides into any watercourse, or on ground.
 - .6 Clean Construction Equipment prior to entering public roadways to prevent littering. Debris from cleaning equipment shall not be permitted into storm sewers or watercourses.
 - .7 Store equipment and materials in orderly manner and in location acceptable to Consultant.
- 8 Spills Reporting
 - .1 In event of spill or other emission of pollutant into natural environment, notify:
 - .1 Local office of the Ministry of Environment and MOE Spill Action Centre (SAC).
 - .2 Municipality or regional municipality within boundaries of which spill occurred.
 - .3 Person having control of pollutant, if known, of spill, of circumstances surrounding the spill and of any action taken or intended to be taken.
- 9 Contingency Plan for Control and Clean-Up of Spill
 - .1 Prior to commencing construction, prepare contingency plan for control and clean-up of spills. Contingency plan to include:
 - .1 Names and telephone numbers of persons in local municipalities and MOE to be notified forthwith of spill.
 - .2 Names and telephone numbers of representatives of fire, police and health departments of local municipalities who are responsible for responding to emergency situation.
 - .3 Names and telephone numbers of companies experienced in control and clean-up of hazardous materials that would be called upon in emergency involving spill.
 - .4 Contingency plan shall include provisions for spills of hazardous or unknown materials (i.e. puncturing on unmarked drain during excavation).
 - .5 Proposal for immediate containment and control of spill, clean up procedures to be initiated immediately and any other action to be taken to mitigate potential environmental damage while awaiting additional assistance.
 - .6 Be responsible for preparing, implementing, directing and supervision of contingency plan.

- .2 Ensure immediate availability of Products with which to effect temporary repair to broken pipelines and other services so spill or other emission of pollutant is immediately controlled and stopped and to mitigate damages.
- .3 Submit for Consultant's review copy of contingency plan and make appropriate changes as requested.

End Of Section

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- 1 All equipment shall be guarded and safeguarded in compliance with the Industrial Regulations O.Reg. 851 and shall meet the latest revision of the applicable standard listed in tables 3 and 4 of the Guidelines for Pre-Start Health and Safety Reviews: How to Apply Section 7 of the Regulation for Industrial Establishments (available on the Government of Ontario website).
- 2 For all equipment that triggers a Pre-Start Health and Safety Review (PSR) as outlined in the Guidelines for Pre-Start Health and Safety Reviews: How to Apply Section 7 of the Regulation for Industrial Establishments and as specified in Section 7 of the Industrial Regulations O.Reg. 851, the Contractor shall provide a PSR report. Alternatively, the Contractor shall provide a Letter of Exemption complete with supporting documentation as outlined in the Guidelines and as specified in Section 7 of the Industrial Regulations O.Reg. 851.

End Of Section

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1 PROPOSED EQUIVALENT PRODUCTS

- .1 Whenever a material or article is specified or described by using the name of a proprietary Product or the name of a particular manufacturer or Vendor, the specific item mentioned shall be understood as establishing type, function, dimension, appearance, and quality of Product desired.
- .2 The words "or accepted equal", "or accepted equivalent" and "or accepted alternative" as used in the Specifications are to be regarded as synonymous in meaning, and are applicable to all Specifications unless specifically stated otherwise. Any material, Product, or equipment which will fully perform or meet the service or function and/or aesthetics represented by a specified Product will be considered for acceptance as a "substitution", provided the Contractor submits proof that such material, Product or equipment is of acceptable equivalent substance and function and is accepted by the Owner. The burden of proof of acceptability rests with the Contractor.

2 PROPOSED SUBSTITUTIONS

- .1 Requests for substitutions must be submitted in writing using Section 01 62 01 Substitution Request Form.
- .2 The net cost of proposed substitution, weighed versus the cost of review, will be a factor in the Owner's final decision.
- .3 Contractor is responsible to determine suitability of accepted substitute Products for general construction purposes and scheduling requirements.
- .4 Acceptability of proposed substitutions is at the sole discretion of the Owner. The Owner however, is under no obligation to consider any or all proposed substitutions. Acceptance of substitutions shall in no way be interpreted as a waiver from full compliance with other Specification requirements.
- .5 Contractor shall declare that such substitution will fit within all constraints of the intended location and operating system in the Work without modification, or clearly described and defined modification, to allied specified systems, materials or assemblies.
- .6 Contractor shall save harmless the Owner, Consultant and their Subconsultants from any costs or third party action as a consequence of accepted substitution. Failure to comply with these requirements will result in rejection of the request.

3 NOTIFICATION OF ACCEPTANCE

- .1 Materials and equipment accepted as substitutions will be formally notified to the Contractor by a Change Order, Supplementary Instruction (SI) or Shop Drawings, as the case may be.

End of Section

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Substitution Request Form (SRF) No.: _____ Date: _____

Project: _____

General Contractor: _____ Subcontractor _____

Owner's Authorization: _____ Proceed (per _____)

1

General

- .1 This section applies to proposed substitutions submitted after Contract award.
- .2 Within four weeks of Contract award, the Consultant will receive requests for substitutions from General Contractor for consideration. Proposed substitutions received after the expiration of the specified period will be marked "substitution review expired" and returned to Contractor.
- .3 Copy Owner on all substitution requests. The Owner will forward authorized substitution requests to Consultant by email. Consultant will not proceed with review without Owner's authorization.
- .4 For the Consultant's services in reviewing submittal, pay a fee of \$180.00/hour plus HST, minimum three hours or \$540.00, per proposed substitution.
- .5 Upon receipt of request, the Consultant will assess time required to review. If up to three hours is required, the Consultant will email Contractor and the Contractor will acknowledge by return email, authorizing the Consultant to proceed.
- .6 If the Consultant requires additional time above the three hours, Consultant will email Contractor with proposed additional hours with a proper breakdown for Contractor's consideration. Contractor shall send an email response accepting the proposed budget to authorize Consultant to do the review.
- .7 The Consultant will complete its review and submit a response back to Contractor in a timely manner.
 - .1 If accepted, a Change Order or Supplementary Instruction is issued.
- .8 Whether rejected or accepted, the Consultant will invoice Contractor for the cost of the review, with a copy of the Contractor's email confirmation attached to the invoice.
- .9 The Owner is under no obligation to consider any or all proposed substitutions.
- .10 For substitutions where cost savings are proposed the cost saving amount proposed by the Contractor will be reduced by the cost for the review.
- .11 Contractor shall declare that such substitution will fit within all constraints of the intended location and operating system in the Work without modification, or clearly described and defined modification, to allied specified systems, materials or assemblies. The proposed substitute shall be equal to or superior to the specified item as determined by Consultant.
- .12 Save harmless the Owner, Consultant and their Subconsultants from any costs or third party action as a consequence of accepted substitution. Failure to comply with these requirements will result in rejection of the request.
- .13 Any system, Product or material utilized without acceptance from the Consultant shall be removed from the Work, and replaced with complete installation of those specified without adjustment of Contract Price or Contract Time.

2 Details of Substitution Request

.1 Specified Product

.1 Section Number: _____

.2 Section Title: _____

.3 Paragraph Number: _____

.2 Proposed Substitution

.1 Manufacturer: _____

.2 Trade Name or Model Number: _____

.3 Manufacturer's Address: _____

.4 Contact Person: _____

.5 Phone No.: _____ Email: _____

.3 Product History

.1 ☐ New ☐ 2 to 5 yrs old ☐ 5 to 10 yrs old ☐ more than 10 yrs old

.2 Similar Installations:

.3 Project Name: _____

.4 Address: _____

.5 Consultant: _____

.6 Owner: _____

.7 General Contractor: _____

.4 Proposed Product Affects Other Parts of Work?

.1 ☐ No ☐ Yes

.2 If "Yes", explain:

.5 Differences between proposed substitution and specified Product:

.6 Reason for not providing specified Product (substitution requests are considered under any of the following conditions only. Indicate conditions with a check (✓) mark):

- .1 ☐ Product(s) selected from those specified is/are unavailable.
- .2 ☐ Method(s) specified is/are too intricate.
- .3 ☐ Delivery date of Product(s), selected from those specified would unduly delay completion of Contract.
- .4 ☐ Method(s) specified would unduly delay completion of Contract.
- .5 ☐ Proposed substitute Product(s) or system(s) will result in a meaningful credit to the Contract Price.
- .7 Change to Contract Price
 - .1 Add/Deduct \$ _____ (_____)
- .8 Change to Contract Time
 - .1 Add/Deduct _____ days
- .9 Contractor's Declaration:
 - .1 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.
 - .2 Same warranty will be furnished for proposed substitution as for specified Product.
 - .3 Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
 - .4 Proposed substitution does not affect dimensions and functional clearances.
 - .5 Proposed substitution is compatible with adjacent materials and assemblies.
 - .6 Coordination, installation, and changes in the Work as necessary for accepted substitution will be the responsibility of the Contractor.

Signed By Contractor: _____

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Reports ☐ Other

3

Consultant's Review

- .1 Substitution Accepted - Provide submittals per Specification requirements.
- .2 Substitution Not Accepted.
 - .1 Reason: _____

Signed By Consultant: _____ Date _____

End Of Form

1 General

1.1 **REQUIREMENTS INCLUDED**

- .1 Product quality, availability, storage, handling, protection, handling on Site.
- .2 Manufacturer's instructions.
- .3 Workmanship, coordination, cutting, fastenings.
- .4 Existing facilities.

2 Products

2.1 **QUALITY**

- .1 Products, material, equipment and articles (referred to as Products throughout the Specifications) incorporated in the Work shall be new, not damaged or defective, and of the best quality, compatible with Specifications for the purpose intended.
 - .1 If requested, furnish evidence as to type, source and quality of Products provided.
- .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 expense caused by rejection.
- .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.
- .4 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout the building.
- .5 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms as approved by the Consultant.

2.2 **AVAILABILITY**

- .1 Immediately after award of Contract, review Product delivery requirements and anticipate foreseeable supply delays for any item. 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 sufficient time to prevent delay in performance of Work.
- .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 Consultant reserves the right to substitute more readily available Products of similar character at no increase in Contract Price.
- .3 Utilize Canadian materials and Products if available and equivalent in price and quality.

2.3 **STORAGE, HANDLING AND PROTECTION**

- .1 Handle and store Products in a manner to prevent damage, deterioration and soiling and in accordance with manufacturer's instructions where applicable.
- .2 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging, crating or bundling until required in the Work.

- .3 Store Products subject to damage from the elements, in weatherproof enclosures.
- .4 Store cementitious Products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for mortar or grout materials, clean and dry. Store sand on 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.
- .8 Remove and replace damaged Products at own expense and to the satisfaction of Consultant.

2.4 **RECEIVING MATERIAL FURNISHED BY OWNER**

- .1 Owner furnished material or equipment are listed in the Specifications.
 - .1 Contractor shall be responsible for unloading and handling material or equipment furnished by Owner to the Site.
- .2 Contractor receiving such items shall give receipts for the item delivered and thereafter will be held responsible for the care and storage of such items and shall pay for the cost of replacing or repairing any items damaged, misplaced or found to be missing while in Contractor's care and custody.

2.5 **TRANSPORTATION**

- .1 Pay costs of transportation of Products required in the performance of Work.
- .2 Transportation cost of Products supplied by the Owner and delivered to Site will be paid for by the Owner.
 - .1 Contractor shall unload, handle and store such Products.

2.6 **MANUFACTURER'S INSTRUCTIONS**

- .1 Unless otherwise indicated in the Specifications, install or erect Products in accordance with manufacturer's instructions. Do not rely solely on labels or enclosures provided with Products.
- .2 Obtain written instructions directly from manufacturers.

2.7 **ALTERNATIVE MATERIALS**

- .1 Purchased items or materials must meet the requirements of the Specifications. Be responsible for all costs for any modifications required for use of such items.
- .2 To receive approval of substitution, the proposed substitute shall be equal to or superior to the specified item. Requests for substitution shall be accompanied by documentary proof of equality and difference in price and delivery.
- .3 Submit request to the Consultant in writing and provide all technical data, samples and other information requested. No substitution shall be made without the written authority of the Consultant whose decision shall be final.

- .4 Products shall be applied, installed, connected, erected, cleaned and conditioned in accordance with the manufacturer's instructions or directions, unless specified to the contrary elsewhere in the Contract Documents.
- .5 Assume responsibility for any additional material or installation costs resulting from the approved use of equivalent materials or equipment.

2.8 **EXPEDITING**

- .1 The Contractor shall submit, when requested by Consultant, an updated material procurement/expediting record indicating clearly the status of material delivery and fabrication. Particulars to be covered by this record shall include the item identification, sub-vendor, order date, order number, Shop Drawing submission date(s) and review date(s), required delivery date, promised delivery date, date received, date checked and general remarks.
- .2 The Contractor shall accumulate and submit similar records from (assigned) Subcontractors and shall ensure that Subcontractors are properly and frequently expediting all equipment and material to meet delivery deadlines to suit installation schedule.
- .3 The Contractor shall allow the Owner, Consultant, or their representative free access to the Contractor's plant and to Subcontractor's plants for visual inspection of allotted material and/or progress of the Work.

3 Workmanship

3.1 **GENERAL**

- .1 Workmanship shall be of 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 required results.
- .2 Do not employ any unfit person or anyone unskilled in their required duties. The Consultant reserves the right to require the dismissal from the Site of workers deemed incompetent, careless, insubordinate or otherwise objectionable.
- .3 Decision as to the quality or fitness of workmanship in cases of dispute rests solely with the Consultant whose decision shall be final.
- .4 Whenever possible, give preference to the use of local labour. Establish rates of wages, and hours of work in accordance with provincial regulations and as generally recognized and accepted in the locality.

3.2 **CO-ORDINATION**

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

3.3 **CONCEALMENT**

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

3.4 CUTTING AND REMEDIAL WORK

- .1 Perform cutting and remedial Work required to make the parts of the Work come together.
 - .1 Coordinate the Work to ensure this requirement is maintained.
- .2 Should Work performed outside this Contract necessitate cutting and/or remedial Work to be performed, the cost of such Work will be valued by the Consultant.
- .3 Perform cutting and remedial Work by specialists familiar with the materials affected. Perform in a manner to neither damage nor endanger any portion of Work.

3.5 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent material unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dipped galvanized steel fasteners and anchors for securing exterior Work, unless stainless steel or other material is specifically requested in the affected Specification section.
- .4 Space anchors within their load limit or shear capacity and ensure that they provide positive permanent anchorage. Wood or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

3.6 PROTECTION OF WORK IN PROGRESS

- .1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Consultant, at no increase in Contract Price.
- .2 Prevent overloading of any part of the Work or building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of the Consultant.

3.7 EXISTING UTILITIES

- .1 Connect to existing services or utilities at times directed by Owner or local governing authorities, with a minimum of disturbance to Work, building occupants, pedestrian and vehicular traffic.
- .2 Protect and 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.

End of Section

- 1 General
- 1.1 **DESCRIPTION**
 - .1 This section includes administrative and procedural requirements for construction waste management activities including the following:
 - .1 Salvaging nonhazardous construction waste.
 - .2 Recycling nonhazardous construction waste.
 - .3 Disposing of nonhazardous construction waste.
- 1.2 **DEFINITIONS**
 - .1 CDL: Construction, Demolition and Landclearing.
 - .2 Construction Waste: Building and Site improvement materials and other solid waste resulting from construction operations. Construction waste includes packaging.
 - .3 Disposal: Removal off-site of construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
 - .4 Recycling: The process of sorting, cleaning, treating, and reconstituting materials for the purpose of using the material in the manufacture of a new Product.
- 1.3 **SUBMITTALS**
 - .1 Recycling and processing facility records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
 - .2 Landfill and incinerator disposal records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- 1.4 **QUALITY ASSURANCE**
 - .1 Regulatory requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
 - .2 Surplus materials, removals, grindings and other debris shall be disposed of offsite. No separate payment shall be made for the costs associated with this Work. The Owner will not make arrangements for the disposal of surplus materials or supply bills of lading. Stockpiling of excavated material is not permitted and shall immediately be disposed of upon removal.
- 2 Products
 - Not Used

3 Execution

3.1 **GENERAL**

- .1 Site access and temporary controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - .1 Designate and label specific areas on Project site necessary for separating materials that are to be recycled.
 - .2 Comply with Project requirements for controlling dust and dirt, environmental protection, and noise control.

3.2 **RECYCLING AND CONSTRUCTION WASTE, GENERAL**

- .1 Provide containers for CDL waste that is to be recycled clearly labeled as such with a list of acceptable and unacceptable materials. The list of acceptable materials must be the same as the materials recycled at the receiving material recovery facility or recycling processor.
- .2 Provide containers for CDL waste that is disposed in a landfill clearly labeled as such.
- .3 Use detailed material estimated to reduce risk of unplanned and potentially wasteful cuts.
- .4 Include in material purchasing agreements, a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, the packaging be taken back for reuse or recycling, and to take back all unused product. Ensure that Subcontractors require the same provisions in their purchase agreements.
- .5 Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.
- .6 Recycle paper and beverage containers used by on-site workers.
- .7 Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 - .1 Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin. Inspect containers and bins for contamination and remove contaminated materials if found.
 - .2 Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - .3 Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - .4 Store components off the ground and protect from the weather.
 - .5 Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.3 **RECYCLING CONSTRUCTION WASTE**

.1 Packaging

- .1 Cardboard and boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
- .2 Polystyrene packaging: Separate and bag materials.
- .3 Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
- .4 Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

.2 Wood Materials

- .1 Clean cut-offs of lumber: Grind or chip into small pieces.
- .2 Clean sawdust: Bag sawdust that does not contain painted or treated wood.
- .3 Gypsum board: Stack large clean pieces on wood pallets and store in a dry location.
 - .1 Clean gypsum board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.4 **SOURCE SEPARATION WASTE**

- .1 General: Separate recyclable materials by type from CDL waste.
- .2 Provide containers, clearly labeled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
- .3 Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
- .4 Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
- .5 Store components off the ground and protect from weather.

3.5 **CO-MINGLED RECYCLING**

- .1 General: Do not put CDL waste that will be disposed in a landfill into a co-mingled CDL waste recycling container.

3.6 **DISPOSAL OF WASTE**

- .1 General: Except for items or materials to be recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - .1 Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on-site.
 - .2 Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

- .2 Burning: Do not burn waste materials.
- .3 Disposal: Transport waste materials off Owner's property and legally dispose of them.

End of Section

A Guide to Waste Audits and Waste Reduction Work Plans for Construction & Demolition Projects

A Guide to Waste Audits and Waste Reduction Work Plans For Construction & Demolition Projects

As Required under Ontario Regulation 102/94

Protecting our environment.



You can view and download the regulation titled *Waste Audits and Waste Reduction Work Plans* by going to www.e-laws.gov.on.ca and entering O. Reg. 102/94 into the search box.

Please direct any questions to the Ministry of the Environment's Public Information Centre at the number listed below.

You can download additional copies of this guide from the ministry's web site at www.ene.gov.on.ca/en/publications/forms/index.php#AuditandReduction or obtain hard copies by calling the Public Information Centre:

135 St. Clair Avenue West, 1st floor

Toronto, Ontario M4V 1P5

Tel: 1 (800) 565-4923

(416) 325-4000

Fax: (416) 325-3159

Email: picemail.moe@ontario.ca

Il existe une version française de ce document.

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WMPB

Revised July 2008

PREFACE

This guide will help you understand the requirements of Ontario Regulation 102/94 (O. Reg. 102/94 – Waste Audits and Waste Reduction Work Plans) as it applies to construction and demolition projects.

O. Reg. 102/94 is an integral part of Ontario's efforts to encourage businesses to reduce the amount of waste they produce, to reuse whatever waste they can and to recycle the rest. Businesses need to do this if Ontario is to meet its overall goal of reducing the amount of waste going to disposal.

This guide is intended to help you understand the minimum requirements for conducting waste audits and preparing waste reduction work plans for construction and demolition projects as required under O. Reg. 102/94. The regulation is part of Ontario's 3Rs Regulations (3Rs stand for reduce, reuse and recycle).

- Note that those who are subject to O. Reg. 102/94 must implement a source separation and recycling program in accordance with O. Reg. 103/94. See A Guide to Source Separation of Recyclable Materials for Industrial, Commercial and Institutional Sectors and Multi-Unit Residential Buildings as Required under Ontario Regulation 103/94, which is available from the ministry.

The other guides in the series are:

- A Guide to Source Separation of Recyclable Materials and Leaf and Yard Waste Systems for Municipalities as Required Under Ontario Regulation 101/94
- A Guide to Approvals for Recycling Sites, Leaf and Yard Waste Composting Sites and Compost Use as Required Under Ontario Regulation 101/94
- A Guide to Waste Audits and Waste Reduction Work Plans for Industrial, Commercial and Institutional Sectors as Required under Ontario Regulation 102/94
- A Guide to Source Separation of Recyclable Materials for Industrial, Commercial and Institutional Sectors and Multi-Unit Residential Buildings as Required under Ontario Regulation 103/94
- A Guide to Packaging Audits and Packaging Reduction Work Plans as Required under Ontario Regulation 104/94

Disclaimer: These guides are for informational purposes only and are not intended to provide specific advice or recommendations in any circumstances. Moreover, these guides are not, and should not be construed as, legal advice. Please review Ontario Regulations 101/94, 102/94, 103/94 and 104/94 and, if you have any questions about the application or interpretation of these regulations or have other legal questions, you should consult a lawyer.

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1.0 INTRODUCTION

O. Reg. 102/94 applies to non-hazardous solid wastes from designated industrial, commercial and institutional (IC&I) sources. This guide focuses on the requirements for waste audits and waste reduction work plans specific to construction and demolition projects.

The implementation of waste audits and waste reduction work plans by those construction and demolition projects required to comply with O. Reg. 102/94 will contribute significantly to the efforts to promote the diversion of waste away from landfills and incinerators as the preferred approach to waste management. Construction and demolition (C&D) waste makes up a large component of the non-hazardous solid waste stream. Efforts to divert C&D waste stream, therefore, will have a large potential for reducing the quantity of materials destined for disposal and increasing the quantity put back into productive use.

Section 2.0 of this guide describes the general requirements for conducting the waste audit, preparing the waste reduction work plan and implementing it. Section 3.0 identifies the construction and demolition projects that must implement a waste reduction program and any special provisions that apply to these projects.

The appendices contain additional material to help affected parties meet regulatory requirements. Appendix B contains information on the steps you need to follow and checklists you may use for conducting the waste audit and preparing the waste reduction work plan. Examples of completed forms are also included here.

2.0 GENERAL REQUIREMENTS

This section outlines the general requirements for the steps needed to undertake all components of your waste audit, your waste reduction work plan and the reporting process to document your activities.

Construction and demolition projects must prepare a waste audit and waste reduction work plan before construction work begins at the site.

There are four basic steps to implementing a waste reduction program required under O. Reg. 102/94:

1. Conducting the waste audit
2. Developing the waste reduction work plan
3. Implementing the waste reduction work plan
4. Updating the waste audit and waste reduction work plan

Only certain construction and demolition projects must comply with O. Reg. 102/94 (see Section 3). To comply, the person undertaking the project (e.g., owner) or the person undertaking a project on someone else's behalf (e.g., contractor) must complete a waste audit and waste reduction work plan before construction work begins at the site.

2.1 Conducting Your Waste Audit

A waste audit is essentially a study relating to waste generated by all the normal activities at the site of the construction or demolition project. O. Reg. 102/94 is intended to ensure that a designated C&D waste generator takes a comprehensive approach to the study. The work you will need to complete as part of the waste audit will involve not only measuring the quantity of waste and identifying its composition, but also the manner by which the waste gets produced, including management decisions and policies that relate to the production of waste.

Under O. Reg. 102/94, all waste audits must address:

- The amount, nature and composition of the waste generated in all functional areas of the project
- How the waste is produced, including relevant management decisions and policies
- How the waste is managed

O. Reg. 102/94 requires that the waste audit be completed before construction work begins at the site. This means that a waste audit for a project will need to be done in conjunction with, and based on, other planning activities related to the project.

2.2 Developing Your Waste Reduction Work Plan

The information resulting from the waste audit forms the basis for developing the waste reduction work plan. The waste reduction work plan addresses 3Rs opportunities that you will pursue during the life of the project.

O. Reg. 102/94 requires that all completed waste reduction work plans include all reasonable actions that can be taken to reduce, reuse and recycle waste. These actions must be identified in a step-wise process that follows the 3Rs hierarchy:

- First - Reduce by developing actions that will stop waste from being produced in the first place.
- Next - Reuse any waste materials at your site or donate to others, e.g., a non-profit organization.
- Last - Recycle any waste materials through a recycling company.

The waste reduction work plan must encompass all administrative, warehousing or other ancillary activities or departments located on the same site and associated with the designated project.

The waste reduction work plan must also set out who will implement each part of the plan, when each part will be implemented and what the expected results are.

2.3 Implementing Your Waste Reduction Work Plan

O. Reg. 102/94 requires that a waste reduction work plan be developed before construction work begins at the site. The work plan must explicitly assign responsibilities and identify resources needed for its implementation and give an estimate of the expected results to be achieved. Your work plan may be structured so that some actions are given a higher priority than others. A number of factors may need to be considered to determine which actions will contribute most to meeting waste reduction objectives.

Note that those who are subject to O. Reg. 102/94 must implement a source separation and recycling program in accordance with O. Reg. 103/94. Further details are contained in A Guide to Source Separation of Recyclable Materials for Industrial, Commercial and Institutional Sectors and Multi-Unit Residential Buildings as Required under Ontario Regulation 103/94, which is available from the ministry.

2.4 Documenting Your Waste Reduction Program

A waste audit and waste reduction work plan must be documented in written reports as described below. In some cases, projects may have specific additional reporting requirements as specified in the regulation.

- A waste reduction work plan must set out who will implement each part of the plan, when each part will be implemented and the expected results.
- A report of a waste audit or a waste reduction work plan must be on a form provided by the ministry or another form as long as the same information is contained. Samples of completed forms are found in Appendix B of this guide. Blank forms are included at the end of the guide. The guides are available at:
www.ene.gov.on.ca/en/publications/forms/index.php#AuditandReduction
- The report of the waste audit and the waste reduction work plan must be kept for at least five years after it was prepared.
- The waste reduction work plan or a summary of the work plan must be posted in places where employees will see it. An employee must also be allowed to see the entire plan where a summary of the plan has been posted.
- Note that O. Reg. 102/94 does not require automatic reporting to the ministry. The builder or demolisher subject to O. Reg. 102/94 must submit the most recent waste audit and waste reduction work plan to the Director within seven days of a request by a Director. For the purposes of the 3Rs Regulations, the “Director” is a Ministry of the Environment (MOE) Regional Director, Assistant Regional Director, District Manager, Director Waste Management Policy Branch (WMPB) or Assistant Director WMPB.
- The waste audit for a designated construction project must also address the extent to which materials or products used by the builder consist of recycled or reused materials or products.

3.0 WHO IS AFFECTED?

A project includes the operations normally associated with the construction or demolition of buildings. Types of projects include construction or demolition of residential, commercial, industrial and institutional buildings such as single-family housing, apartments, offices, factories and hospitals. O. Reg. 102/94 does not address renovation projects.

3.1 Construction Projects

The builder of a “construction project” that consists of the construction of one or more buildings with a total floor area of at least 2,000 square metres is subject to O. Reg. 102/94 and must conduct a waste audit covering the waste generated in the construction project. The builder – a person who is undertaking the construction project on their own behalf or on behalf of another – must prepare and implement a waste reduction work plan.

For the purposes of determining when construction begins at the site, the ministry’s position is that construction generally begins at the point foundations for the building(s) are being dug. Where, however, a building is going to be constructed in phases (e.g. one builder constructs the outer shell and another contractor constructs the inner shell), construction for the second phase begins when the builder begins construction on the second phase.

3.2 Demolition Projects

The demolisher of a “demolition project” that consists of the demolition of one or more buildings with a total floor area of at least 2,000 square metres is subject to O. Reg. 102/94. The demolisher – a person who is undertaking the demolition project on his/her own behalf or on the behalf of another – must conduct a waste audit covering the waste generated in the demolition project and must prepare and implement a waste reduction work plan.

3.3 Definition of Floor Area

Building floor area is to be calculated as “gross area” according to the Ontario Building Code: "the total area of all floors above grade measured between the outside surfaces of exterior walls or between the outside surfaces of exterior walls and the centre line of firewalls except that, in any other occupancy than a residential occupancy, where an access or a building service penetrates a firewall, measurements shall not be taken to the centre line of such firewall."

The total floor area should be calculated as the total area of the building. This is the area normally reported on Building Permits. Multi-story or underground parking lot areas must be included in the total building area. However, any outside areas, such as ground-level outdoor parking lots or recreation parks, are not part of the total area. For example, an apartment complex project consists of three buildings, with areas of 800, 500 and 600 m², and an outdoor ground level parking lot of 1,000 m². The sum of the three building areas, or 1,900 m², would be the total area of the project and, therefore, it would not need to comply with the regulation. However, if a building has an area of 1,700 m² and it has an underground parking area that is 400 m², it would have to comply with the regulations as the total floor area (2,100 m²) would exceed 2,000 m².

APPENDIX A – Links to Additional Information

1. e-laws:

You can view and download O. Reg. 102/94 by going to e-laws and entering O. Reg. 102/94 into the search function. You can find all four of the 3Rs regulations or other acts and regulations by entering their name: www.e-laws.gov.on.ca

2. Copies of the 3Rs Guides:

Additional copies of the ministry's 3Rs guides are available at:
www.ene.gov.on.ca/en/publications/forms/index.php#AuditandReduction

3. Helpful guide:

“The Environmentally Responsible Construction and Renovation Handbook,” *Public Works and Government Services Canada*. This Technical Guidebook has been prepared for portfolio and asset managers, project managers and building professionals, leasing agents, accommodation users and property managers to assist them in planning and undertaking renovations in an environmentally responsible manner, and to achieve Green Office Building Plan (GOBP) status. Building operators and property managers in the private sector will also find this document useful. Although the emphasis of the handbook is on environmentally responsible renovation, many of the principles and guidelines also apply to new construction projects. Available at: www.tpsgc-pwgsc.gc.ca/biens-property/gd-env-cnstrctn/index-eng.html

4. Ontario Environment Business Directory:

The Ministry of the Environment (MOE) maintains a web site for Ontario companies that provide environmental goods and services at: www.envirodirectory.on.ca

Appendix B – A Typical Waste Reduction Program

Getting Started

Ideally, a person who is interested in resource conservation and has sound knowledge and experience of your company's operations should manage your waste reduction program. An effective Waste Reduction Coordinator will have the greatest impact when fully involved in all aspects of the waste audit and reduction work plan program.

For larger projects, you may wish to form a Waste Reduction Committee to set up and maintain your waste reduction program. The committee could consist of the coordinator, owner, general contractor and site supervisor, representatives of various sub-trades and a waste hauler. This will allow you to generate ideas collectively and ensure that the program is designed to provide opportunities for everyone to participate.

Examples of what role(s) the coordinator/committee could play to successfully undertake a waste audit and to implement a waste reduction work plan include the following:

- Identifying and interpreting government requirements and regulations
- Securing senior management support
- Conducting and/or overseeing the waste audit
- Establishing the waste reduction goals
- Identifying funding requirements and the costs and benefits of the program
- Developing a 3Rs program and implementation schedule
- Monitoring the waste reduction, reuse and recycling activities
- Promoting and communicating waste reduction activities.

Communicating Project Objectives

Before initiating a waste audit or waste reduction work plan, you should inform everyone involved of the objectives of the program and the importance of their cooperation. Sub-trades should be informed also. They will need to work cooperatively to characterize and measure waste streams and effectively implement waste reduction measures.

CONDUCTING A WASTE AUDIT

Introduction

An important factor in planning your waste audit is the level of audit detail you choose to use. The level of detail depends upon the size of the project, complexity of operations and accuracy you require for your reduction work plan.

The following waste audit process is one approach that will provide you with enough information to proceed with your waste reduction work plan and to meet the requirements of O. Reg. 102/94. This approach is intended to identify the major wastes and to provide a starting point for your waste diversion initiatives. Figure 1, Waste Audit Flowchart, provides an overview of the audit process.

Step 1: Assemble Basic Information

Review Operations

You should review and record the following basic information about your construction or demolition project:

- Building floor area or other indicators relevant to your projects
- Type and size of construction or demolition project
- Location
- Stages of project, e.g. excavation, structural, interior finishing
- Stages of the project that are sub-contracted to trades
- Purchasing policies.

It is also important to review all areas of your project so that you will not miss future opportunities for waste reduction. The scope of the review will include the traditional waste generation areas. This level of review, with waste reduction in mind, often leads to significant opportunities.

Here are the minimum points to review:

- Composition and quantity of all wastes directly generated within the project through all normal activities
- The extent to which materials or products used consist of recycled or reused materials
- Management decisions and policies that relate to the production of waste
- The way in which the waste is managed.

Review Existing Waste Reduction and Disposal Activities

You should review your current waste management activities to provide start-up information for your waste audit and for later efforts in waste reduction planning. Basic questions to be asked include:

- Who is responsible for waste management and reduction?
- What are the current waste separation and recycling activities?
- What are the timing and frequency of waste collections?
- What methods of waste collection will be employed, including internal and external waste handling?
- What quantities of waste and recyclables are to be collected?
- Who are the contractor(s) for waste collection and recycling services?
- What are the responsibilities of sub-trades for their own waste disposal?
- What is the gross cost of waste collection and disposal?
- Are there recycling companies in your area?

Step 2: Identify Wastes

The objective of this step is to estimate categories of wastes and places where they will be generated. During the review, you should note collection and storage practices and any other special considerations that should be taken into account later when you develop your waste reduction work plan.

It is your responsibility to ensure that the information that appears in the audit reflects the waste that will be generated by your project. Sources of information may include:

- Engineering estimates
- Material purchasing records
- Waste disposal invoices for similar projects
- Records of waste produced at generation points in daily operations of other projects
- Studies of similar projects.

You can identify your wastes by:

- Estimating wastes generated through each stage of a project based on building construction and demolition methods, materials and efficiencies. Staff and sub-trades may be required to submit information to the coordinator for summary.
- Conducting a walk-through review of operations on similar projects to ensure that all waste streams have been identified. Look inside waste containers, and, above all, ask questions.

Classify your wastes as follows:

- Materials that the Ministry of the Environment requires you to source separate for recycling (see “A Guide to Source Separation of Recyclable Material for Industrial, Commercial and Institutional Sectors and Multi-Unit Residential Buildings”, *Appendix A for link*).
- Other materials identified within your project that could be source-separated for reuse or recycling.
- Residual material that would go for disposal.

Use **Figure 1**, Waste Sampling Record (next page) to summarize the results.

Step 3: Identify Recycled Content of Building Materials and Products

This step requires you to examine the current reduction activities at the front end of your operations. You should now examine purchasing specifications to identify the recycled content of purchased building products and raw materials. This will be useful for determining whether you can take steps to increase use of items with higher recycled content.

It is not necessary to examine all of your incoming materials and products. Look at your major material and product purchases and review the recycled content of each material. Approach your suppliers if the information needed is not readily available.

Figure 1: Waste Sampling Record

Location 3777 Recycle St., Anytown, ON A1B 2C3			Date October 10, 2008	
Sample Taken Demolition Phase		Time Period Oct, Nov, Dec 2008		
Operation Characteristics Normal activities.				
Material	Characteristics	Volume * (yd³)	Weight (tonnes)	% of Total Sample **
Wood	Lumber, pallets	60	9	16 %
Concrete & Masonry	Rubble from exterior walls	120	40	71%
Plaster	Broken pieces from walls	30	4	7%
Cardboard	Packaging	2	.25	.4%
Drywall	Clean drywall	2	.25	.4%
Misc		64	3	5.3%
Totals		278	56.5	100 %

* Please note if you measure your waste by volume, you must convert these figures to weights. See Appendix C for Conversion Table.

** If using purchasing records, calculation of % is not applicable.

Step 4: Complete a Waste Audit Report

You should maintain a record of the information reviewed, assumptions made, waste samples examined (including the sample dates) and the material weights and/or volumes calculated.

You are now ready to complete the Waste Audit Report, as required by O. Reg. 102/94. See a *sample* of a completed waste audit report on the next page. A blank Waste Audit Report form is provided at the end of this guide. A Microsoft Word version of the form is available from the ministry's website (see Appendix D). You can use your own forms as long as the same information is provided.

You may want to calculate the amount of waste generated per “unit of measure.” For example, by calculating the total waste generated per 100 m² floor area of the project to that of other projects, you might observe whether a change in overall waste generation is due to project size, type or other factors.

Sample

Ministry of the Environment Waste Form

Report of a Waste Audit

Large Construction and Demolition Projects

As required by O. Reg. 102/94

This report must be prepared before construction or demolition begins at the site. The waste audit must be retained on file for at least five years after it is prepared, and be made available to the ministry upon request.

I. GENERAL INFORMATION

Name of Owner/Contractor Undertaking Project and Company Name: <i>Mr. Bricks, 1234 Ontario Ltd.</i>			
Name of Contact Person and Company: <i>Ms. Builder, 1234 Ontario Ltd.</i>		Telephone #: <i>416-123-4567</i>	Email address: <i>builder@1234Ontario.com</i>
Project Type (Check One)*	Construction Project	<input checked="" type="checkbox"/>	Demolition Project
Floor Area (square metres): <i>2500 m2</i>		Number of Buildings: <i>20 houses</i>	
Street Address of Project Site (if known): <i>123 Yellowbrick Road</i>			
Lot and Plan Number: <i>Lot 50; Plan Number 12345</i>		Municipality: <i>Anyplace</i>	
Estimated Start Date of Project: <i>June 30, 2008</i>		Estimated Completion Date of Project: <i>August 1, 2009</i>	

** Separate reports must be made for construction and demolition projects regardless if they occur on the same site.*

II. DESCRIPTION OF PROJECT

Provide a brief overview of the construction or demolition project:
<i>Construction of 20 new one storey luxury brick houses with rear garages on newly developed land. Some of the main construction materials that will be used for this project will include clay brick, concrete, vinyl windows, wooden framing, drywall, hardwood floors and asphalt shingles. There will be waste diversion depot areas for reusable or recyclable materials located throughout the project. In addition, a main waste collection area will be situated on site and will include a roll-off waste container. The project is located outside of the Anyplace main retail district near a ravine area.</i>

III. CATEGORIES OF WASTE AND WASTE ITEMS

List the categories of waste the project will produce and the associated waste items for each category (*see part VI for examples of categories of waste*):

Categories of Waste	Waste Items
<i>Blue Box Materials</i>	<i>Glass, cans, newspaper, plastic bottles</i>
<i>Brick and Concrete</i>	<i>Cut offs, broken bricks; spilled concrete, cut or broken blocks</i>
<i>Cardboard</i>	<i>Boxes, sleeves on side of pallet loads</i>
<i>Carpet</i>	<i>Cuttings/remnants</i>
<i>Drywall</i>	<i>Cutoffs, broken or damaged pieces, cut outs for windows/doors</i>
<i>Drywall Compound</i>	<i>Compound that is contaminated, old or hardened.</i>
<i>Insulation</i>	<i>Cuttings, damaged pieces</i>
<i>Metal</i>	<i>Electrical, beams, light tracks, hangers, pipe, conduit, etc.</i>
<i>Plastic</i>	<i>Cuttings from plastic pipe, plastic film/wrap</i>
<i>Roofing Shingles</i>	<i>Cutoffs, damaged shingles</i>
<i>Tile Flooring</i>	<i>Cutoffs, damaged tiles</i>
<i>Wood</i>	<i>Lumber cut-offs, damaged studs, skids</i>

IV. PRODUCTION OF WASTE

For each category of waste listed in Part III of this form, explain how the waste at the construction or demolition project will be produced. Include references to how management decisions and policies will affect the production of waste:

How Waste Is Produced	Decisions/Policies Affecting Waste Produced
<i>Blue Box - Glass, cans, newspaper, plastic bottles</i>	<i>Cannot be avoided.</i>
<i>Bricks - Cutoffs, broken bricks</i> <i>Concrete - spilled; broken blocks/cutoffs</i>	<i>Brick waste cannot be avoided;</i> <i>Review how concrete is handled to reduce spillage.</i> <i>Cannot avoid broken blocks/cutoffs</i>
<i>Cardboard - boxes, sleeves on side of pallet loads</i>	<i>Will consider reusable shipping containers.</i>
<i>Carpet - cuttings/remnants</i>	<i>Cannot be avoided</i>
<i>Drywall - cutoffs, broken or damaged pieces, cut outs for windows/doors</i>	<i>Cannot be avoided.</i>
<i>Drywall Compound - contaminated, old or hardened</i>	<i>Will review how compound is stored to avoid contamination/hardening</i>
<i>Insulation - cuttings, damaged pieces</i>	<i>Will review how insulation is stored and how to protect it from becoming damaged</i>
<i>Metal - Electrical, beams, light tracks, hangers, pipe, conduit, etc.</i>	<i>Difficult to avoid scrap metal or cut offs from being generated. Will review reuse.</i>
<i>Plastic - cut offs from piping; film wrap</i>	<i>Plastic pipe cutoffs cannot be avoided; To review shipping of materials without plastic wrap.</i>
<i>Roofing shingles - Cutoffs, damaged shingles</i>	<i>Will try to ensure that shingles are not damaged during storage or movement on site. Will speak to supplier if damaged shingles are received.</i>
<i>Tile Flooring</i>	<i>Cut offs cannot be avoided. Damage is minimal.</i>
<i>Wood - cut offs, damaged studs, skids</i>	<i>Review how wood is purchased, including proper lengths required. Review how skids can be returned to company.</i>

V. MANAGEMENT OF WASTE

For each category of waste listed in Part III of this form, indicate which waste items will be disposed or reused/recycled and how each item will be managed at the project:		
Category	Waste to be Disposed	Reused or Recycled Waste
<i>Blue Box Materials</i>	<i>n/a</i>	<i>To be recycled in Blue Boxes and Carts</i>
<i>Bricks - Cutoffs, broken bricks; Concrete - spilled concrete, cut or broken blocks</i>	<i>Unusable pieces of brick will be disposed; Spilled concrete or unusable broken blocks will be dumped into roll off waste container.</i>	<i>Reusable pieces of brick will be used where possible. Will look into market for crushed brick for landscaping; Useable broken blocks will be reused where possible.</i>
<i>Cardboard - boxes, sleeves on side of pallet loads</i>	<i>Soiled Cardboard will be disposed in waste bin.</i>	<i>Strict policy that all cardboard that is not soiled must be recycled.</i>
<i>Carpet</i>	<i>Small pieces will be disposed in waste bin.</i>	<i>Reusable pieces will be reused.</i>
<i>Drywall - cutoffs, broken or damaged pieces, cut outs for windows/doors</i>	<i>Unusable pieces will be disposed in waste bin.</i>	<i>Any reusable pieces will be used.</i>
<i>Drywall Compound - old/hardened</i>	<i>Contaminated or hardened compound will be disposed in waste bin.</i>	<i>n/a</i>
<i>Insulation - cuttings, damaged pieces</i>	<i>Unusable pieces of insulation will be disposed in waste bin.</i>	<i>Reusable pieces of insulation will be reused as insulation.</i>
<i>Metal - Electrical, beams, light tracks, hangers, pipe, conduit, etc.</i>	<i>Small cuttings that end up in sweepings will be disposed in waste bin.</i>	<i>All larger pieces of metal will be recycled.</i>
<i>Plastic - Cut offs from pipes; film wrap</i>	<i>Unusable pieces of pipe/wrap will be disposed in waste bin.</i>	<i>Will reuse pipe cut offs where possible (e.g., to protect water turn off valves during construction), Film wrap will be reused during project where possible to cover materials.</i>
<i>Roofing shingles - Cutoffs, damaged shingles</i>	<i>Unusable shingles will be disposed in waste bin.</i>	<i>Reusable pieces of shingle will be used.</i>
<i>Tile Flooring</i>	<i>Small unusable pieces of tile will be disposed in waste bin.</i>	<i>Reusable pieces of tile will be used.</i>
<i>Wood - cut offs, damaged studs, skids</i>	<i>Unusable pieces will be disposed in waste bin.</i>	<i>Reusable pieces will be reused for bridging/blocking, etc.</i>

VI. ESTIMATED QUANTITY OF WASTE PRODUCED

Categories of Waste	Estimated Amount of Waste Produced (tonnes)	Categories of Waste (continued)	Estimated Amount of Waste Produced (tonnes)
Asphalt	<i>n/a</i>	Plastic (pipes, film, etc)	<i>50 kg</i>
Aluminum	<i>n/a</i>	Plaster (<i>Drywall compound</i>)	<i>50 kg</i>
Blue Box – Newspaper, cans, etc.	<i>25 kg</i>	Polystyrene Foam	<i>n/a</i>
Brick and Concrete	<i>1 tonne</i>	Porcelain Fixtures	<i>n/a</i>
Cardboard	<i>2 tonnes</i>	Roof Shingles	<i>200 kg</i>
Carpet	<i>100 kg</i>	Tile Flooring	<i>25 kg</i>
Drywall (unpainted)	<i>300 kg</i>	Wood (unpainted or untreated)	<i>1.5 tonne</i>
Drywall (painted)	<i>500 kg</i>	Wood (painted/treated)	<i>250 kg</i>
Glass	<i>n/a</i>	Other	<i>n/a</i>
Insulation	<i>10 kg</i>		
Metal	<i>200 kg</i>		
		TOTAL	~ 6 tonnes

VII. EXTENT TO WHICH MATERIALS OR PRODUCTS USED BY THE ENTITY CONSIST OF RECYCLED OR REUSED MATERIALS OR PRODUCTS

Please answer the following questions:

- Do you have a management policy in place that promotes the purchasing and/or use of materials or products that consist of recycled and/or reused materials or products? If yes, please describe.

Yes. Our construction company has a management policy in place to encourage the purchase of materials and products that contain recycled or reused materials. At this project we will be using aggregate/stone for constructing driveways that contains crushed concrete. The wood trim that will be used will be paint grade wood (made from finger joined scrap wood pieces). We will also be incorporating other recycled wood products in various applications. Most of the carpeting will have recycled content also.

- Do you have plans to increase the extent to which materials or products used consist of recycled or reused materials or products? If yes, please describe.

Yes, Our company does plan to increase the amount of recycled or reused material that is contained in the products or materials we use. We are currently considering a new floor tile that contains recycled material as well as paint that is recycled (remanufactured from old paint). In addition, we will be installing and testing roofing shingles that contain a high percentage of recycled material at this construction project.

Please attach any additional page(s) as required to answer the above questions.

I hereby certify that the information provided in this Report of Waste Audit is complete and correct.		
Signature of authorized official: <i>Mr. Bricks</i>	Title: <i>President, 1234 Ontario Ltd.</i>	Date: <i>March 1, 2008</i>

CREATING A WASTE REDUCTION WORK PLAN

Introduction

Now you are ready to create your waste reduction work plan.

Step 1: Review Waste Audit Information

To begin the process, review your Waste Audit Report and assemble information relating to 3Rs actions currently in place, including:

- Waste reduction policies
- Current waste reduction, reuse, recycling and disposal activities
- Types and quantities of materials in each activity
- Achievement of current waste reduction targets
- Operating cost impacts as a result of 3Rs activities.

Step 2: Identify Areas of Greatest Waste Reduction Impact

A key factor in finding 3Rs opportunities for waste reduction involves examining those materials that make up a large part of the waste produced. Such a move to organize your waste audit data will highlight areas where your reduction efforts will have the greatest impact. Waste audit data can be organized in different ways by:

- Weight or volume
- Disposal cost
- Potential for source separation
- Potential to reduce, reuse or recycle
- Complexity of handling
- Current and potential regulatory requirements.

Material Type	Volume (m ³)	Weight (tonne)	Waste Cost (\$/tonne)	Rank by Volume	Rank by Weight	Rank by Cost
Wood	60	9	110.00	2	2	3
Concrete & masonry	120	40	40.00	1	1	5
Cardboard	2	.25	Revenue	5	5	1
Drywall	2	.25	75.00	6	6	4
Roofing materials	25	2	150.00	3	3	2
Metal	10	.75	Revenue	4	4	1

Note: You should also consider issues you may face in implementing 3Rs programs, including: health and safety regulations, storage space at your project, availability of recycling markets and collection services and operating costs.

Step 3: Assess Waste Reduction Priorities

After identifying general areas for potential waste reduction, you should look at the possible impact of other priorities on your 3Rs options. You should consider at least the following items:

- Current and potential regulatory requirements
- Costs and benefits of each waste reduction opportunity.
- Be aware of planned or anticipated landfill closures or other disposal limitations that may affect your waste materials, including waste material bans or increased tipping fees.

Step 4: Determine Why Waste Is Generated

In assessing your waste reduction options, you should ask the following basic question at the start: Why is this material being used? Questions such as this can stimulate thought and help you develop many other ways of dealing with the material under review.

One approach to framing the questions you might ask yourself is to use the following matrix:

Purpose	Why is the material being used?	What else could be used?	What should be used?
Place	Where is it used?	Where else could it be used?	Where should it be used?
Sequence	When is it used?	When could it be used elsewhere?	When should it be used?
Person	Who uses it?	Who else could use it?	Who should use it?
Means	How is it used?	How else could it be used?	How should it be used?

Answers to these questions may show the way to various options for reducing, reusing, and/or recycling your wastes, including:

- Where waste can be reduced by eliminating the use of certain product materials or processes in your operations
- Where other materials can be used that, in turn, can be reused or recycled
- Where less wasteful/disposable materials can be used
- Where less material can be purchased (e.g. buying in bulk versus individually wrapped items)
- Where previously recycled materials can be used

Step 5: Identify Opportunities for Reducing, Reusing and Recycling Wastes

This section outlines some 3Rs opportunities that are in common use. Your own situation may differ, however, and not all these possibilities will apply. In many cases the ideas are very simple yet these can often lead to more significant initiatives.

Reducing Wastes

Workers on your project may already use various methods to reduce the quantity of waste being generated. For example, you may have replaced some disposable products with either reusable products or disposable products that can be recycled.

You should take a similar approach for each of the materials you use to support and maintain your construction/demolition projects. Focus on reducing the quantities of disposable supplies and equipment used, and on improving purchasing policies to reduce the amount of incoming packaging. You could also make changes to processes in your operation to decrease the quantity of material consumed (e.g., to reduce the amount of wood used in your project).

State expectations in trade contracts. Waste reduction policies and initiatives should be clearly stated in tendering and contract documents. Establish contracts with trades to supply both labour and materials. If trades supply materials, they will be fully committed regarding usage. Alternatively, establish policies that require contractors to remove and divert waste materials from disposal.

Produce more efficient construction designs where possible. Reducing material wastage begins at the design stage. Designers, architects, and builders should evaluate their plans for efficiency of material usage (e.g., consider standardizing room sizes and minimizing off-cuts).

Use more prefabricated products. Less waste may be generated on-site if more prefabricated or pre-cut products such as floor joists, trusses, and truss-joints are used.

Purchase selected materials in bulk containers. Purchase materials such as fasteners, paint, caulking and drywall mud in bulk containers. Stored in such containers, they are not as vulnerable to weather damage.

Reduce illegal dumping and contamination of recyclables. Protect waste bins and piles by covering them, securing them with locks and locating them in well-lit areas. Signs stating the company's commitment to waste reduction and dumping restrictions should be posted on-site and on bins.

Reusing Wastes

A reuse strategy to avoid waste is common on construction sites. Forms for pouring foundations, scaffolding and other systems all lead to less waste. Also consider using wastes from one application on other projects. For example, aluminum sheet off cuts from one job may provide the raw material input to another smaller job. Although you may already reuse certain materials, there may be others who can make beneficial use of your waste. This option can also help reduce your disposal costs.

Remove items carefully during demolition. Disassemble items carefully during demolition to minimize damage and salvage for reuse as many items as possible. Selected residual components of construction are often relatively simple to remove for reuse and will continue to have a useful lifespan.

Invite the public to reuse materials. Conduct a "strip-out sale" or advertise that certain items are free-for-the-taking by the public once they are removed from the building. Items of interest to the public may include bundles of wood off-cuts, doors, windows, decorative mouldings, cabinets, plumbing and electrical fixtures and older appliances.

Collect and store reusable materials. Space permitting, warehouse your unused materials and salvaged items for future use or re-assembly in another project. If not, direct your reusable materials to your local "reuse" facility or salvage yard. Join other companies to collect, re-distribute, and reuse waste materials. For example, excess brick from one or several projects can be reused as part of a fireplace or chimney on another project.

Reuse Items On-Site for Different Purposes. Many items have reuse potential on the job site. Reuse lumber off-cuts as bridging, blocking, or forming stakes. Recover plastic vapour barrier and wrappings and reuse as protection for tools and materials when not in use. Excess insulation from exterior walls can be added to interior walls or attics.

Recycling of Source Separated Wastes:

Most construction/demolition projects can take advantage of opportunities for external recycling of wastes. Markets exist for many recyclable materials such as steel, aluminum, corrugated cardboard, wood, drywall, concrete and glass.

The economics of recycling will vary with the material. For some materials you will receive direct revenue. For others, the cost of recycling may simply be less than the cost of landfill tipping fees.

Establish a recycling program. The ministry requires that the construction and demolition projects identified in this guide have a recycling program in place. See "A Guide to Source Separation of Recyclable Materials for the Industrial, Commercial and Institutional Sector and Multi-Unit Residential Buildings" (*refer to Appendix A for link*).

Source Separate Recyclables. Several alternatives exist to source separate recyclables. Several recycling containers and bins should be provided on every site to facilitate source separation.

Provide Adequate Training. Workers should be provided with training in source separation techniques and supplied with adequate means to perform this task efficiently.

Back-charge trades. Consider charging trades for the waste that they generate and the additional labour hours the general contractor takes to clean it up. Alternatively, all trades could be required to remove all waste off site.

Investigate waste handling techniques and equipment. Waste handling techniques and equipment such as split-bins and split-chutes are available. They can be useful on small sites as they help to maximize use of space.

Waste haulers or recycling companies: Set up contracts with waste haulers or recycling companies to provide reduced costs or revenue for source separated waste. Set up incentives (e.g., bonuses) to companies that assist with diverting the most waste and have them review the types of waste materials your project will generate before it starts.

Step 6: Assess Impact of Material Purchasing on Waste Reduction

Many of your waste reduction opportunities will involve your material purchasing practices. In some cases, you may develop a purchasing policy to buy materials that already have a recycled content. This action has the added benefit of improving the overall market for recycled materials.

Actions to change the material used in construction may involve discussions with your suppliers. For other products, you can work with your supplier to provide you with more environmentally sound materials. Replacing non-recyclable materials with reusable or recyclable materials gives economic benefits as well as greater waste diversion.

Another important waste reduction action with suppliers involves reducing packaging and containers. Many companies, as part of their purchasing and materials management policies, set up distribution systems with their suppliers to use returnable transportation/storage containers.

On a general basis, you should also review the materials and products currently purchased from your supplier to ensure optimum “environmental friendliness”. This will increase your level of reliance on your suppliers to advise your company on the availability of previously recycled or more easily recyclable materials for your own use.

Step 7: Complete an Achievable Waste Reduction Work Plan

Your waste reduction work plan is a compilation of the waste reduction opportunities you have identified and the actions you intend to take in reducing your wastes. At this stage you should also set waste reduction targets. Try to set *realistic* reduction targets as it is important that your work plan is achievable.

Your targets will form the basis for waste reduction actions for each waste material. These decisions reflect the benefits of accurate waste audit information. Missed targets could have negative impacts on your workers attitudes and confidence in future waste reduction work plans.

The waste reduction work plan is designed to complement the waste audit report. The waste reduction work plan focuses on the wastes for which reduction actions have been identified and reduction targets set. The format allows actions on separate waste materials to be identified as well as the total amounts of waste reduced, reused and/or recycled.

See next page for a *sample* waste reduction work plan. A blank form is included at the back of the guide. A Microsoft Word version is available through the ministry’s website (see Appendix D). You can use your own forms as long as the same information is provided.

Sample

Ministry of the Environment Waste Form Report of a Waste Reduction Work Plan Large Construction and Demolition Projects

As required by O. Reg. 102/94

This report must be prepared before construction or demolition begins at the site. The waste reduction work plan must be retained on file for at least five years after it is prepared, and be made available to the ministry upon request.

I. GENERAL INFORMATION

Owner/Contractor Undertaking Project and Company Name: <i>Mr. Bricks, 1234 Ontario Ltd.</i>			
Name of Contact Person and Company Name: <i>Ms. Builder, 1234 Ontario Ltd.</i>		Telephone #: <i>416-123-4567</i>	Email Address: <i>builder@1234Ontario.com</i>
Project type (check one)*	<input checked="" type="checkbox"/> Construction Project	<input type="checkbox"/> Demolition Project	
Floor Area (square metres): <i>2500 m2</i>		Number of Buildings: <i>20 houses</i>	
Street Address of Project Site (if known): <i>123 Yellowbrick Road</i>			
Lot and Plan Number: <i>Lot 50; Plan Number 12345</i>		Municipality: <i>Anyplace</i>	
Estimated Start Date of Project: <i>June 30, 2008</i>		Estimated Completion Date of Project: <i>August 1, 2009</i>	

** Separate reports must be made for construction and demolition projects regardless if they occur on the same site.*

II. DESCRIPTION OF PROJECT

Provide a brief overview of the construction or demolition project: <i>Construction of 20 new one storey luxury brick houses with rear garages on newly developed land. Some of the main construction materials that will be used for this project will include clay brick, concrete, vinyl windows, wooden framing, drywall, hardwood floors and asphalt shingles. There will be waste diversion depot areas for reusable or recyclable materials located throughout the project. In addition, a main waste collection area will be situated on site and will include a roll-off waste container. The project is located outside of the Anyplace main retail district near a ravine area.</i>
--

III. PLANS TO REDUCE, REUSE AND RECYCLE WASTE

For each category of waste described in Part III of “Report of a Waste Audit” (on which this plan is based), explain what your plans are to reduce, reuse and recycle the waste, including: 1) how the waste will be source separated at the project, and 2) the programs to reduce, reuse and recycle all source separated waste.	
Waste Category	Source Separation and 3Rs Program
<i>Blue Box Materials</i>	<i>Blue Box Recycling Program: Blue boxes will be located throughout the site for the collection of materials such as plastic, metal and aluminum drink containers and newspapers. Materials will be source separated into recycling carts for collection by recycling company.</i>
<i>Brick and Concrete</i>	<i>(i) Brick Recycling Program: Any broken or non-reusable bricks will be source separated in piles beside each house. Front end loader will remove waste brick at end of the construction project and place into one pile so that it can be sent for recycling or as clean fill (e.g., Leslie St. Spit.), if possible. (ii) Concrete 3Rs Program: Source separate waste concrete, including dried spills, and recycle if quantities are significant via aggregate recycling company.</i>
<i>Cardboard</i>	<i>Cardboard Recycling: Will replace with reusable containers, where possible. Source separate cardboard into roll-off box for recycling company.</i>
<i>Carpet</i>	<i>Reuse cuttings where possible. Ensure that pieces of the same style/colour of carpet are reused in other houses/where required.</i>
<i>Drywall</i>	<i>Drywall 3Rs Program: Any unpainted drywall will be collected in wooden bunker. Will reuse cut pieces as much as possible. If waste drywall quantities are significant, will send for recycling through Gypsum Recycling Limited.</i>
<i>Drywall Compound</i>	<i>n/a</i>
<i>Insulation</i>	<i>Reusable pieces of insulation will be reused as insulation.</i>
<i>Metal</i>	<i>Metal Recycling Program: Scrap metal will be source separated and collected in box and saved for recycling by scrap metal company.</i>
<i>Plastic</i>	<i>Will reuse pipe cutoffs on site, e.g., to protect water shut off valves. Will reuse plastic wrap to cover materials during construction. Will look for company to recycle plastics and will recycle if possible (low quantities).</i>
<i>Roofing Shingles</i>	<i>Roofing Shingles 3Rs Program: Waste asphalt shingles, including cuttings, will be reused where possible. Attempts will be made to minimize waste, including minimizing the amount of overruns/unnecessary stock by accurately estimating the amount of shingles required. Will determine if recycling markets exist, if there are large quantities available.</i>
<i>Tile Flooring</i>	<i>Will reuse tile cuttings, where possible. Ensure that pieces of the same style/colour of tile are reused in other houses.</i>
<i>Wood</i>	<i>Wood Recycling Program: Reuse scrap wood where possible for bridging or blocking or any other application where it can be utilized.</i>

IV. RESPONSIBILITY FOR IMPLEMENTING THE WASTE REDUCTION WORK PLAN

Identify who is responsible for implementing the Waste Reduction Work Plan at the construction or demolition project. If more than one person is responsible for implementation, identify each person who is responsible and indicate the part of the Waste Reduction Work Plan that each person is responsible for implementing.		
Name of Person	Responsibility	Telephone #
<i>Jack Reduce</i>	<i>Inform all workers and visitors to the site about the 3Rs program and provide information sheets where necessary.</i>	<i>416-123-4567</i>
<i>Tim Reuse</i>	<i>Ensure that only the required amount of construction material is ordered (to decrease overruns). Review and purchase materials that are reused or have recycled content.</i>	<i>416-123-4567</i>
<i>Kim Recycle</i>	<i>Oversee collection of recyclables by recycling companies, search for new markets for materials that are currently not recyclable.</i>	<i>416-123-4567</i>

V. TIMETABLE FOR IMPLEMENTING WASTE REDUCTION WORK PLAN

Provide a timetable indicating when each Source Separation and 3Rs program of the Waste Reduction Work Plan will be implemented.	
Source Separation and 3Rs Program	Schedule for Completion
<i>Blue Box Recycling Program</i>	<i>Before project begins, (i) purchase blue boxes and recycling carts, and prepare signs. (ii) Instruct all workers to use the Blue Boxes. (iii) Set up collection with recycling company.</i>
<i>Brick and Concrete Recycling Program</i>	<i>(i) Before brick laying starts, instruct brick layers to place all unusable brick in piles beside each house. Determine area that will accept brick for recycling or as clean fill. Remove brick at end of project for recycling, <u>if possible</u>. (ii) Set up contract/pricing with concrete recycling company before construction. Inform all workers to minimize spillage of concrete. Set up area for all waste concrete to be stored before construction. Send waste concrete to recycling company at the end of the project - August 2009.</i>
<i>Cardboard Recycling Program</i>	<i>Before construction, set up signs, bins. Bring cardboard to recycling company during and/or at the end of the project.</i>
<i>Drywall 3Rs Program</i>	<i>Before the project starts, (i) instruct workers about using as much scrap drywall as possible during construction, (ii) set up bin to store waste drywall, (iii) find companies that recycle drywall. At the end of project, send all drywall to recycling company.</i>
<i>Insulation Reuse Program</i>	<i>During construction - insulation will be reused where possible in each house. Any additional pieces will be carried over and reused in other houses.</i>
<i>Metal Recycling Program</i>	<i>Before project starts, (i) instruct workers about program, (ii) set up collection bin, (iii) determine recycling company. During or at the end of the project have materials collected.</i>
<i>Plastic Reuse Program</i>	<i>During construction. Plastic pipe will be used for various purposes as will plastic film to protect materials.</i>
<i>Roofing Shingles 3Rs Program</i>	<i>Before roofing begins, instruct all workers about utilizing as much of the asphalt shingles as possible. Determine if any recycling companies exist. At end of the project, recycle shingles, if possible.</i>
<i>Tile Flooring Reuse Program</i>	<i>Set up during construction. Tile cuttings will be reused in each house and carried to other houses with similar tile pattern for reuse, where possible.</i>
<i>Wood Reuse Program</i>	<i>Before construction, inform all workers to reuse as much scrap wood as possible.</i>

VI. COMMUNICATION TO WORKERS

Explain how the Waste Reduction Work Plan will be communicated to workers at the site of the construction or demolition project:

Jack Reduce will hold a meeting with all workers prior to project commencement to discuss the waste diversion programs to be followed for the project. A one page hand out entitled "waste diversion summary" will be provide to each worker or visitor to the site. Signs will be developed for each waste source separation bin. If any of the source separation bins are used incorrectly, staff will be informed about this and given proper instruction. Input from all workers will be encouraged regarding how to improve the waste diversion program.

VII. ESTIMATED ANNUAL WASTE PRODUCED BY MATERIAL TYPE AND THE PROJECTED ANNUAL AMOUNT TO BE DIVERTED BY THE 3Rs

Material Categories (as stated in Part III)	Estimated Waste Produced/Yr.* (kgs or tonnes)	Name of Proposed 3Rs Program (as stated in Part III)	Projections to Reduce, Reuse or Recycle Waste/Yr. (kgs or tonnes)			Estimated Waste Diversion Rate** (%)
			Reduce	Reuse	Recycle	
<i>Blue Box Materials</i>	<i>50 kg</i>	<i>Blue Box Recycling</i>			<i>45 kg</i>	<i>90 %</i>
<i>Brick and Concrete</i>	<i>(i) 1.5 tonne (ii) 2 tonnes</i>	<i>Brick and Concrete Recycling</i>	<i>Concrete 300 kg</i>		<i>Bricks 1 tonne[†] Concrete 1 tonne[†]</i>	<i>66%</i>
<i>Cardboard</i>	<i>300 kg</i>	<i>Cardboard Recycling</i>			<i>220 kg</i>	<i>73%</i>
<i>Drywall</i>	<i>500 kg</i>	<i>Drywall 3Rs</i>		<i>50 kg</i>	<i>250 kg[†]</i>	<i>60%</i>
<i>Insulation</i>	<i>10 kg</i>	<i>Insulation Reuse</i>		<i>5 kg</i>		<i>50%</i>
<i>Metal</i>	<i>200 kg</i>	<i>Metal Recycling</i>			<i>170 kg</i>	<i>85%</i>
<i>Plastic</i>	<i>50 kg</i>	<i>Plastic Reuse</i>		<i>25 kg</i>		<i>50%</i>
<i>Roofing Shingles</i>	<i>250 kg</i>	<i>Roofing Shingles 3Rs</i>		<i>50 kg</i>	<i>150 kg[†]</i>	<i>80%</i>
<i>Tile Flooring</i>	<i>25 kg</i>	<i>Tile Flooring Reuse</i>		<i>10 kg</i>		<i>40%</i>
<i>Wood</i>	<i>1 tonne</i>	<i>Wood Reuse</i>		<i>600 kg</i>		<i>60%</i>

(† - depends on whether a company will recycle this material from our project)

* Estimated Waste Produced = Waste Diverted (3Rs) + Waste Disposed

** Estimated Waste Diversion Rate = Amount of Waste Diverted (3Rs) ÷ Estimated Waste Produced x 100%

I hereby certify that the information provided in this Waste Reduction Work Plan is complete and correct.

Signature of authorized official: <i>Mr. Bricks</i>	Title: <i>1234 Ontario Ltd.</i>	Date: <i>March 1, 2008</i>
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LAUNCHING THE WORK PLAN

Creating Awareness

Launching your waste reduction work plan needs several important actions to ensure success:

- Your Waste Reduction Coordinator/Committee should be clear about the goals and objectives of the work plan. They should assign responsibilities and authorities to appropriate personnel in all project areas.
- It is essential to make the right resources available. This may involve staff time to manage and operate your work plan and basic equipment to contain wastes. Consultation with end users or recycling service providers will help you identify what equipment is needed.
- At the same time, your coordinator/committee should develop awareness of your work plan among all staff and workers. Open display of the work plan, as required by the regulation, and explanation of its goals will help secure full participation.

Please note that the work plan must also be communicated to outside trades who come to work on the project. In these cases a short summary of the waste reduction work plan can be handed out with instructions and the locations of recycling bins.

Staying on Course

To ensure success, you should monitor waste reduction performance against the targets established. You may find that additional waste reduction opportunities will arise, or find that more action is needed or different methods become available. You may need to adjust operating procedures and amend reduction targets, ideally upwards.

You might compare the performance of similar projects to check your reduction achievements against your targets. You can then make changes to your waste diversion targets and planned actions.

APPENDIX C: Conversion Factors

Metric Conversions

1 metric ton (mt) = 1000 kilograms (kg)
1 kilogram (kg) = 2.2 pounds (lb)
1 cubic metre (m³) = 1.3 cubic yards (yd³)
1 metric ton (mt) = 2200 pounds (lb)

Typical Weights of Items (kg)

Pallet – Softwood = 9
Pallet – Hardwood = 13.6
Pallet - 1 cu. yd. (not compacted) = 45
Pallet - 1 cu. yd. (compacted) = 91
Drum - Steel, top = 18
Drum – Steel = 16
Drum - Fibre, top = 9
Drum – Fibre = 5.5
Drum - Plastic, top = 16
Drum – Plastic = 14

Typical Container Sizes

4 yd³ = 3.1 m³
6 yd³ = 4.6 m³
8 yd³ = 6.2 m³
14 yd³ = 10.7 m³
20 yd³ = 15.4 m³
40 yd³ = 30.8 m³

Example Densities (kg/m³)

Asphalt (milled, ripped) = 800-1000
Concrete, Brick & Block = 1200-2372
Mixed Demolition, noncombustible = 1000-1600
Mixed Demolition, combustible = 300-400
Odd Plastic (loose) = 30
Odd Plastic (compacted) = 416
Glass (loose) = 300-357
Glass (compacted) = 595-1189
Corrugated Container (loose) = 24-27
Corrugated Container (compacted) = 241-342
Wood – pallets = 170
Wood - dimensional lumber = 145
Wood - sawdust/shavings = 241-288
Wood - trimmings = 577
Wood - crates = 108
Metal Scrap – heavy = 2408
Metal scrap – light = 803
Mixed Residential Waste = 150-300

APPENDIX D: Ministry of the Environment Forms

- **Waste Audit Report**
- **Waste Reduction Work Plan**

The blank forms included here are in PDF format. Copies of the blank forms are also available as Microsoft Word documents. This will allow you to modify the size of the tables, including the number of rows or the width of columns. The forms are available from the ministry as Word documents at:

www.ene.gov.on.ca/en/publications/forms/index.php#AuditandReduction

Ministry of the Environment Waste Form
Report of a Waste Audit
Large Construction and Demolition Projects

As required by O. Reg. 102/94

This report must be prepared before construction or demolition begins at the site. The waste audit must be retained on file for at least five years after it is prepared, and be made available to the ministry upon request. (Revised July 2008)

I. GENERAL INFORMATION

Name of Person Undertaking Project and Company Name:			
Name of Contact Person and Company:		Telephone #:	Email address:
Project Type (Check One)*	Construction Project		Demolition Project
Floor Area (square metres):		Number of Buildings:	
Street Address of Project Site (if known):			
Lot and Plan Number:		Municipality:	
Estimated Start Date of Project:		Estimated Completion Date of Project:	

** Separate reports must be made for construction and demolition projects regardless if they occur on the same site.*

II. DESCRIPTION OF PROJECT

Provide a brief overview of the construction or demolition project:
--

III. CATEGORIES OF WASTE AND WASTE ITEMS

List the categories of waste the project will produce and the associated waste items for each category (<i>see part VI for examples of categories of waste</i>):	
Categories of Waste	Waste Items
<i>Example: Wood</i>	<i>Lumber cut-offs, Old Window frames</i>

IV. PRODUCTION OF WASTE

For each category of waste listed in Part III of this form, explain how the waste at the construction or demolition project will be produced. Include references to how management decisions and policies will affect the production of waste:	
How Waste Is Produced	Decisions/Policies Affecting Waste Produced
<i>Example: Cut-offs and over-runs of waste shingles are produced during roofing.</i>	<i>Look at more accurate measurements for estimating amount of roofing shingles required</i>

V. MANAGEMENT OF WASTE

For each category of waste listed in Part III of this form, indicate which waste items will be disposed or reused/recycled and how each item will be managed at the project:

[illegible]

VI. ESTIMATED QUANTITY OF WASTE PRODUCED

Categories of Waste	Estimated Amount of Waste Produced (tonnes)	Categories of Waste (continued)	Estimated Amount of Waste Produced (tonnes)
Brick and Concrete		Tile Flooring	
Cardboard		Carpet	
Drywall (unpainted)		Glass	
Drywall (painted)		Plaster	
Steel		Blue Box – Newspaper, cans, etc.	
Wood (unpainted or untreated)		Other	
Wood (painted/treated)			
Plastic (pipes, film, etc)			
Polystyrene Foam			
Porcelain Fixtures			
Insulation			
Asphalt			
Aluminum			
Roof Shingles			
TOTAL		TOTAL	

Note: When completing this form, write “n/a” in the Estimated Amount of Waste Produced column where the project will not produce any waste for a category of waste.

VII. EXTENT TO WHICH MATERIALS OR PRODUCTS USED BY THE ENTITY CONSIST OF RECYCLED OR REUSED MATERIALS OR PRODUCTS

Please answer the following questions:

1. Do you have a management policy in place that promotes the purchasing and/or use of materials or products that consist of recycled and/or reused materials or products? If yes, please describe.

2. Do you have plans to increase the extent to which materials or products used consist of recycled or reused materials or products? If yes, please describe.

Please attach any additional page(s) as required to answer the above questions.

I hereby certify that the information provided in this Report of Waste Audit is complete and correct.		
Signature of authorized official:	Title:	Date:

Ministry of the Environment Waste Form
Report of a Waste Reduction Work Plan
Large Construction and Demolition Projects

As required by O. Reg. 102/94

This report must be prepared before construction or demolition begins at the site. The waste reduction work plan must be retained on file for at least five years after it is prepared, and be made available to the ministry upon request.

I. GENERAL INFORMATION

Name of Person Undertaking Project and Company Name:			
Name of Contact Person and Company Name:	Telephone #:	Email Address:	
Project type (check one)*	Construction Project	<input type="checkbox"/>	Demolition Project
Floor Area (square metres):	Number of Buildings:		
Street Address of Project Site (if known):			
Lot and Plan Number:		Municipality:	
Estimated Start Date of Project:		Estimated Completion Date of Project:	

** Separate reports must be made for construction and demolition projects regardless if they occur on the same site.*

II. DESCRIPTION OF PROJECT

Provide a brief overview of the construction and/or demolition project:

III. PLANS TO REDUCE, REUSE AND RECYCLE WASTE

For each category of waste described in Part III of “Report of a Waste Audit” (on which this plan is based), explain what your plans are to reduce, reuse and recycle the waste, including:

1) how the waste will be source separated at the project, and 2) the programs to reduce, reuse and recycle all source separated waste.

[illegible]

IV. RESPONSIBILITY FOR IMPLEMENTING THE WASTE REDUCTION WORK PLAN

Identify who is responsible for implementing the Waste Reduction Work Plan at the construction or demolition project. If more than one person is responsible for implementation, identify each person who is responsible and indicate the part of the Waste Reduction Work Plan that each person is responsible for implementing.

Name of Person	Responsibility	Telephone #

V. TIMETABLE FOR IMPLEMENTING WASTE REDUCTION WORK PLAN

Provide a timetable indicating when each Source Separation and 3Rs program of the Waste Reduction Work Plan will be implemented.

[illegible]

VI. COMMUNICATION TO WORKERS

Explain how the Waste Reduction Work Plan will be communicated to workers at the site of the construction or demolition project:

[illegible]

VIII. ESTIMATED ANNUAL WASTE PRODUCED BY MATERIAL TYPE AND THE PROJECTED ANNUAL AMOUNT TO BE DIVERTED BY THE 3Rs

[illegible]

* Estimated Waste Produced = Waste Diverted (3Rs) + Waste Disposed

** Estimated Waste Diversion Rate = Amount of Waste Diverted (3Rs) ÷ Estimated Waste Produced x 100%

Note: When completing this form, write “n/a” in the Estimated Waste Produced column where the project will not produce any waste from a material category.

I hereby certify that the information provided in this Waste Reduction Work Plan is complete and correct.

Signature of authorized official:

Title:

Date:

CREM Construction and Demolition Non-Hazardous Waste Management



Process Owner:	PM, SPM, MNG, P.DIR	Approver:	N/A
Document #:	PMO-ENV-001		

Background

This document outlines CREM's waste management obligations when undertaking Construction and Demolition (C&D) projects over 2,000 sq. metres.

Part 1 – Compliance with Ontario Regulations 102/94 and 103/94

Part 2 – Obligatory Waste Tracking Report on completion of project (NEW)

Part 3 – Compliance with Toronto Green Standard v4 for new projects

Part 4 – City of Toronto's guidelines for Renovations by Divisions, Agencies and Corporations

Part 5 – Forms and Resources

Revision History

Version	Description of Change	Date	Approved By
1.1	N/A	N/A	N/A
1.0	Initial Release	2025/06/13	Environment Team



Process Owner:	PM, SPM, MNG, P.DIR	Approver:	N/A
Document #:	PMO-ENV-001		

Part 1 - Compliance with Ontario Regulations 102/94 and 103/94

Projects over 2,000 sq. metres

The successful bidder (General Contractor) for a project must comply with Ontario Regs 102/94 and 103/94 when dealing with Construction & Demolition (CD) waste.

The Project Manager (PM) must highlight this compliance in their RFT/RFQ under Terms and Conditions, "Compliance with Laws."

The RFT/RFQ must include the GC's obligation to submit a CREM Waste Tracking Report to the PM on completion of project. Details in Part 2.

At the PM's project's kick-off meeting, the above items should be discussed with the Consultant/Construction Administrator (CA) and General Contractor (GC).

The GC is responsible for conducting a Waste Audit, preparing a **Waste Audit Report** and a **Waste Reduction Work Plan** before the project commences. The reports should be kept on file, by the owner, for at least five years after they were prepared.

The GC is responsible to maintain regular tracking of the Waste Material as defined in the plan. A minimum monthly report is to be provided and upon Substantial Completion.

It is the Construction Administrator's (CA's) responsibility to ensure the GC is complying with these Regs.

Under O. Reg 102/94 the GC must:

- Conduct a Waste Audit
- Write a Waste Audit Report that *identifies* the materials to be generated by the project (Appendix 1)
- Prepare a report of a Waste Reduction Work Plan, based on the Waste Audit Report, showing *how* these materials will be diverted through reduction, reuse, and recycling (see Appendix 2).

Under O. Reg 103/94, the GC must:

- Separate wastes identified in the Schedule from each other and from other generated wastes on-site – see link below. Refer to SCHEDULE WASTES TO BE PROVIDED FOR IN SOURCE SEPARATION PROGRAMS in Part 111 and Part 1V.



Process Owner:	PM, SPM, MNG, P.DIR	Approver:	N/A
Document #:	PMO-ENV-001		

- The source separation program shall be implemented before the Work begins at the site.

OR

- Provide for the removal of commingled wastes identified in the Schedule above from the building site, and the immediate separation of those identified wastes from each other at a waste disposal site operating under the authority of an environmental compliance approval.

Further details are available in the links below.

<https://www.ontario.ca/laws/regulation/940102> - O. Reg 102/94 - see Part IV Large Construction Projects and Part V Large Demolition Projects

<https://www.ontario.ca/laws/regulation/940103> – O. Reg 103/94 Source Separation Programs - #7 Large Construction Projects, #8 Large Demolition Projects.



Process Owner:	PM, SPM, MNG, P.DIR	Approver:	N/A
Document #:	PMO-ENV-001		

Appendix 1

Detailed Waste Audit and written Waste Audit Report O. Reg 102/94

Before the project starts, to comply with O. Reg 102/94, the GC will conduct a *waste audit* that identifies the waste materials expected to be generated by the construction and/or demolition project.

The GC's *waste audit report*, based on the audit findings, will identify the materials that have to be source-separated to comply with Regulation 103/94 as well as other materials that can be source-separated for recycling, reuse, or salvage. It will identify the materials that cannot be diverted (residual waste) that will go to landfill.

See Part 5 of this document for the Ministry of the Environment, Conservation and Parks (MOECP) form.



Process Owner:	PM, SPM, MNG, P.DIR	Approver:	N/A
Document #:	PMO-ENV-001		

Appendix 2

Waste Reduction Work Plan O. Reg 102/94 & O. Reg 103/94

The Construction Administrator (CA) shall confirm the GC has completed the waste audit report before creating the waste reduction work plan.

Using the waste audit report results, the GC creates a *waste reduction work plan* which shows how the waste will be separated at the project site and what programs will reduce, reuse, and recycle the waste generated by the project.

Download the MOECP's Waste Reduction Work Plan form [here](#).

See Part 5 of this document for the Ministry of the Environment, Conservation and Parks (MOECP) form.

End of Part 1



Process Owner:	PM, SPM, MNG, P.DIR	Approver:	N/A
Document #:	PMO-ENV-001		

Part 2 - CREM Obligatory Waste Tracking Report on completion of project (NEW)

To track the waste generated by large construction and demolition projects (2,000 sq. ft), the PMO is directing PMs to ensure GCs submit a waste tracking report at regular intervals and upon completion. It is essential the PMO has a record of the types of waste and how the wastes were managed by the GC in compliance with the Ontario Regulations 102/94 and 103/94.

Identifying how waste was recycled, salvaged, or landfilled can highlight project areas where waste reduction can be introduced with a view to salvaging materials for future reuse.

Once the project is completed, and as part of the project closure documents, the GC will sign and submit a Waste Tracking Report to the CM / PM.

The PM will acknowledge receipt of the Report and submit it to be filed in the project's closeout folder.

Signed and dated weigh tickets and receipts from all haulers and recycling facilities, salvage companies and landfill sites, must accompany the report.

The PM is responsible for acknowledging receipt of the Report and filing it with attachments in the project's closeout folder.

See Part 5 of this document for the CREM Waste Tracking Report template.

End of Part 2



Process Owner:	PM, SPM, MNG, P.DIR	Approver:	N/A
Document #:	PMO-ENV-001		

Part 3 - Toronto Green Standard v4

The following is taken from the TGS v4 website.

The Toronto Green Standard Version 4 consolidated Standard applies to **all new City Agencies, Corporations & Division-Owned** residential and non-residential development projects (including additions) that are greater than 100m² GFA.

The TGS includes two requirements for waste management plans for your projects under the Solid Waste section, Construction Waste Management, SW 4.1 and 4.2 with detailed specifications outlining the requirements.

SW 4.1 Construction Waste Management

Manage construction and demolition waste in accordance with O. Reg. 103/94, of the Environmental Protection Act, which applies to large construction projects that contain one or more City buildings and have a total floor area greater than 2000m², as amended: Industrial, Commercial and Institutional Source Separation Programs. 1,2

SW 4.2 Construction Waste Diversion ((Refer to Specifications & Resources 3,4,5)

Waste Management Plan and Report

All projects must develop and implement a construction and demolition waste management plan and divert at least 75 per cent of the total construction and demolition material from landfill: diverted materials must include at least four material streams.

OR

Generate less than 100 kg/m² of construction and demolition waste through reuse and source reduction design strategies. Salvage or recycle renovation and demolition debris and utilize waste minimizing design strategies for new construction elements. Track all materials generated by the project from start of construction through project completion to determine the project's total waste generation. Include all waste and diverted materials in the calculation of total project waste. Exclude hazardous materials and land-clearing debris from calculations.

Further specifications and resources available at

<https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/toronto-green-standard/toronto-green-standard-version-4/city-agency-corporation-division-owned-facilities-version-4/waste-and-the-circular-economy/>

End of Part 3



Process Owner:	PM, SPM, MNG, P.DIR	Approver:	N/A
Document #:	PMO-ENV-001		

Part 4 - City of Toronto's guidelines for Renovations by Divisions, Agencies and Corporations

The City's Renovation Projects Guidelines provide a consistent approach when dealing with renovations in the City of Toronto to mitigate health and safety concerns associated with this work through enhanced communication, selection of products and recommended work practices.

Renovations are not covered by Regs 102/94 and 103/94.

CREM PMs are expected to follow 'best practices' regarding waste generated by renovation projects. There is no need for waste audit reports or waste reduction plans, but PMs should be aware of what is happening with the waste the project generates.

These are the City of Toronto Renovation Projects Guidelines for project managers doing office renovations.

<https://www.toronto.ca/city-government/accountability-operations-customer-service/city-administration/corporate-policies/people-equity-policies/renovation-projects-guidelines/>







End of Part 4



Process Owner:	PM, SPM, MNG, P.DIR	Approver:	N/A
Document #:	PMO-ENV-001		

Part 5 - Forms and Resources

Guides and Forms:

Document Name	
A Guide to Waste Audits and Waste Reduction Work Plans for Construction & Demolition Projects	 2481e01-A Guide to Waste Audits and W
Completed Waste Audit Form Form Sample	 CompletedWASamp le-CD.pdf
Completed Waste Reduction Work Plan Form Sample	 CompletedWRWPS ample-CD.pdf
Blank Waste Audit Form	 WA-CD.doc
Blank Waste Reduction Work Plan Form	 WRWP-CD.doc
CREM Waste Tracking Report	 2025.06.05-Waster Tracking Report v1.0.c

End of Part 5

Ministry of the Environment Waste Form
Report of a Waste Audit
Large Construction and Demolition Projects

As required by O. Reg. 102/94

This report must be prepared before construction or demolition begins at the site. The waste audit must be retained on file for at least five years after it is prepared, and be made available to the ministry upon request. (revised July 2008)

I. GENERAL INFORMATION

Name of Person Undertaking Project and Company Name:			
Name of Contact Person and Company:		Telephone #:	Email address:
Project Type (Check One)*	Construction Project		Demolition Project
Floor Area (square metres):		Number of Buildings:	
Street Address of Project Site (if known):			
Lot and Plan Number:		Municipality:	
Estimated Start Date of Project:		Estimated Completion Date of Project:	

** Separate reports must be made for construction and demolition projects regardless if they occur on the same site.*

II. DESCRIPTION OF PROJECT

Provide a brief overview of the construction or demolition project:
--

III. CATEGORIES OF WASTE AND WASTE ITEMS

List the categories of waste the project will produce and the associated waste items for each category (<i>see part VI for examples of categories of waste</i>):	
Categories of Waste	Waste Items
<i>Example: Wood</i>	<i>Lumber cut-offs, Old Window frames</i>

IV. PRODUCTION OF WASTE

For each category of waste listed in Part III of this form, explain how the waste at the construction or demolition project will be produced. Include references to how management decisions and policies will affect the production of waste:	
How Waste Is Produced	Decisions/Policies Affecting Waste Produced
<i>Example: Cut-offs and over-runs of waste shingles are produced during roofing.</i>	<i>Look at more accurate measurements for estimating amount of roofing shingles required</i>

V. MANAGEMENT OF WASTE

For each category of waste listed in Part III of this form, indicate which waste items will be disposed or reused/recycled and how each item will be managed at the project:

[illegible]

VI. ESTIMATED QUANTITY OF WASTE PRODUCED

Categories of Waste	Estimated Amount of Waste Produced (tonnes)	Categories of Waste (continued)	Estimated Amount of Waste Produced (tonnes)
Brick and Concrete		Tile Flooring	
Cardboard		Carpet	
Drywall (unpainted)		Glass	
Drywall (painted)		Plaster	
Steel		Blue Box – Newspaper, cans, etc.	
Wood (unpainted or untreated)		Other	
Wood (painted/treated)			
Plastic (pipes, film, etc)			
Polystyrene Foam			
Porcelain Fixtures			
Insulation			
Asphalt			
Aluminum			
Roof Shingles			
TOTAL		TOTAL	

Note: When completing this form, write “n/a” in the Estimated Amount of Waste Produced column where the project will not produce any waste for a category of waste.

VII. EXTENT TO WHICH MATERIALS OR PRODUCTS USED BY THE ENTITY CONSIST OF RECYCLED OR REUSED MATERIALS OR PRODUCTS

Please answer the following questions:

1. Do you have a management policy in place that promotes the purchasing and/or use of materials or products that consist of recycled and/or reused materials or products? If yes, please describe.

2. Do you have plans to increase the extent to which materials or products used consist of recycled or reused materials or products? If yes, please describe.

Please attach any additional page(s) as required to answer the above questions.

I hereby certify that the information provided in this Report of Waste Audit is complete and correct.		
Signature of authorized official:	Title:	Date:

Ministry of the Environment Waste Form
Report of a Waste Reduction Work Plan
Large Construction and Demolition Projects

As required by O. Reg. 102/94

This report must be prepared before construction or demolition begins at the site. The waste reduction work plan must be retained on file for at least five years after it is prepared, and be made available to the ministry upon request.

I. GENERAL INFORMATION

Name of Person Undertaking Project and Company Name:			
Name of Contact Person and Company Name:	Telephone #:	Email Address:	
Project type (check one)*	Construction Project	<input type="checkbox"/>	Demolition Project
Floor Area (square metres):	Number of Buildings:		
Street Address of Project Site (if known):			
Lot and Plan Number:		Municipality:	
Estimated Start Date of Project:		Estimated Completion Date of Project:	

** Separate reports must be made for construction and demolition projects regardless if they occur on the same site.*

II. DESCRIPTION of PROJECT

Provide a brief overview of the construction and/or demolition project:

III. PLANS TO REDUCE, REUSE AND RECYCLE WASTE

For each category of waste described in Part III of “Report of a Waste Audit” (on which this plan is based), explain what your plans are to reduce, reuse and recycle the waste, including:

1) how the waste will be source separated at the project, and 2) the programs to reduce, reuse and recycle all source separated waste.

[illegible]

IV. RESPONSIBILITY FOR IMPLEMENTING THE WASTE REDUCTION WORK PLAN

Identify who is responsible for implementing the Waste Reduction Work Plan at the construction or demolition project. If more than one person is responsible for implementation, identify each person who is responsible and indicate the part of the Waste Reduction Work Plan that each person is responsible for implementing.

Name of Person	Responsibility	Telephone #

V. TIMETABLE FOR IMPLEMENTING WASTE REDUCTION WORK PLAN

Provide a timetable indicating when each Source Separation and 3Rs program of the Waste Reduction Work Plan will be implemented.

[illegible]

VI. COMMUNICATION TO WORKERS

Explain how the Waste Reduction Work Plan will be communicated to workers at the site of the construction or demolition project:

VII. ESTIMATED ANNUAL WASTE PRODUCED BY MATERIAL TYPE AND THE PROJECTED ANNUAL AMOUNT TO BE DIVERTED BY THE 3Rs

[illegible]

* Estimated Waste Produced = Waste Diverted (3Rs) + Waste Disposed

** Estimated Waste Diversion Rate = Amount of Waste Diverted (3Rs) ÷ Estimated Waste Produced x 100%

Note: When completing this form, write “n/a” in the Estimated Waste Produced column where the project will not produce any waste from a material category.

I hereby certify that the information provided in this Waste Reduction Work Plan is complete and correct.

Signature of authorized official:

Title:

Date:

1 General

1.1 **SUMMARY**

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

.2 Restore damaged or disturbed Work.

.3 Be responsible for providing and performing items required and necessary other than specified, in order to complete the Work.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

.1 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **SUBMITTALS**

.1 Shop Drawings:

.1 Submit Shop drawings indicating proposed location and construction of hoarding, fencing, barriers, and dust-tight partitions, including plan for maintaining access during each stage of the Work.

.2 Submit a demolition plan for Consultant's review. Demolition plan shall be prepared by a qualified Professional Engineer licensed in the Province of Ontario.

.3 Submit copies of certified weigh bills receipts from authorized disposal sites and reuse and recycling facilities for all material removed from Site upon request of Consultant. Written authorization from the Consultant is required to deviate from the haulers facilities receiving organizations listed in waste reduction workplan.

1.4 **MAINTAINING ACCESS**

.1 Maintain and preserve Owner's access requirements to and from existing buildings in areas where demolition and removal Work is carried out and throughout the existing structures.

.2 Do not close, obstruct, place or store material in Owner's driveways and passageways. Conduct operations with minimum interference to roads, streets, driveways and passageways.

.3 Provide and erect barriers, maintain lights, and traffic control as required by the Owner, municipal traffic regulations or building by-laws.

.4 Maintain access to fire exits.

1.5 **HAULING OPERATIONS**

.1 Haul and move machines, vehicles and equipment over designated route and within Work areas as designated by Consultant.

.2 Maintain roadways and paving in the hauling areas clean on a daily basis and as required by municipal authorities.

- .3 Location of chutes, rubbish containers, hoisting equipment and the like shall be subject to approval by Owner and such that they will not unduly impede pedestrian or vehicular traffic and will not obstruct entrances and exits.

1.6 **INTERRUPTIONS TO OWNER'S OPERATIONS**

- .1 There will be absolutely no interruptions to Owner's operations permitted. Execute machine and equipment movements, deliveries and removals at time or times that will permit uninterrupted Owner's operations in and around buildings, including parking, deliveries and Site access and egress.
- .2 Carry out Work in such a manner to cause a minimum of noise or interference to adjoining operations and approval of Owner obtained before proceeding with any Work which may cause interference.
- .3 Service lines to be modified, if any, must be kept in service throughout the construction period except for brief change-over periods.
- .4 Maintain such services. Prepare sketches and detailed schedule of Work, and submit to Consultant for review.

1.7 **PROJECT/SITE CONDITIONS**

- .1 Existing Conditions
 - .1 The Demolition Drawings indicate the physical dimensions, existing levels and similar items being indicated where known and shall be read in conjunction with the new Drawings. Not all demolition Work may be shown in its entirety; the Contractor shall include for any demolition required to complete the new Work specified and on the Drawings.
 - .2 All information relative to existing conditions is offered to assist the Contractor in evaluation of the Work, but with no specific representation, either expressed or implied, as to completeness or accuracy. Be responsible for any deductions or conclusions made on the basis of this information and that of any additional Site inspections, if made.
- .2 Prior to beginning field construction Work, survey and record the condition of existing conditions to remain in place that might be affected by the demolition operations. After demolition operations are completed, survey the conditions again and restore existing facilities to their pre-demolition condition.
- .3 Protection
 - .1 Protect Work to remain against damage. Repair or replace damaged Work.
 - .2 Maintain in service and protect from damage, the existing utilities that are to remain.
 - .3 Conduct demolition operations to ensure safety of all persons and to prevent damage to existing structures and utilities, construction in progress, and other property.
 - .4 Conduct demolition operations and remove debris to disposal areas in a manner to ensure maximum safety and minimum interference with other operations.

- .5 Protect building floor and roof against damage from operations under this section, including lifting, moving, rolling, etc., of materials. Use 13 mm thick plywood covers with ends mechanically joined, over floor for any such handling. Over roof, provide 19 mm thick plywood underlaid with 25 mm thick polystyrene insulation board adhered to same. Provide same when working from, or over roof surfaces. Be responsible for repairs of any damage caused.
- .6 Provide temporary sheeting, shoring, bracing, underpinning and other protective measures, as required to prevent movement, collapse of, or damage to unsupported walls and other facilities as a result of demolition operations.
- .7 Support affected structures and, if safety of structure being demolished or adjacent structures or services appears to be endangered, take preventative measures and then cease operations and notify Consultant.
- .8 Remove and dispose of all temporary Work when no longer required.
- .9 Should material resembling spray or trowel applied asbestos or any other designated substance listed be encountered in the course of demolition, stop Work, take preventative measures, and notify Consultant immediately. Do not proceed until written instructions have been received.
- .10 Prevent extraneous materials from contaminating air beyond application area, by Providing temporary enclosures during demolition Work.
- .11 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on temporary roads.
- .12 Provide temporary means of exit as required for affected exits or entrances.
- .13 Protect existing air intakes for existing building ventilation system. Carry out all operations so as to prevent dust entering these intakes, using dampening abatement measures and protection.
- .14 Pay particular attention to prevention of fire and elimination of fire hazards which would endanger the Work or adjacent buildings and premises.
- .15 Keep and maintain fire extinguishers throughout the Work at all times to the approval of the fire marshal, and located at convenient and accessible points.

1.8 **UNEXPECTED CONDITIONS**

- .1 If existing active services are unexpectedly encountered, are not indicated on Drawings, or otherwise made known and interfere with permanent facilities under construction, notify Consultant and Owner in writing, requesting instructions on their disposition. Take immediate steps to ensure that services provided are not interrupted, and do not proceed with the Work until written instructions are received.

1.9 **COORDINATION**

- .1 Mechanical
 - .1 This clause is supplementary and complementary to demolition requirements specified in the mechanical divisions. Where there is conflict between this section and the mechanical divisions, the requirements of the mechanical divisions shall govern.
 - .2 Coordinate the Work to facilitate removal of walls and cutting of new openings. Disconnect, remove, cap off and relocate existing lines interfering with such Work. Remove and/or relocate equipment as required.

- .3 Carry out alterations to existing mechanical systems as shown on Drawings and as required to interconnect new and existing systems.
- .4 Do all cutting, patching and making good of existing structure required to complete mechanical Work.
- .5 Refer to mechanical division for specific requirements.
- .2 Electrical
 - .1 This clause is supplementary and complementary to demolition requirements specified in the electrical divisions. Where there is conflict between this section and the electrical divisions, the requirements of the electrical divisions shall govern.
 - .2 Coordinate to facilitate demolition, removals, cutting of new openings, door widening and alteration in existing building, disconnecting, removing and/or relocating existing wiring, fixtures and devices interfering with such Work.
 - .3 Carry out all alterations to existing electrical, signal, and fire alarm systems as shown on Drawings and as required to interconnect new and existing systems.
 - .4 Disconnect and/or re-route electrical data, communication and telephone service lines entering structures to be demolished. Remove abandoned lines as indicated on Drawings. Post warning signs on electrical lines and equipment which is required to remain energized.
 - .5 Remove or relocate existing equipment and services unexpectedly encountered, not indicated on Drawings, and interferes with such Work.
 - .6 Do all cutting, patching, and making good of existing structure and finishes as required to complete electrical Work. Remove and replace existing acoustic tile ceilings where required. Be responsible for replacement of any tile soiled or marred as a result.
- 2 Products
 - 2.1 **MATERIALS**
 - .1 Temporary wood studs: Construction grade spruce.
 - .2 Polyethylene sheet: 0.152 mm, thick, clear, stapled in place.
 - .3 Plywood: Douglas fir plywood.
 - 3 Execution
 - 3.1 **EXISTING FURNITURE**
 - .1 Remove and store existing furniture:
 - .1 Contractor will coordinate the removal and storage of existing desks on the 2nd floor with Guardian, contact Jordan Bedwell at jordan@guardianvanlines.com.

3.2 **TEMPORARY PARTITIONS OR DUST PROOF SCREENS**

- .1 Dust proof partitions or screens: Before any Work proceeds in any particular area in the existing building, temporarily enclose the area and access thereto, with light stud and plywood, clean polyethylene sheet material or, clean polyethylene sheet screen overlapped 100 mm and taped at floor, ceiling and doors, walls or intersecting members, in a manner to prevent dust and dirt infiltration into the adjoining areas.
- .2 Where access is required through partition, provide a solid core wood door or hollow steel door, in steel frame, equipped with self-closing and latching hardware.
- .3 Where an exit is closed off due to construction activities, provide alternate exit acceptable to both the Owner and to Authorities Having Jurisdiction. Temporary exits shall be clearly identified with appropriate signage.
- .4 Take every possible precaution to prevent dust and dirt resulting from the Contract operations from entering Owner's operational areas. Adjust and relocate such partitions or screens as required for the various operations under the Contract.
- .5 As Work progresses, Contractor shall remove and relocate, reconfigure or adjust the dust proof partitions and/or construction hoarding as required to accommodate the construction progress and to ensure that the construction areas remain secure at all times.
- .6 Weather Protection
 - .1 Provide weather protection screens similar to above in areas where existing building interior is exposed to the elements.
 - .2 Provide protection in the form of tarpaulins, plywood or polyethylene for temporary roof and wall openings and other exposed areas, before final construction is in place.

3.3 **DEMOLITION AND REMOVALS**

- .1 Carry out demolition Work, removal of existing materials and equipment, and disposal of resultant debris. Proceed with demolition of or alteration to any portion of existing building ONLY after thorough protection of existing building has been achieved.
- .2 Demolition shall proceed safely in systematic manner from roof to grade and as necessary to accommodate remedial Work indicated. Work on each floor level shall be complete before commencing Work on supporting structure and safety of its supports are impaired. Parts of building which would otherwise collapse prematurely shall be securely shored. Walls and piers shall not be undermined.
- .3 Do not overload floor or wall with accumulations of material or debris or by other loads.
- .4 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as Work progresses.
- .5 During demolition operations, keep Work wetted down with fog sprays to prevent dust and dirt rising. Provide heavy duty water hose for this purpose; connect to Owner's existing water source where directed by Consultant.
- .6 Where Work includes cutting of roof openings, Provide a plywood catchboard immediately under the areas to be cut so as to protect the building interior from falling debris. Provide catchboard in combination with weather screens previously specified.

- .7 Confine operations and workmen to those parts of the building which are defined on Drawings, and exercise great care not to damage existing construction beyond that necessary for carrying out new Work and make good any such damage in every respect.
- .8 Concrete:
 - .1 Demolish concrete by methods which avoid impact loads on items which are not to be demolished.
 - .2 Where only part or parts of a concrete floor, wall, roof, foundation or other items are to be demolished, use saw cuts to isolate areas which are to be demolished except where existing reinforcing steel is to be left in place. Prior to such isolating, install suitable support to prevent premature movement of area(s) being isolated and undesirable transfer of loads as cutting progresses. If necessary remove area(s) to be demolished by successively isolating small sections.
 - .3 Where reinforcing steel is to be left in place, use saw cuts from surface of concrete reinforcing steel around perimeter(s) of area(s) to be demolished, chip concrete without damaging reinforcing steel. Retouch damaged epoxy coating of existing reinforcing steel.
- .9 Masonry: Demolish block or brick walls in small sections of not more than 2 m². Where only part(s) of a wall is to be demolished, install adequate support for adjacent part(s). Do not permit masonry to fall in mass from one level to another
- .10 Where doors are scheduled to be removed for disposal, include removal of door frames and door hardware.
- .11 Remove interior partitions, fittings, fixtures and accessories as indicated on Drawings. Partitions and walls shall be removed full height to structure above.
- .12 Ceiling
 - .1 Removal of existing ceilings shall include complete removal including bulkheads and suspension system.
 - .2 Where ceilings are to be removed to accommodate Work, and later reinstalled, carefully disassemble ceilings to the extent required.
 - .3 Where ceilings are to remain after wall or bulkheads are demolished, remove ceiling components as required to complete demolition work. Coordinate with trades doing new ceiling work, and confirm what components are to be retained for reuse. Cut tiles may not be used; new full or appropriately cut tiles will be required.
- .13 At end of each day's Work:
 - .1 Leave Work in safe and stable condition. Protect interiors of parts not to be demolished from exterior elements at all times.
 - .2 Leave Work in safe condition so that no part is in danger of toppling or falling.
 - .3 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.
 - .4 Ensure that demolition Work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.

- .5 Do not dispose of waste or volatile materials such as: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers. Ensure proper disposal procedures are maintained throughout Project.
- .14 Materials to be reused: Where designated on Drawings to be removed and stored for future use, remove, handle and transport such items to point of storage. Perform such Work carefully and with diligence to prevent any damage to the items during removal and in storage.
- .15 Cutting
 - .1 Cut openings through existing walls, partitions, roofs and floors. Establish exact location of steel reinforcing in existing concrete slabs or walls before cutting. Be responsible for damage to existing steel reinforcing and be liable for structural failure. Make good surfaces disturbed with materials to match existing.
 - .2 Use power operated cutting devices. Chipping will not be allowed. Commence breaking out operations only after sawcutting of the cut-off points has been performed in order to prevent damage to remainder of structure and to obtain straight and clean junctions of new and existing works.
 - .3 Use a saw blade which will achieve superior sawing performance. Spalling of remaining concrete at sawcut points will be judged as defective and shall be rectified at no increase in Contract Price. Do not overcut corners (i.e. avoid "intersecting" sawcuts).
 - .4 Demolish masonry and concrete in small sections.
 - .5 Coordinate with mechanical trade and sawcut and breakout existing floor or wall to accommodate new mechanical piping. Have mechanical trade lay out and supervise Work.

3.4 **DISPOSAL OF MATERIALS, RUBBLE AND DEBRIS**

- .1 Surplus materials: Take ownership of surplus materials and remove from Site daily, unless such materials are designated to be reused (or turned over to Owner).
- .2 Rubble and debris: Clean up rubble and debris as they are generated. Dispose of same at end of each day's Work or place in waste disposal bins and empty on a regular basis.
- .3 Stockpiling of surplus materials, rubble and debris on Site will not be permitted.
- .4 Do not burn material on Site.

3.5 **CLEAN-UP**

- .1 Upon completion, clean site(s) in areas disturbed by construction activities, including landscaped areas. Remove and dispose of rubbish, surplus materials, waste materials, tools and other equipment. Leave site(s) in a neat clean and safe condition acceptable to Consultant.
- .2 Vacuum clean and wet mop floors and wipe clean wall surfaces free of dust on completion of Work.

End of Section

1 General

1.1 **GENERAL CONDITIONS AND RELATED WORK**

- .1 This section forms a part of the Contract Document and should be read in conjunction with Section 02 82 00.01 City of Toronto Asbestos Management Policy, Section 02 82 00.02 City of Toronto Asbestos Management Plan and all other Divisions in order to comply with the requirements of the General Conditions of the Contract. Sections 02 82 00.01 and 02 82 00.02 take precedence where there is a conflict in this section.
- .2 It is the intent that work performed as outlined in this specification will result in the removal and disposal of asbestos-containing materials (ACM), lead-containing materials (LCM) and materials that become contaminated by asbestos or lead, as a result of the required work activities.
- .3 Dispose of all waste as specified in applicable sections of the specifications document.
- .4 The Environmental Consultant may perform area air monitoring to verify the effectiveness of dust suppression methods used by the Contractor. Contractor's personnel shall co-operate with the Environmental Consultant in collecting the required air samples.
- .5 This project and all work associated with it is regulated by The Occupational Health and Safety Act, the Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations, Ontario Regulation 278/05; the Designated Substances Regulation, Ontario Regulation 490/09; the Regulation for Construction Projects-Ontario Regulation 213/91; and other applicable regulations, manuals, and guidelines.
- .6 Provide all equipment, material, services, supervision and labour required or specified to complete the scope of work of this project as described in the Contract and Specifications Documents.
- .7 In cases of conflict between procedures outlined in this document, the more stringent requirement will apply.

1.2 **DESCRIPTION OF WORK**

- .1 **Before submitting a bid, confirm the scope of work of the project by visiting the site and reading the entire specification documents and associated drawings. The estimated quantity and other information presented in supporting documents should not be used as the only basis for submitting a bid. It is the abatement contractor's responsibility to confirm all quantities and measurements during the mandatory site meeting.**
- .2 **Each Work Area:** dependent of type of ACM and/or LCM in this Work Area will determine the abatement method best suited for the scope of work. Refer to Table 1 (attached) for a list of the suitable methods based on the abatement scope of work. The following preparations applies to all methods.
 - .1 Pre-clean and remove all moveable objects and items present in the work area.
 - .2 Remove all non-asbestos containing building materials that may be impeding reasonable access to the ACM to be abated, prior to preparations of any abatement work.
 - .3 Pre-clean and remove all debris on the floor prior to preparations of the abatement work.
 - .4 The abatement Contractor shall install scaffolding, if it is required, to access the materials to be cleaned, as required.
 - .5 The abatement Contractor shall be responsible for providing their own temporary lighting, if it is required.

- .6 The abatement Contractor shall be responsible for abatement enclosures that are set up in occupied area(s) to be supervised 100% of the time or a secondary lockable barrier (hoarding) needs to be installed.
- .7 Protect the floor in the immediate vicinity of the Work Area using rip-proof poly drop- sheets.
- .8 Maintain the fire alarm and other life/safety systems in operation. Immediately advise the Project Manager in case the systems are damaged during the execution of the work.
- .9 All the asbestos waste generated in the Work Area shall be double bagged using asbestos labelled yellow bags and disposed as asbestos waste.

The abatement Contractor shall be responsible for the disposal of all waste generated as part of the subject project. This includes the costs related to the procurement of waste bins and the associated handling, transportation and disposal fees. The disposal of waste includes, but is not limited to ACM or LCM, as well as general waste and debris. The abatement Contractor shall ensure that the disposal and recycling of wastes is accounted for in their bid submitted for the project.

1.3

DEFINITIONS

- .1 Abatement: Procedures to control fibre release from asbestos containing building materials. Includes encapsulation, enclosure, and removal.
- .2 Amended Water: Water containing a wetting agent or surfactant that is added for the purpose of reducing water surface tension to allow proper wetting of asbestos material.
- .3 Asbestos: The term includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite, and any of these that have been chemically treated and/or altered.
- .4 Airlock: A system for ingress or egress without permitting air movement between a contaminated area and an uncontaminated area, consisting of two curtained doorways at least 6 feet apart.
- .5 Area Monitoring: Sampling of asbestos fibre concentrations within the asbestos control area and outside the asbestos control area which is representative of the airborne concentrations of asbestos fibers which may reach the breathing zone.
- .6 Asbestos Work/Control Area: An area where asbestos removal operations are performed which is isolated by physical boundaries to prevent the spread of asbestos dust, fibers, or debris.
- .7 Air Monitoring: The process of measuring the asbestos fibre content of a specific volume of air in a stated period of time.
- .8 Asbestos Containing Material (ACM): Any material analyzed and found to contain 0.5 percent more asbestos either alone or mixed with other fibrous or nonfibrous materials.
- .9 Asbestos Fibers: For this specification, asbestos fibers are those fibers 5 microns or longer having an aspect ratio of at least 3:1.
- .10 Authorized Visitor: The building Owner or his representative, persons of any regulatory or other agency having jurisdiction over the project and the asbestos abatement Consultant or his representative.
- .11 Barrier: Any surface that closes up the work area to prevent the movement of fibres.
- .12 Curtained Doorway: A device to allow ingress or egress from one room to another while permitting minimal air movement between the rooms, constructed by placing two overlapping sheets of rip-proof plastic over an existing or temporarily framed doorway, securing each along the top of the doorway, securing the vertical edge of one along one

vertical side of the doorway, and securing the vertical edge of the other sheet along the opposite vertical side of the doorway. The free bottom edge of the plastic sheets shall be weighted to ensure proper closure. The plastic sheets shall overlap by no less than 1.5 meters.

- .13 Critical Barrier: One or more layers of plastic sealed over all openings into a regulated area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a regulated area from migrating to an adjacent area.
- .14 Chemical Stripping Agent Neutralizer: Chemical stripping agent neutralizers may be used on exterior surfaces only. Neutralizers shall be compatible with and not harmful to the substrate that they are applied to and the stripping agent that has been applied to the surface substrate.
- .15 Chemical Stripping Removers: Chemical removers shall contain no methylene chloride products and shall be compatible with and not harmful to the substrate that they are applied to.
- .16 Clean Room: An area or room which is part of the worker decontamination enclosure system used for changing into uncontaminated protective clothing, putting on respiratory equipment, storing clean clothing and, after showering, for dressing in street clothes. No asbestos-contaminated items are allowed in this room.
- .17 Contractor/Supervisor: An individual who supervises asbestos abatement work and has the proper qualifications and training as specified in this document.
- .18 Control Area: An area which is considered uncontaminated and is suitable for regular occupancy.
- .19 Disposal: Procedures necessary to transport and deposit the asbestos contaminated material stripped and removed from the building, piping, and equipment in an approved waste disposal site in compliance with the applicable environmental regulations.
- .20 Demolition: The razing, removing or wrecking of any building component, assembly or system together with any associated handling operations.
- .21 Decontamination Area: An enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.
- .22 Dioctylphthalate (DOP) Test: A test method that uses Dioctylphthalate aerosol to challenge a HEPA filter-equipped negative pressure unit to determine its integrity and effectiveness to filter out asbestos fibres.
- .23 Dirty Room: A contaminated area or room which is part of the worker decontamination enclosure system, with storage for contaminated clothing and equipment.
- .24 Emery 3004 – a compound (a poly-alpha olefin) that may be substituted for DOP in HEPA filter testing.
- .25 Encapsulant: A liquid material which can be applied to ACM and which controls the possible release of asbestos fibers from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant). A third type of encapsulant (removal encapsulant) is a penetrating encapsulant and is designed to be applied during the removal of asbestos-containing materials to minimize the release of fibres.
- .26 Disposal Bag: A 0.15 mm 6 mil thick, leak-tight plastic bag, pre-labeled as containing asbestos waste and used for transporting asbestos waste from containment to disposal site.

- .27 Disturbance: Activities that disrupt the matrix of ACM, crumble or pulverize ACM, or generate visible debris from ACM.
- .28 Encapsulation: Procedures necessary to coat all asbestos-containing materials with an encapsulant to control the possible release of asbestos fibers into the ambient air.
- .29 Enclosure: All herein specified procedures necessary to complete enclosure of all hazardous materials behind airtight, impermeable, permanent barriers.
- .30 Equipment Room: A contaminated area or room which is part of the worker decontamination enclosure system, with storage for contaminated clothing and equipment.
- .31 Friable Asbestos Material: Material that when dry can be crumbled, pulverized or powdered by hand pressure and includes material that is crumbled, pulverized or powdered.
- .32 Filtration System for Water: A multistage system for filtering water from the decontamination shower and wastewater. The system is usually manufactured with two filters: a primary filter and a secondary filter. The primary filter collects and retains particles that are 20 microns or larger and the secondary filter removes particles that are 5 microns or larger.
- .33 Glove Bag System: A portable asbestos abatement system designed for the isolation of an object from which materials containing asbestos are to be removed.
- .34 HEPA Filter Equipment: High efficiency particulate air filtered vacuuming equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall be capable of trapping and retaining at least 99.97 percent of 0.3 micrometer diameter particles.
- .35 Lead: The term includes elemental lead, and/or inorganic and organic lead compounds derived from chemically treated and/or altered elements (i.e. paints, plastics, pigments, glasses, and rubber compounds).
- .36 Lead Cleaning Agent: A cleaning agent suitable for lead dust. Acceptable detergents include products with a high phosphate content (containing at least 5% trisodium phosphate) and/or phosphate-free lead dissolving agents such as LedisolTM or similar product.
- .37 Lead Leachate Material: Any material analyzed and found to have a concentration equal to or greater than 5.0 milligrams per litre (mg/l) or 100 milligrams per kilogram (mg/kg)/ micrograms per gram (µg/g) as per the Regulation Respecting Hazardous Materials (R.S.Q., c.Q-2, r.32).
- .38 Lead Surface Contamination: Any surfaces analyzed and found to have a concentration equal to or greater than 40 micrograms per square feet (µg/ft²) or 4 micrograms per 100 square centimetres (µg/cm²) for floors, 250 µg/ft² (25 µg/cm²) for window sills, and 400 µg/ft² (40 µg/cm²) for window troughs as per the U.S. Environmental Protection Agency (EPA) Lead, Identification of Dangerous Levels of Lead, Final Rule, January 2001 (40 CFR Part 74).
- .39 Lead Waste Container: An impermeable container acceptable to a disposal site and Ministry of Sustainable Development, Environment, and Parks. It shall be labelled as required by the Ministry of Sustainable Development, Environment, and Parks and Transport Canada.
- .40 Lead Work Area: An area where lead removal operations are performed which is isolated by physical boundaries to prevent the spread of lead dust or debris.
- .41 Negative Pressure Fan System: An air purifying fan system located within or outside the isolated work area, which draws air out of the work area through a HEPA filter and discharges this air directly to the exterior of the building, thus keeping the static air pressure in the work area lower than in adjacent areas and preventing infiltration of

contaminated air from work area to adjacent areas. This system shall be equipped with an alarm to warn of system breakdown, shall maintain a minimum pressure differential of 0.02" water gauge relative to adjacent areas outside of work areas and shall be equipped with an instrument to continuously monitor and automatically record pressure differences.

- .42 Non-friable Asbestos Material: Material that contains asbestos in which the fibers have been locked in by a bonding agent, coating, binder, or other material so that the asbestos is well bound and will not release fibers during any appropriate use, handling, demolition, storage, transportation, processing, or disposal.
- .43 Negative Pressure Respirator: A respirator in which the air inside the respiratory inlet covering is negative during inhalation in relation to the air pressure of the outside atmosphere and positive during exhalation in relation to the air pressure of the outside atmosphere.
- .44 Powered Air Purifying Respirator (PAPR): A full-face mask into which filtered air is pumped at approximately 100 – 150 litres per minute (4 – 6 cubic feet per minute). The PAPR consists of a full-face mask, a battery pack, an air pump, high efficiency filter and hoses.
- .45 Personal Monitoring: Sampling of asbestos fibre concentrations within the breathing zone (within 12 inches of the mouth) of an employee.
- .46 Personnel: Supervisors, Contractor employees, subcontractor employees.
- .47 Positive Pressure Respirator: A respirator that maintains a positive pressure inside the facepiece during inhalation and exhalation in relation to the atmospheric pressure.
- .48 Shower Room: A room between the clean room and the equipment room in the worker decontamination enclosure system, with hot and cold or warm running water and arranged for complete showering during decontamination. The shower room comprises an airlock between contaminated and clean areas.
- .49 Supplied-air respirator – an accepted respirator and air-supply hose with a hood/helmet, a tight fitting facepiece that is supplied with compressed breathing air from a compressed breathing air system.
- .50 Surfactant: A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.
- .51 Tape-Sealed Polyethylene Sheets: Rip-proof polyethylene sheets or polyethylene sheets of type and thickness as specified, sealed with tape along the edges, around objects, over cuts and in other locations as required to provide a continuous polyethylene membrane to protect underlying surfaces from water damage and damage by sealant and to prevent the escape of asbestos fibres through the sheeting into a clean area.
- .52 Wet Cleaning: The process of eliminating asbestos from building surfaces and objects by using cloths, mops, or other cleaning tools dampened with water.
- .53 Work Decontamination Enclosure System: A decontamination system for workers, consisting of a clean room, a shower room, and an equipment room. One entrance to the clean room shall be outside of the contaminated area. One entrance to the equipment room shall be connected directly to the contaminated area.
- .54 Work: Includes all labour, supervision, materials and equipment required for the complete execution of the project as specified in the contract.

1.4

WORK SCHEDULE

- .1 It is the responsibility of the contractor to provide the necessary manpower and work shifts to meet the schedule.
 - .1 The start date for the project is to be determined by the Owner (IBI Group)

- .2 The Contractor shall, at no extra cost to the Owner, be responsible for the completion of work required or scheduled to be performed on weekends, holidays and after regular hours and shall be carried out as required to meet the schedule specified.

1.5 **SUBMITTALS**

- .1 All submittals must be received by the Consultant or his representative before the work is allowed to commence.
- .2 The Contractor shall submit the following:
 - .1 Proof that the Contractor has made arrangement for the transport and disposal of asbestos waste. The proof shall be satisfactory to the Consultant.
 - .2 Proof satisfactory to the Consultant that each Supervisor scheduled to work on the project has successfully completed an approved asbestos abatement course and can provide an up to date training certificate issued by a competent entity.
 - .3 One supervisor shall remain on site while asbestos removal or cleanup is being carried out.
 - .4 Copies of Insurance certificates and Workplace Safety and Insurance Board status.
 - .5 D.O.P test results and performance data for negative air unit systems.
 - .6 Proposed work schedule.
 - .7 Work force expected to be present on site daily or according to the schedule.
 - .8 Proposed number of shifts.
 - .9 Layouts of proposed platforms and hoardings for the Consultant's review and approval.
 - .10 Layout of proposed waste and worker decontamination facilities and asbestos work area enclosures.
 - .11 Proof that all workers have successfully completed an approved asbestos abatement course and can provide an up to date training certificate issued by a competent entity.
 - .12 Proof that all workers have received Workplace Hazardous Material Information System (WHMIS) training.
 - .13 A WHMIS information package containing documentation addressing test results, flammability and fire data and Safety Data Sheets (SDSs) for products, chemicals and materials used on site during the course of the asbestos abatement project.
 - .14 Proof satisfactory to the Consultant that each worker scheduled to work on the project has been fit tested for the appropriate respirator to be used.
 - .15 Code of practice for respiratory protection.
 - .16 Pressure differential monitoring data – to be submitted on a daily basis.

1.6 **QUALITY ASSURANCE**

- .1 Ensure that work progresses according to schedule.
- .2 Ensure that work complies with all the requirements of the applicable regulations, guidelines and manuals.
- .3 Ensure that no water runoff or airborne asbestos material contaminates areas outside the asbestos removal work area enclosures. The Consultant has been given authorization by

the Owner to stop any work where contamination of areas outside enclosures is suspected. The Contractor shall be responsible for all costs to rectify the problem.

- .4 Use only skilled and qualified workers for all trades required to work on this project.
- .5 Only the asbestos abatement Contractor, and never the Consultant, is responsible for the following:
 - .1 Safety programs and precautions required by applicable regulations for the work being performed.
 - .2 Control over the acts and omissions of the Contractor's workers, agents, subcontractors and other employees of the Contractor required to perform work on the project.
 - .3 Control over construction techniques, methods, means or procedures.

1.7 **SUPERVISION**

- .1 The Contractor shall provide a trained and qualified shift supervisor for each and every shift during which asbestos removal is being carried out. The Owner reserves the right to stop all work if this requirement is not complied with, at no additional charge to the Owner.
- .2 The shift supervisor shall have the authority to make decisions and take actions with respect to production, manpower and equipment.

1.8 **REGULATIONS**

- .1 The Contractor shall comply with all local, provincial and federal requirements relating to asbestos and lead,
- .2 In case of conflict among the above mentioned requirements or with these specifications, the more stringent requirements shall apply.
- .3 Perform work following the requirements of the various regulations in effect at the time the work is being carried out.
- .4 The regulations shall include, but are not limited to:
 - .1 Ontario Occupational Health and Safety Act.
 - .2 Ontario Regulation 278/05, Regulation Respecting Asbestos on Construction Projects and in Building and Repair Operations.
 - .3 The Designated Substances Regulation, Ontario Regulation 490/09.
 - .4 Ontario Ministry of Environment Regulation 347 (as amended) for the disposal of asbestos waste made under the Environmental Protection Act.
 - .5 Health and Safety Guideline: Lead on Construction Projects, Published by the Ministry of Labour.
 - .6 Health and Safety Guideline: Silica on Construction Projects, Published by the Ministry of Labour.
 - .7 Standard Construction Document, Canadian Construction Association, CCA 82 - 2004.
 - .8 Regulations respecting the Handling, Offering for Transport and Transportation of Dangerous Goods.
 - .9 WHMIS Regulations.

1.9 **NOTIFICATIONS**

- .1 The Contractor shall be responsible for notifying the appropriate regulatory bodies before any work on this project commences:
- .2 The Contractor shall notify an approved industrial land fill site equipped to accept hazardous waste and one which has agreed to accept the waste:
- .3 The Fire Marshall, in cases where the execution of the work will result in blocking building exists or when turning off, removing or temporarily altering fire alarms.
- .4 Prior to conducting any planned abatement work, the Contractor shall notify human resources' occupational health and safety team and the joint health and safety committee of the proposed work schedule.

1.10 **PROSCRIPTIONS**

- .1 The use of compressed air for removal or clean up of asbestos dust and debris from any surface is not allowed.
- .2 Smoking, eating, drinking or chewing is not allowed in the work area.
- .3 Unauthorized persons or persons not using proper personal protective equipment shall not be allowed to enter the work area.
- .4 No entry into the work area shall be permitted to any person who has facial hair growth that prevents the establishment of a proper seal between the respirator and the skin.
- .5 The use of torches, propane-fired heaters and other open flames shall not be permitted in the abatement work area.

1.11 **WORKER AND VISITOR PROTECTION**

- .1 Instruct all personnel (workers and visitors) in all aspects of work procedures and protective equipment before allowing entry into the asbestos and lead abatement work areas.
- .2 A competent person (as defined by the Occupational Health and Safety Act) shall provide all the training and instructions.
- .3 Instructions and training shall include, but shall not be limited to, the following:
- .4 Entry and exit from asbestos abatement work areas.
- .5 Work practices and personal hygiene.
- .6 The use, cleaning and care of respirators and protective clothing.
- .7 Protective measures and work procedures.
- .8 Asbestos work area entry and exit procedures shall be posted in the clean room of the decontamination unit.
- .9 Respiratory Protection:
- .10 All personnel required to wear respirators shall be fit tested either by a qualitative or quantitative fit testing method.
- .11 Each worker or visitor required to enter an asbestos abatement work area shall be provided with a personally issued respirator that is:
- .12 Appropriate for the work that is being carried out.
- .13 Acceptable to the Ministry of Labour, Occupational Health and Safety Division.
- .14 The worker shall be responsible for wearing a respirator that is issued by the Contractor.

- .15 The following criteria, as outlined in Table 2 of O. Reg. 275/05, shall be followed when selecting an appropriate respirator.
- .16 Respirator shall be stored in a clean location such as the clean room of the decontamination unit. This room can also be used for charging PAPR batteries.
- .17 The procedures specified by the equipment manufacturer shall be followed while using and maintaining the respirators.
- .18 Respirators shall be cleaned and inspected at the end of each shift. All damaged and deteriorated parts found during the inspection shall be replaced before the respirator is used again.
- .19 Appropriate combination cartridges shall be used if substances other than asbestos are to be handled inside the asbestos removal work area.
- .20 Used filters shall be tested and replaced as specified by the manufacturer or as specified below. The more stringent testing and replacement protocol shall be followed.
- .21 Cartridges for negative pressure respirators should be replaced every 16 hours of actual usage.
- .22 Cartridges for PAPRs should be replaced every 8 hours.
- .23 Cartridges shall be treated as asbestos waste and shall be disposed of accordingly after usage inside an asbestos removal work area.
- .24 Protective Clothing:
- .25 The Contractor shall provide every worker and authorized visitor with full body disposable coveralls.
- .26 All personnel shall wear the protective coveralls before they are allowed to enter into the asbestos removal work area.
- .27 Coveralls shall be equipped with head covering (hood), foot covering and tight fitting cuffs at the neck, ankles and wrists.
- .28 The disposable coveralls shall be made up of materials that do not readily permit the penetration of asbestos fibers.
- .29 Disposable coveralls shall be immediately repaired (using duct tape) or replaced once torn.
- .30 Coveralls shall be disposed of as asbestos waste once they are worn inside an asbestos abatement area.
- .31 Workers are allowed to wear reusable protective clothing provided that the clothing is left in the equipment room until the end of the asbestos abatement project. The clothing shall then be disposed of as asbestos waste.
- .32 Safety shoes, hard hats and additional body protection equipment shall be used as necessary to meet the requirements of applicable safety regulations.

1.12 **INSPECTIONS**

- .1 The Environmental Consultant will be present on site to carry out quality control inspections for the entire duration of the project. The inspections will be performed during the preparation phase, removal phase and a final inspection upon completion of the abatement work. The inspection will be carried out inside and outside the work areas.
- .2 The purpose of the inspections is to ensure that the work is being carried out following the requirements and procedures outlined in the specification documents and applicable regulations.

- .3 The Environmental Consultant will issue written or verbal instructions to the asbestos abatement Contractor throughout the duration of the project. The instructions will authorize the Contractor to proceed to next phase of work. The general phases of work will consist of the following: Pre-cleaning, set-up and preparation of the work area, removal of specified materials, clean-up of work area and tear down of containment.
- .4 The Contractor shall not proceed to the next phase of work without obtaining authorization from the Environmental Consultant.
- .5 The Environmental Consultant has been given authorization by the Owner to order a shutdown of work in case contamination of areas adjacent to controlled work areas has occurred.
- .6 In all non-controlled areas where it is determined by the Environmental Consultant (through visual inspection or air monitoring) that contamination has leaked, the Contractor shall be responsible to the complete isolation and cleaning of such areas under the direction of the Environmental Consultant and at no extra charge to the Owner.
- .7 The Environmental Consultant has been given authorization by the Owner to ensure that the Contractor adheres to specified procedures and materials and to inspect for completion and final cleanliness. Any additional work (including labour and material charges) specified by the Environmental Consultant to achieve completion of work to the level specified shall be carried out by the Contractor at no additional charge to the Owner.
- .8 The Contractor shall ensure that all equipment and materials to be used on the project are acceptable to the Environmental Consultant. Unacceptable materials and equipment shall be replaced by the Contractor at no additional charge to the Owner.
- .9 The Contractor shall be responsible for all additional inspection charges which are carried out as a result of a failure by the Contractor to meet set criteria relating to schedule, health and safety and quality.

1.13 **AIR MONITORING**

- .1 Air samples will be collected by the Environmental Consultant (on behalf of the owner) from the start of work until the completion of the tear down operations, both inside and/or outside the controlled work areas.
- .2 The objective of air monitoring is to detect defects in the containment of controlled areas and to ensure that any contamination of building spaces beyond the controlled areas is discovered and rectified immediately.
- .3 Any contamination of areas outside the limits of the controlled work areas (as determined by air monitoring) shall be contained and shall be thoroughly cleaned to the Consultant's satisfaction.
- .4 Air monitoring will be carried out following procedures specified in the latest edition of the National Institute for Occupational Safety and Health (NIOSH) method 7400A. The samples will be analyzed by the Phase Contrast Microscopy (PCM) technique as specified in NIOSH method 7400A.
- .5 Air monitoring may also be carried out according to either, or both NIOSH methods described below:
- .6 The latest edition of the National Institute for Occupational Safety and Health (NIOSH) Method 7082. The samples will be analyzed by the Flame Atomic Absorption Spectrophotometer technique as specified in the above noted NIOSH method.
- .7 The Contractor shall cooperate with the Environmental Consultant during air monitoring and shall:
- .8 Ensure that the workers exercise care and avoid damaging the Consultant's equipment.

- .9 Ensure that the samples and equipment are not tampered with.
- .10 Air samples will be analyzed by the PCM method. The area will be considered clean and clear for public occupancy only if the fibre levels are less than 0.01 fibres/cc.
- .11 In case the fibre levels are equal to or greater than 0.01 fibres/cc, the Contractor shall be responsible for re-cleaning the asbestos work area and re-applying the lock-down agent. This process will have to be repeated until the fibre levels are below the specified limit.
- .12 Re-occupancy air samples may be collected and analyzed by NIOSH method 7082 or 77032. The area will be considered clean and clear for public occupancy only if the airborne concentrations levels are less than 0.005 mg/m³ (5 µg/m³).
- .13 In case the concentration levels are equal to or greater than 0.005 mg/m³ (5 µg/m³), the Contractor shall be responsible for re-cleaning the lead work area. This process will have to be repeated until the concentration levels are below the specified limit.

1.14 **WASTE TRANSPORT AND DISPOSAL**

- .1 All hazardous materials, including but not limited to, asbestos or lead containing materials, and equipment and systems containing mercury, existing asbestos or lead contaminated materials and materials that become contaminated by asbestos or lead, as a result of the work, shall be disposed of as prescribed by Ontario Regulation 347, Waste Management Regulation, made under the Environmental Protection Act and the provincial and federal regulations for the Transportation of Dangerous Goods.
- .2 All wash water generated from decontamination activities shall be treated as asbestos waste and shall be disposed of accordingly.
- .3 All non-asbestos containing waste generated during demolition activities inside an asbestos work area shall be treated as asbestos waste.
- .4 Non-porous materials that can be washed and properly cleaned can be disposed of as clean waste.
- .5 All sharp asbestos-contaminated materials (such as hangers, T-bars, wood, etc) that could rip or damage a 6mil polyethylene waste disposal bag shall be disposed of in a sealed solid asbestos waste container.
- .6 The waste must be stored and transported in an enclosed, lockable waste bin.
- .7 Every vehicle used for the transportation of asbestos waste shall display a Class 9 Label.
- .8 Both sides of the vehicle used for the transportation of asbestos waste and every waste bag and container shall display the word CAUTION in letters not less than 10 cm in height and the words:

CONTAINS ASBESTOS FIBRES

Avoid Creating Dust

Asbestos May Be Harmful to Your Health

Wear Approved Protective Equipment

- .9 The transport vehicle must be properly equipped to deal with asbestos waste spills. Equipment shall include, but not limited to, respiratory protective equipment, disposable protective clothing, 6 mil polyethylene bags, shovel and broom and wetting agent.
- .10 For asbestos waste of unknown material or an asbestos type other than Chrysotile, the words Asbestos, Blue, Product Identification Number must be displayed on every waste container.
- .11 For Chrysotile asbestos, the words Asbestos, White, Product Identification Number must be displayed on every waste container.

1.15 **WIPE SAMPLING (WHEN REQUIRED)**

- .1 Wipe samples may be collected by the Environmental Consultant (on behalf of the Owner) following a 2 hour settling period as part of the clearance inspection once the final cleaning procedures have been completed inside the work area(s).
- .2 The objective of wipe sampling is to verify the effectiveness of the cleaning procedures and to ensure that any contamination on surfaces inside the lead work area(s) is discovered and rectified immediately.
- .3 Wipe sampling will be carried out following procedures specified in the latest edition of the National Institute for Occupational Safety and Health (NIOSH) Method 9100 or the American Society for Testing of Materials (ASTM) Standard E1728-99. The samples will be analyzed by either the Flame Atomic Absorption Spectrophotometer technique as specified in NIOSH method 7082 or Graphite Furnace Atomic Absorption Spectrophotometer technique, NIOSH method 7105.
- .4 The clearance standards for settled lead dust inside a lead work area is 40 µg/ft² (4 µg/100cm²) for floors, 250 µg/ft² (25 µg/100cm²) for interior window sills, and 400 µg/ft² (40 µg/100cm²) for window troughs.
- .5 In case the dust levels are equal to or greater than the specified clearance standards, the Contractor shall be responsible for re-cleaning the lead work area. This process will have to be repeated until the concentration levels are below the specified limit.

2 Execution

ASBESTOS

2.1 **TYPE 1 REMOVAL OPERATION**

- .1 Initial Preparation and Isolation of Work Areas: Unless otherwise specified, work carried out as part of this phase shall proceed as follows:
 - .1 Carry out a survey of the work areas to compile an inventory of existing damages and provide a copy to the Consultant.
 - .2 The Contractor is responsible for moving materials and objects which are present in the work areas.
 - .3 Prevent the spread of dust from the work area using measures appropriate to the work to be done.
 - .1 Shut off, lock out and seal all ventilation duct vents with the application of one layer of 6 mil (0.15mm) thick clear polyethylene sheet sealed with tape.
 - .2 Use FR polyethylene drop sheets over all flooring in work areas where dust and contamination cannot otherwise be thoroughly cleaned. This does not apply if work involves the removal of asbestos-containing floor tiles.
 - .3 Use one layer of 6 mil (0.15 mm) thick clear polyethylene sheets to cover walls.
 - .4 Separate parts of the building required to remain in use from the work area by polyethylene drop sheets at the perimeter of the work area.
 - .5 Separate the work area with clearly visible warning signs advising of the hazards of asbestos dust and that entry is restricted to authorized trained personnel wearing personal protective equipment.
 - .6 Erect scaffolding or platforms where necessary to perform the removal work. All platforms that exceed 25 feet in height will require the

submission of a shop drawing stamped by a professional engineer for approval by the inspector within a minimum of 5 days prior to commencing the work. Guard rails shall be provided around all platforms or scaffolding where practicable. Cover the floor area of the scaffold or platform with one layer of FR polyethylene. Extend the floor of scaffolding or platform under an item being removed to act as a receptacle. Polyethylene sheeting shall be suitably braced and/or restrained so that billowing or failure of the polyethylene sheeting or taped joints does not occur.

.2 Entry and Exit Procedures from Asbestos Removal Work Areas: the following general procedures shall be adhered to when entering into and exiting from asbestos abatement work areas:

.1 Work Area Entry Procedures:

- .1 Every worker and visitor planning to enter the work area should remove all street clothing and should store them in a designated clean change room.
- .2 The person shall then put on disposal coverall with head covering, respirators with clean filters and foot covering and shall proceed to the work area.

.2 Work Area Exit Procedures:

- .1 Each worker shall decontaminate their protective clothing, boots and respirator by first HEPA vacuuming and then by damp wiping using soap and water.
- .2 The removed disposable coveralls shall be disposed of as asbestos waste in a 0.15 mm (6 mil) labelled waste bag. Respirator filter inlets shall be sealed in tape or disposed of as asbestos waste.

.3 Asbestos Removal Procedures

.1 Asbestos Removal shall not commence until:

- .1 The work area is effectively separated from clean areas of the building.
- .2 Warning signs are posted outside the removal work areas.
- .3 All surfaces which are not possible to clean are sealed with polyethylene sheeting and tape.
- .4 Arrangements have been made for waste disposal, landfill site operator has been contacted and storage bin is on site.
- .5 Tools equipment and materials are on hand and in the work area.
- .6 Facilities for the washing of hands and face are available for workers leaving the work area.

.2 Before beginning work remove visible dust from surfaces in the work area where dust is likely to be disturbed during the course of the work. Use HEPA vacuum, or damp cloths where damp cleaning does not create a hazard and is otherwise appropriate. Do not use compressed air to clean up or remove dust from any surface.

.3 Wet materials containing asbestos to be cut, ground, abraded, drilled, or otherwise disturbed with amended water. Use garden type low velocity fine mist sprayer. Perform work in a manner to reduce dust creation to lowest levels practicable. Spray asbestos material repeatedly during the work process to minimize asbestos fibre release.

- .4 Additional cement board removal procedures.
 - .1 Cement board shall be removed intact where possible.
 - .2 When not possible to remove intact, the board shall be cut with hand saws where necessary and dust shall be collected with a HEPA vacuum cleaner nozzle held under the cut area.
 - .3 Drop sheets shall be used no more than 0.5 metres below the cutting location and shall be constructed in such a manner that any dust not removed by the HEPA vacuum is collected.
- .5 Remove material in sections as intact as possible.
- .6 Frequently during the work and immediately after completion of the work, clean up dust and waste containing asbestos using a HEPA vacuum or by damp wiping.
- .4 Final Clean
 - .1 When removal is complete, clean the entire work area by HEPA vacuuming and wet wiping.
 - .2 The work area shall be deemed clean by the Inspector when there is no visible residue, dirt, film, stain, or discolouration resulting from either asbestos removal or cleaning activities.
 - .3 After completion of the initial cleaning and after the Inspector has passed the visual inspection, spray sealant on all surfaces in the work area, including, but not limited to:
 - .1 Where asbestos material has been removed.
 - .2 Polyethylene sheeting used on walls, floors and ceilings.
 - .4 Sealant should be sprayed using a garden reservoir type low velocity fine mist sprayer. The sprayer cannot be used if the nozzle is partially obstructed, or if a uniform fine mist spray cannot be obtained.
 - .5 After the area is declared clean and written approval to proceed has been received from the Inspector:
 - .1 Dismantle boundaries and isolating barriers as asbestos waste. Drop sheets shall be wetted and folded to contain dust and then placed in waste bags.
 - .2 Immediately before their removal from the work area, and disposal, clean each filled labelled waste bag using damp cloths or HEPA vacuum and place in second clean clear polyethylene waste bag.
 - .3 Dispose of waste as per procedures specified in subsection 1.14 Waste Transport and Disposal.
 - .6 Repair or replace objects damaged in the course of the work. Re-establish objects moved to temporary locations in the course of the work, in their proper positions. Re-secure mounted objects removed in the course of the work in their former positions.

2.2 **TYPE 2 REMOVAL OPERATION: FOR WORK IN ENCLOSURES**

- .1 Initial Preparation and Isolation of Work Areas: Unless otherwise specified, work carried out as part of this phase shall proceed as follows:
 - .1 Carry out a survey of the work areas to compile an inventory of existing damages and provide a copy to the Consultant.

- .2 The Contractor is responsible for moving materials which are present in the work.
- .3 Prevent the spread of dust from the work area using measures appropriate to the work to be done.
 - .1 Shut off, lock out and seal all ventilation duct vents with the application of one layer of 6 mil (0.15 mm) thick clear polyethylene sheet sealed with tape.
 - .2 Clean all moveable objects within proposed work area using a HEPA vacuum.
 - .3 Clean fixed casework, plant, and equipment within proposed work area, using a HEPA vacuum and cover with polyethylene sheeting sealed with tape.
 - .4 Clean proposed work areas using, where practicable, HEPA vacuum cleaning equipment. Do not use methods that raise dust, such as dry sweeping, or vacuuming using other than HEPA filter-equipped vacuums.
 - .5 Cover and seal airtight light fixtures, duct openings and other suspended ceiling objects using clear 6 mil polyethylene sheeting and tape.
 - .6 Erect scaffolding or platforms necessary to perform the removal work. All platforms that exceed 25 feet in height will require the submission of a shop drawing stamped by a professional engineer for approval by the inspector within a minimum of 5 days prior to commencing the work. Guard rails shall be provided around all platforms or scaffolding where practicable.
 - .7 Cover floor area of scaffold or platform with one layer of FR polyethylene.
 - .8 Extend scaffolding or platform under the item being removed to prevent material from falling.
 - .9 Separate parts of the building required to remain in use from the work area by polyethylene drop sheets at the perimeter of the work area.
 - .10 Set up an airtight enclosure around the work area where the work on friable asbestos- containing material is to be carried out. Enclosure should be set up using 1 layer of FR polyethylene sheeting to cover the floors, and 1 layer of 6 mil (0.15 mm) thick clear polyethylene sheeting to cover the walls. Two layers of FR polyethylene sheeting should be used to cover carpeted floors. Polyethylene on the walls should be made to overlap with the polyethylene on the floor a minimum of 300 mm.
 - .11 Polyethylene sheeting shall be suitably braced and/or restrained so that excessive billowing or failure of the polyethylene sheeting or taped joints does not occur as a result of the negative pressure differential created by the vacuums.
 - .12 Erect a temporary structure made of wooden studs to support polyethylene sheeting where necessary.
 - .13 Insert a hose of a HEPA filter equipped vacuum into the enclosure to provide negative air pressure inside the enclosure.
 - .14 Entrance to the enclosure should be covered with two pieces of overlapping polyethylene sheeting.

- .15 Separate the work area with clearly visible warning signs advising of the hazards of asbestos dust and that entry is restricted to authorized trained personnel wearing personal protective equipment.
- .2 Entry and Exit Procedures from Asbestos Removal Work Areas: the following general procedures shall be adhered to when entering into and exiting from asbestos abatement work areas:
 - .1 Work Area Entry Procedures:
 - .1 Every worker and visitor planning to enter the work area should remove all street clothing and should store them in a designated clean change room.
 - .2 The person shall then put on disposal coverall with head covering, respirators with clean filters and foot covering and shall proceed to the work area through the flaps covering the entrance to the enclosure.
 - .2 Work Area Exit Procedures:
 - .1 Each worker shall decontaminate their protective clothing, boots and respirator by first HEPA vacuuming and then by damp wiping using soap and water.
 - .2 The removed disposable coveralls shall be disposed of as asbestos waste in a 0.15 mm (6 mil) labelled waste bag. Respirator filter inlets shall be sealed in tape or disposed of as asbestos waste.
- .3 Asbestos Removal Procedures
 - .1 Asbestos Removal shall not commence until:
 - .1 The work area is effectively separated from clean areas of the building.
 - .2 Warning signs are posted outside the removal work areas.
 - .3 All surfaces which are not possible to clean are sealed with polyethylene sheeting and tape.
 - .4 Arrangements have been made for waste disposal, landfill site operator has been contacted and storage bin is on site.
 - .5 Tools equipment and materials are on hand and in the work area.
 - .6 Facilities for the washing of hands and face are available for workers leaving the work area.
 - .2 Before beginning the work remove visible dust from surfaces in the work area. Use HEPA vacuum, or damp cloths where damp cleaning is considered more appropriate. Do not use compressed air to clean up or remove dust from any surface.
 - .3 Wet materials containing asbestos to be removed, disturbed, or sealed with amended water. Garden reservoir type low velocity fine mist sprayer may be used. Perform work in a manner to reduce dust creation to lowest levels practicable. Spray asbestos material repeatedly during the work process to minimize asbestos fibre dispersion.
 - .4 Removed material has to be placed directly in waste bags. Wherever possible, asbestos- containing material should be removed in sections as intact as possible.
 - .5 Areas that used to be covered with the asbestos-containing material should be cleaned after the material is removed, using brushes, steel wool, or any other tools suitable.

- .6 Frequently during the work and immediately after completion of the work, clean up dust and waste containing asbestos using a HEPA vacuum or by damp wiping.
- .7 All labelled waste bags should be placed in clean clear 6 mil poly bags before they are taken out of the enclosure.
- .4 **Final Clean**
 - .1 When removal is complete, clean the entire work area by HEPA vacuuming and wet wiping.
 - .2 All tools and equipment used in the removal process such as hook knives, extension cords, scrapers, wire brushes, garden sprayers etc, should be washed and cleaned and placed in 6 mil polyethylene bags.
 - .3 The work area shall be deemed clean by the Inspector when there is no visible residue, dirt, film, stain, or discolouration resulting from either asbestos removal or cleaning activities.
 - .4 After completion of the initial cleaning and after the Inspector has passed the visual inspection, spray sealant on all surfaces in the work area, including, but not limited to:
 - .1 Where asbestos material has been removed.
 - .2 Polyethylene sheeting used on walls, floors and ceilings.
 - .5 Sealant should be sprayed using a garden reservoir type low velocity fine mist sprayer. The sprayer cannot be used if the nozzle is partially obstructed, or if a uniform fine mist spray cannot be obtained.
 - .6 Enclosure should be left standing until all the sealant has dried or, if required, until an air sample is taken inside the enclosure, and the fibre concentration level is below 0.05f/cc.
 - .7 After the area is declared clean and written approval to proceed has been received from the Inspector:
 - .1 Dismantle boundaries and isolating barriers and treat as asbestos waste. Drop sheets shall be wetted and folded to contain dust and then placed in waste bags.
 - .2 Immediately before their removal from the work area, and disposal, clean each filled labelled waste bag using damp cloths or HEPA vacuum and place in second clean clear polyethylene waste bag.
 - .3 Dispose of waste as per procedures specified in subsection 1.14 Waste Transport and Disposal.
 - .8 Repair or replace objects damaged in the course of the work. Re-establish objects moved to temporary locations in the course of the work, in their proper positions. Re- secure mounted objects removed in the course of the work in their former positions.

2.3 **TYPE 2 REMOVAL OPERATION: FOR WORK USING GLOVE BAGS**

- .1 **Initial Preparation and Isolation of Work Areas:** Unless otherwise specified, work carried out as part of this phase shall proceed as follows:
 - .1 Carry out a survey of the work areas to compile an inventory of existing damages and provide a copy to the Consultant.
 - .2 Prevent the spread of dust from the work area using measures appropriate to the work to be done.

- .1 Shut off, lock out and seal all ventilation duct vents with the application of one layer of 6 mil (0.15 mm) thick clear polyethylene sheet sealed with tape.
 - .2 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over all flooring in work area where dust and contamination cannot otherwise be safely contained.
 - .3 Separate parts of the building required to remain in use from the work area by polyethylene drop sheets around the perimeter of the work area.
 - .4 Separate the work area with clearly visible warning signs advising of the hazards of asbestos dust and that entry is restricted to authorized trained personnel wearing personal protective equipment.
- .2 Worker Protection Procedures
- .1 Before proceeding to the work area:
 - .1 Each worker shall don respirator and disposable coveralls, including head covering and suitable foot wear. Removal of street clothes in a designated clean room before wearing the disposable coveralls is recommended.
 - .2 Before leaving the work area:
 - .1 Each worker shall decontaminate their protective clothing, boots and respirator by first HEPA vacuuming and then by damp wiping using soap and water.
 - .2 The removed disposable coveralls shall be disposed of as asbestos waste in a 6 mil (0.15 mm) labelled waste bag.
 - .3 The worker shall proceed to clean their hands and arms. The waste water should be collected and filtered using a filter that passes particles 5 microns in size and smaller, before it is discharged into the municipal sewer system.
- .3 Asbestos Removal Procedures
- .1 Asbestos Removal shall not commence until:
 - .1 The work area is effectively separated from clean areas of the building by polyethylene drop sheets and the placing of rope barriers at the boundary of the designated work area. The boundaries of the work area shall be a minimum of 10 feet from the location of the insulation being removed.
 - .2 Warning signs are posted outside the removal work areas.
 - .3 All surfaces which are not possible to clean are sealed with polyethylene sheeting and tape.
 - .4 Arrangements have been made for waste disposal, landfill site has been contacted and storage bin is on site.
 - .5 Tools equipment and materials are on hand and in the work area.
 - .6 Facilities for the washing of hands and face are available for workers leaving the work area.
 - .2 Before beginning work remove visible dust from surfaces in the work area where dust is likely to be disturbed during the course of the work. Use HEPA vacuum, or damp cloths where damp cleaning does not create a hazard and is otherwise

- appropriate. Do not use compressed air to clean up or remove dust from any surface.
- .3 Remove all obstructions from around pipe. Where access is required above plaster ceilings, provide sufficient openings to gain access.
 - .4 Friable material containing asbestos to be removed or disturbed shall be thoroughly surface wetted before and during work unless wetting creates a hazard or causes damage. Use garden type low velocity fine mist sprayer. Sprayers that are partially clogged, or that does not produce uniformly fine mist will not be accepted. Perform work in a manner to reduce dust creation to lowest levels practicable.
 - .5 Inspect all glove bags for defects before using. A defective bag shall not be used.
 - .6 Ensure that the following tools are used:
 - .1 Knife shall have a retractable blade.
 - .2 Saw shall be a flexible wire type.
 - .3 Brushes shall not have metal bristles.
 - .7 After written authorization has been received from the Inspector to proceed perform the removal using the following procedures.
 - .1 Place tools necessary to remove insulation, in tool pouch. Wrap the bag around pipe and close zippers. Seal bag to pipe with restraining nylon straps. Welds and folds of glove bag are to remain intact without modification to manufacturers design.
 - .2 Place hands in gloves and use necessary tools to remove insulation. Cut or remove exterior insulation covering where applicable to expose asbestos pipe covering. Wet exposed pipe or duct covering with sufficient mixture to suppress any dust. Arrange insulation in bag to obtain full capacity of bag.
 - .3 Insert nozzle of spray pump prefilled and primed with water and surfactant into bag through valve and wash down pipe and interior of bag thoroughly, use cloth or sponge to aid in washing process. Wet surface of insulation in lower section of bag.
 - .4 Waste material in bags intended for use at more than one location and which are equipped with internal zippers to seal off waste, shall have the upper section of bag thoroughly cleaned then shall be sealed off in lower sections of bag before bag is removed from pipe. Reinstall bag in new location before opening zip lock.
 - .5 If bag (**Only if bag is a Safe-T-Strip**) is to be moved along pipe, loosen straps, move bag, re seal to pipe using double pull zipper to pass hangers. Repeat stripping operation.
 - .6 To remove bag after completion of stripping wash top section and tools thoroughly. Seal off waste in lower section of bag using zipper. Pull polyethylene waste container over glove bag before removing from pipe. Release one strap and remove freshly washed tools. Place tools in water. Remove second strap and zipper. Fold over into appropriately labelled waste disposal bags and seal.
 - .7 Prior to removal of bag ensure that pipe is free of all residue. Remove all residue using wet cloths as necessary. Ensure that surfaces are free of sludge which after drying could release asbestos dust into atmosphere.

Seal exposed surfaces of pipe and ends of insulation with slow drying sealer to seal in any residual fibres.

.8 Upon completion of work, cover exposed ends of remaining pipe insulation with polyethylene tape.

.9 If the glove bag is ripped, cut or opened in any way, work that may disturb friable material shall cease immediately. If the rip, cut or opening is small and easy to repair then the glove bag shall be repaired forthwith with tape. Work may continue once the repairs are complete. If the rip, cut or opening is not small and cannot be easily repaired, place the glove bag forthwith in a suitable asbestos waste container. Any spilled material containing asbestos shall be cleaned up and removed by using a vacuum equipped with a HEPA filter.

.8 All work will be subject to visual inspection and air monitoring. Any contamination of surrounding areas indicated by visual inspection or air monitoring will require the complete enclosure and clean up of affected areas.

.4 Cleanup:

.1 Frequently during the work and immediately after completion of the work clean up dust and waste containing asbestos using a HEPA vacuum or by damp mopping.

.2 Place dust and waste containing asbestos in sealed dust tight waste bags. Drop sheets and disposable protective clothing shall be treated as asbestos waste and shall be wetted and folded inward to contain dust and then placed in waste bags.

.3 Glove bags, disposal bags, drop sheets, cloth rags and any porous materials are to be considered as asbestos waste and handled according to disposal subsection.

.4 Immediately before their removal from the work area, and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.

.5 Seal and remove double bagged waste from site. Dispose of in accordance with procedures specified in subsection 1.14 Waste Transport and Disposal.

.6 Perform final thorough cleanup of work areas and adjacent areas affected by the work using HEPA vacuums.

2.4 **TYPE 3 REMOVAL OPERATION**

.1 Initial Preparation and Isolation of Work Areas: Unless otherwise specified, work carried out as part of this phase shall proceed as follows:

.1 Carry out a survey of the work areas to compile an inventory of existing damages and provide a copy to the Consultant.

.2 The Contractor is responsible for moving materials and objects which are present in the work areas.

.3 Separate the asbestos removal work areas from other areas in the mechanical room required to remain in use as follows by erecting rip-proof polyethylene sheeting and plywood sheeting. The polyethylene sheeting should extend from floor to ceiling and the plywood hoarding should extend 8ft from the floor on the separation side of the enclosure. Use one layer of rip proof poly on the exterior side of the wood stud framing under the plywood sheets. Use two layers of poly on the interior side of the wood frame. The inner layer shall be made up of clear 6 mil poly sheets. The outer layers shall be made up of rip proof poly.

- .4 All surfaces, equipment and objects located in the work areas and not scheduled for removal shall be pre-cleaned by HEPA vacuuming or wet wiping and shall be protected by one layer of rip proof poly sheeting unless otherwise specified. Dry sweeping or vacuuming with units not equipped with HEPA filters shall not be allowed.
- .5 All equipment, objects and articles scheduled for removal shall be taken out of the work area only if its removal will not disturb any asbestos-containing materials.
- .6 Ensure that smoke detectors, fire alarms, heat detectors and other life safety equipment remain active and operating as installed.
- .7 All specified clean demolition work can be carried out before the Type 3 enclosure is set up on condition that the demolition work does not disturb any asbestos-containing materials.
- .8 Construct the decontamination enclosure systems for workers and for equipment and materials as specified.
- .9 Independently seal off all openings leading to the work area using polyethylene sheeting and duct tape. Such openings include, but are not limited to, windows, doorways, corridors, skylights, diffusers, grills and air ducts. Also seal all floor openings independently before covering the entire floor with polyethylene sheeting. Ensure that the individual seals are air tight and water tight.
- .10 Cover floors with two independently sealed layers of polyethylene sheeting and seal with duct tape. Poly on the floor shall extend a minimum of 30 cm up all vertical surfaces located in the work area.
- .11 Cover walls with one layer of 6 mil rip-proof polyethylene sheeting (unless specified otherwise). Overlap floor poly with wall poly by a minimum of 30 cm at each layer. The layers of wall poly shall always overlap the layers of the floor poly.
- .12 Ensure that adjoining sheets of poly used on walls and floors overlap by at least 30 cm.
- .13 Ensure that poly sheets are properly supported to avoid excessive billowing and failure of the enclosure as a result of applying negative pressure differential. Brace the poly in case of excessive billowing using 1"x2" straps.
- .14 Use flame resistant polyethylene sheeting near heat sources.
- .15 Create negative pressure in the work area using HEPA-filtered negative air unit distributed evenly (horizontally and vertically) within the work area. Supply any necessary platforms as required to elevate the negative air unit.
- .16 Provide enough negative air units to be able to exchange the air volume of the work area at least once every 20 minutes (three air changes per hour) and to maintain a minimum of 0.02" water gauge differential.
- .17 The pressure differential shall be continuously monitored using an automatic recorder as specified. Place the monitor outside the contaminated work area. A backup negative air unit shall be set up and ready for operation in case one of the original units fail.
- .18 Operate the negative air units from the start of the preparation and isolation phase until completion of the final clean up work and air testing.
- .19 Ensure that the necessary make up air is supplied to the work area through flaps installed in the perimeter seal.

- .20 Replace pre-filters and HEPA filters as necessary to maintain the proper flow rate and to ensure that the unit continues to function properly.
- .21 Contaminated air from the work area shall be exhausted directly to the outside through sealed ducts. Where necessary, remove existing windows and replace with a plywood panel. Secure panel in place and make weather tight using caulking. Install appropriately sized openings for exhaust (typically 12"). Replace windows upon completion of work.
- .22 All negative air units which are set up to discharge inside the building shall be leak tested in place using the DOP method.
- .23 The Contractor is allowed to connect to the Owner's existing water supply for use in the asbestos work areas and in the temporary shower and decontamination facilities. The Contractor shall be responsible for making all the connections using vacuum breakers and other backflow preventers.
- .24 The Contractor shall use copper pipes and fittings and high pressure hoses when making connections to the main water supply. The Contractor shall also install a main shut-off valve on the clean side of the decontamination enclosure. All connections shall be made down stream from the main shut-off valve. Ensure that the pressure in the temporary water distribution system is relieved if the system is to be left unattended. Ensure that no leaks are present around hose pipe connections. Minimize the possibility of water damage through spills or leaks by providing drip pans of suitable size and by ensuring that the drip pans are drained regularly.
- .25 Ensure that all water from the drainage facilities installed on the shower and other decontamination enclosures is passed through filtration systems as specified.
- .26 Test all temporary piping installed during this project and ensure that they are watertight. All temporary pipe installation shall remain water tight for the duration of the project. Pipes shall be installed parallel to walls and shall be temporarily secured to existing structures. Ensure that all piping is removed upon completion of work. Avoid damaging or altering the owner's existing water equipment and piping.
- .27 All electrical work shall be performed by a licensed electrician in compliance with all applicable regulations. Isolate, disconnect and lockout all power supplying or passing through the work area. Ensure that power supply to the remaining areas of the building is not disrupted during work in asbestos contaminated areas.
- .28 Unless specified, the use of the existing power and lighting circuits shall not be allowed. Use temporary electrical panels to provide power and lighting to the decontamination facilities and the work area. One electrical panel shall be provided for every 5000 square feet of contained asbestos work areas. Electrical panels shall be equipped and sized to handle all electrical equipment required for the completion of the project. The Contractor shall also be required to provide other additional electrical equipment such as temporary lighting, circuit breakers, panels, transformers and switch gears.
- .29 The contractor shall be responsible for establishing and maintaining fire and emergency exits from the work area that are acceptable to the Provincial Fire Marshall and other authorities having jurisdiction. The emergency exits shall be sealed in a manner that will not hinder the use of the doors during an evacuation and shall be clearly marked by using proper exit signs.
- .30 Battery powered emergency lighting shall be installed by the Contractor to provide general lighting throughout the work area in case of loss of power supply

to the ground fault panel and to ensure that the emergency exits and the exit routes remain lit during the power failure.

- .31 Ensure that fire extinguishers are installed throughout the asbestos work area at each of the emergency exits and on both sides of the decontamination facilities. All fire extinguishers installed inside the work area shall be protected by clear polyethylene sheets and shall be easily accessible in case of an emergency.
- .32 The Contractor shall place warning signs at all access points leading to the contained work area. The signs shall be posted at the curtained door ways and shall read:

CAUTION
ASBESTOS HAZARD AREA
NO UNAUTHORIZED ENTRY
WEAR ASSIGNED PROTECTIVE EQUIPMENT
BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM

- .33 Once the initial clean preparation and isolation of the work area is completed, the Contractor shall request an inspection from the Consultant before proceeding to next phase. Notify the Consultant 24 hours before the inspection is needed.
- .34 Once authorization is obtained from the Consultant, proceed to setting up critical seals that might become accessible once removal operations commence.
- .35 Shut off and lock out the HVAC system serving the subject work area. Ensure that all work requiring the complete shut down of the HVAC system is carried out during the time when the building is not occupied.
- .36 Unless otherwise specified, all electrical systems scheduled to remain inside the work area during asbestos removal activities shall be sealed using duct tape and poly sheets. Examples of such systems include speakers, wiring, smoke and heat detectors, alarm equipment, communication systems, PA systems, junction boxes, etc.
- .37 Once all the preparation work is complete, the contractor shall ensure that the work area is maintained neat and organized. All the enclosures shall be inspected by the supervisor before and after the completion of each work shift to ensure that the hoarding walls, polyethylene barriers and enclosures are intact. Any damaged discovered during the inspection shall be repaired immediately. Maintain an inspection log book on site to document when (date and time) the inspection was carried out and by whom (name and signature of the person). Summarize any problems encountered during the inspection.
- .38 Ensure that the negative air units and the associated ducting and exhaust openings are regularly inspected during the work shift. The pressure differential monitoring unit shall be also inspected regularly during the work shift to ensure that the specified negative pressure inside the work area is maintained.

- .2 Entry and Exit Procedures from Asbestos Removal Work Areas: the following general procedures shall be adhered to when entering into and exiting from asbestos abatement work areas:

- .1 Work Area Entry Procedures:

- .1 Every worker and visitor planning to enter the work area shall remove all street clothing including undergarments and shall store them in the clean change room.
- .2 All uncontaminated articles such as clothing, footwear, towels, personal effects, etc. shall be store in the clean room of the decontamination facility.

- .3 The person shall then put on disposal coverall with head covering, respirators with clean filters and foot covering and shall proceed to the work areas through the shower and then the equipment and access room.
- .2 Work Area Exit Procedures:
 - .1 Using HEPA vacuuming or wet wiping, remove all gross contamination from personal protective equipment (disposable coveralls, boots, hard hats, safety glasses, exterior of respirator, etc.) in the work area and then proceed to the equipment and access room.
 - .2 In the equipment and access room, remove all protective clothing except the respirator and proceed to the shower. All disposal contaminated clothing shall be placed in asbestos disposal bags. Reusable items shall be stored neatly in the equipment and access room for use during the next shift.
 - .3 Proceed naked to the shower while still wearing the respirator. While showering, clean the outside of the respirator with soap and water. Seal the openings in the filter as per the manufacturer's instruction or using duct tape. Alternatively, the filters can be disposed of as asbestos waste. Continue showering by thoroughly wetting and washing the body and the head. Wet and clean the inside of the respirator. Filters shall not be allowed in the clean room if not properly sealed.
 - .4 Upon completion of showering and drying off, proceed to the clean room and dress in street clothing.
- .3 Asbestos Removal Procedures
 - .1 Asbestos removal work shall not commence until the following requirements have been met:
 - .2 All work areas have been and contained as specified, decontamination enclosure systems have been set up and occupied areas of the building have been properly isolated.
 - .1 All required notifications have been made and a notice of project has been posted in a visible area.
 - .2 Warnings signs have been displayed at all potential access points into the work area.
 - .3 All arrangements have been made with the waste disposal facility.
 - .4 All equipment, materials and tools needed inside the work area are available and in working condition.
 - .5 Appropriate negative pressure differential have been established inside the work area with proper allowance for make up air.
 - .6 All building security arrangements have been made.
 - .7 Written authorization has been obtained from the Consultant to commence asbestos removal work.
 - .3 Using an airless sprayer, spray the asbestos-containing material with water mixed with a wetting agent. Apply enough amended water to ensure that the material is wet all way through to the substrate. Avoid dripping. Etch the surface of the material being wetted in cases where the water does not penetrate the outer layer of the material.

- .4 Remove the wet asbestos-containing materials in layers and/or small sections while maintaining exposed surfaces of insulation in a wet condition. Spray the material regularly throughout the removal work to maintain saturation and to minimize the generation and dispersion of dust. Ensure that the wet material does not dry out.
 - .5 Ensure that the removed material and other waste generated during the removal process is collected and bagged immediately. Place the material in yellow labelled bags. Ensure that the waste water is also collected regularly. Avoid pooling of water. Dispose of the waste water in labelled 6 mil polyethylene bags (or other suitable rigid containers) or pump it straight into the sanitary sewer after passing it through the specified two stage filters.
 - .6 Dispose of waste in accordance with procedures specified in subsection 1.14 Waste Transport and Disposal
 - .7 Mist the air during the removal process using an airless sprayer capable of producing a fine mist and amended water to keep the airborne fibres levels as low as possible. Monitor the air inside the work area during removal. Airborne fibre levels in excess of 2.5 fibres/cc require the utilization of more airless sprayers.
 - .8 Remove deck mounted objects and other obstructions as necessary to facilitate the removal of the asbestos-containing materials. Ensure that the removal work includes all asbestos-contaminated materials specified for removal.
 - .9 After completion of gross asbestos removal work, perform a more thorough cleaning of all surfaces that used to be covered by asbestos to remove all visible residue and fibrous materials. Cleaning shall be carried out using wire brushing (stiff bristle brushes such as nylon or fibre bristles not metal), wet sponging and vacuuming. Ensure that the surfaces remain wet during the performance of this work.
 - .10 Notify the Consultant in cases where asbestos-containing materials is encountered which cannot be properly removed without demolishing building structural members or removing major service elements. The Consultant will advise the Contractor in writing regarding the next course of action. If sealing the material in place is the recommended course of action, apply a penetrating sealer onto the material and ensure that it penetrates all the way to the substrate.
 - .11 Continue with the wet thorough cleaning activities and include other surfaces in the work area including, but not limited to, decontamination facilities, polyethylene sheeting, walls and floor surfaces, equipment, containers, piping, ducts, conduits and poly surfaces used in the equipment and access room and the equipment decontamination facilities. Pre- filters used on the negative air units shall be removed and shall be disposed of as asbestos waste.
 - .12 Request a visual clearance inspection by the Consultant once all the cleaning activities are completed. The level of cleanliness shall be acceptable to the Consultant before a written authorization is issued to apply the lock-down material.
- .4 Procedures for Handling of Materials and Waste
- .1 Seal all filled asbestos waste containers and clean the exterior of the containers and other items by wet sponging. Move the containers from the filling area to a temporary storage area located within the enclosure and close to the equipment waste decontamination facility.
 - .2 Move the item to the container cleaning room, clean by wet sponges and pass it through the curtained doorway to a second worker stationed in the holding room.

The second worker shall be fully protected (similar to the removal workers) and can only leave by going through the work area and exiting through the worker decontamination facility (after taking a shower). The second worker shall then clean or double bag and seal the item and shall pass it through the curtained doorway to a third worker stationed in the transfer room. The third worker enters the transfer room from the clean side and does not need to use personal protective equipment. The third worker is then responsible for transferring the item to the disposal bin or to the Contractor's temporary storage room or truck.

- .3 All waste generated within the asbestos work area shall be treated as asbestos-contaminated waste and shall be disposed of accordingly. Non-porous materials which can be properly washed and cleaned can be disposed of as normal waste after cleaning.
- .4 The contractor shall use a combination of a rigid container with 6 mil poly bag to transport and dispose of waste containing sharp materials which could rip two 6 mil poly bag.
- .5 Transportation of waste and materials through occupied areas of the building shall be limited to a time when the building is not occupied. The Contractor shall use covered carts to transport the waste inside the building. Predetermined transport routes shall be approved by the Owner or his representative.
- .6 Workers transporting the waste shall be equipped with spill kits and full personal protective equipment and shall be trained to contain and clean any spilled asbestos-containing materials resulting from a failure in the waste containers.
- .7 Ensure that waste transport routes, loading areas and garbage bin storage areas are kept clean at all times. Garbage bins shall be of the fully enclosed type and shall be locked at all times when not in use. Garbage bins shall be placed only in locations specified and approved by the Owner or his representative.
- .8 Schedule garbage bin pick up and drop off times in consultation with the Consultant and ensure that the scheduled times do not interfere with the operations of the building Owner or his tenants.
- .9 Transport and dispose of asbestos waste as procedures specified in subsection 1.14 Waste Transport and Disposal.

.5 Procedures for Locking-Down of Work Area

- .1 Upon completion of clean up operations and after receiving written authorization from the Consultant to proceed, apply a lock-down agent acceptable to the Consultant on all surfaces in the work area such as areas where asbestos materials has been removed, pipes, ducts and other exposed objects present in the work area, polyethylene sheeting and other exposed walls, ceilings and floors, etc. Ensure that the sprayed material covers all surfaces. Apply twice as much lock-agent on areas that used to be covered by asbestos-containing materials.
- .2 Ensure that proper respiratory protective equipment is used during the application of the lock-down agent since, depending on the nature of the sealer used, potentially hazardous materials could be generated during the application process.
- .3 Restrict access to the work area for a period of 24 hours after completion of the lock-down application to allow for the dust to settle and for the lock-down agent to dry off. Clearance air samples will then be collected inside the work area.
- .4 The work area shall be considered acceptable for public occupancy only if the airborne fibre levels inside the work area are less than 0.01 fibres/cc. Levels above 0.01 fibres/cc requires that the entire area be re-cleaned and another coat

of lock-down agent be applied by the Contractor on all surfaces in the work area. Re-sampling will be carried out and the entire process shall be repeated until the fibres levels are less than 0.01 fibres/cc.

- .5 The Contractor shall be responsible for all charges associated with re-cleaning work and other associated requirements as specified.

.6 Procedures for Work Area Teardown and Dismantling

- .1 Proceed with the teardown of the work area only after obtaining written authorization from the Consultant. Ensure that Type 3 procedures remain in effect during this phase of work. The worker and equipment and material decontamination units shall remain fully operational. The negative air units shall continue to operate throughout the duration of the teardown work.
- .2 Start by removing polyethylene sheeting by carefully folding it away from the walls to the centre of the work area making sure that any loose debris is trapped within the poly. Also remove all enclosures, duct tape, caulking, polyurethane foam and other materials used in setting up the enclosure. Ensure that one layer of polyethylene sheeting is kept in place in situations where re-application of fireproofing is required. Polyethylene and other materials used in setting up enclosures shall be disposed of as asbestos-contaminated waste.
- .3 Clean all vacuum units, fittings, hoses and other small tools used during the removal work inside the work area, seal in 6 mil poly bags and remove from the work area through the equipment and materials decontamination unit. Wash down and clean other equipment used during the work and remove from the work area.
- .4 Clean up the asbestos work area including all surfaces and all decontamination enclosures. Remove negative air units pre-filters and dispose of as asbestos waste. Seal the exterior of the unit on all sides with poly and remove from the work area.
- .5 Remove all waste bags containing polyethylene sheets and other materials used to set up the enclosures and dispose of as specified.
- .6 Remove all hoarding walls separating the work area from occupied areas except in locations where the walls are set up adjacent to other areas that still contain asbestos. Obtain approval of Consultant before dismantling hoarding walls.
- .7 Dismantle the remainder of the enclosure including scaffolding, platforms, decontamination facilities, tunnels, etc. Final clean the work area using HEPA vacuuming and wet wiping. Clean and remove all ground fault panels and temporary lighting.

.7 Procedures for Re-Establishment of Objects and Systems

- .1 Re-establish mechanical and HVAC systems and install new clean air filters where previously removed. Re-establish all electrical system and return to as found condition unless otherwise specified.
- .2 Repair, replace and make good on all damages not identified during the per-removal survey.
- .3 Unless otherwise specified, all items and objects removed during the initial preparation phase of the work shall be returned to their original position and shall be properly mounted and secured.

TABLE 1

Asbestos Containing Building Material	ACM Abatement Scope of Work	Required Abatement Method	Specification Section
Sprayed Fireproofing	< 1m ²	Type 2	2.2
Thermal Insulation / Vermiculite	> 1m ²	Type 3	2.4
Plaster	< 1m ²	Type 2	2.2
Texture Finish	> 1m ²	Type 3	2.4
Drywall Joint Compound	< 1m ²	Type 1	2.1
	> 1m ²	Type 2	2.2
Pipe Insulation – Aircell	< 1m ² or can be contained in a glove bag for removal	Type 2 or Type 2 Glove Bag	2.2 or 2.3
	> 1m ²	Type 3	2.4
Pipe Insulation – Parging Cement	< 1m ² or can be contained in a glove bag for removal	Type 2 or Type 2 Glove Bag	2.2 or 2.3
	> 1m ²	Type 3	2.4
Duct Insulation	< 1m ² or can be contained in a glove bag for removal	Type 2 or Type 2 Glove Bag	2.2 or 2.3
	> 1m ²	Type 3	2.4
Acoustic Ceiling Tile	< 7.5 m ²	Type 1	2.1
	> 7.5 m ²	Type 2	2.2
Cement Products like Transite pipe/board	Hand Tools	Type 1	2.1
	Power Tools	Type 3	2.4
Vinyl Floor Tile	Hand Tools	Type 1	2.1
Vinyl Sheet Flooring	Power Tools	Type 3	2.4
Door/Window Caulking		Type 1	2.1
Putty		Type 1	2.1
Gaskets		Type 1	2.1
Fire Doors		Type 1	2.1
Asphalt		Type 1	2.1

End of Section

City of Toronto

Asbestos Management Policy

Purpose

It is the policy of the City of Toronto to:

- eliminate, or minimize to the extent possible, the potential for worker and tenant exposure to airborne asbestos fibres, thereby protecting their health, and
- maintain compliance with legislative requirements by appropriately managing asbestos in buildings on an ongoing basis as well as during any construction and renovation work that may potentially disturb any asbestos-containing material.

Application

This policy applies at all City-owned or leased facilities at which asbestos-containing materials are, or may be, present.

Specifically, it outlines owner responsibilities for implementing and maintaining asbestos management programs in every building with material which may contain asbestos. During construction projects, it outlines responsibilities of the constructor, every employer and workers engaged in or on the project, as well as responsibilities of the owner of the project. During repair, alteration, maintenance or demolition of a building, it outlines responsibilities of all workers and employers involved, as well as, responsibilities of the owner.

Definitions

Asbestos	Any of the following fibrous silicates: actinolite, amosite, anthophyllite, chrysotile, crocidolite or tremolite. Asbestos is most commonly found in sprayed-on insulation or fireproofing, fibrous or corrugated paper pipe insulation, cement pipe, drywall and drywall joint compound, floor and ceiling tiles.
Asbestos-containing material	Material that contains 0.5% or more asbestos by dry weight.
Building	Means any structure, vault, chamber or tunnel including, without limitation, the electrical, plumbing, heating and air handling equipment (including rigid duct work) of the structure, vault, chamber or tunnel.
Building asbestos record	A document that details the current location (by room, hallway, stairwell, etc.), type, condition and whether material is friable or non-friable of asbestos-containing material(s) in a facility, as well as associated inspection and repair records.
Building asbestos assessment and report	A document (showing material likely to be handled, disturbed or removed during demolition, alteration or repair work, whether or not material is asbestos-containing material, its condition, whether friable or non-friable and drawings, plans and specifications showing location of material in question) that is prepared in addition to the building asbestos record and provided to prospective contractors prior to

asking for tenders.

Friable material	Material that when dry can be crumbled, pulverized, or powdered by hand pressure and any material which is crumbled, pulverized or powdered. It is important to recognize that damage or deterioration may cause non-friable material to become friable.
Competent person	An individual meeting the definition of “competent person” under the Occupational Health and Safety Act. It means a worker who, (a) is qualified because of knowledge, training and experience to perform the work, (b) is familiar with the Act and with the provisions of the regulations that apply to the work, and (c) has knowledge of all potential or actual danger to health or safety in the work.
HEPA filter	A high efficiency particulate aerosol filter that is at least 99.97% efficient in collecting a 0.3 aerosol.
Homogenous material	Material that is uniform in colour and texture.
Owner	Includes a trustee, receiver, mortgagee in possession, tenant, lessee, or occupier of any lands or premises used or to be used as a workplace, and a person who acts for or on behalf of an owner as an agent or delegate.
Type 1 operations	Installing or removing ceiling tiles that are asbestos-containing if the tiles cover an area less than 7.5 square metres and are installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated. Installing or removing non-friable asbestos-containing material, other than ceiling tiles, if the material is installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated. Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material if the material is wetted to control the spread of dust or fibres and the work is done only by means of non-powered hand-held tools. Removing less than one square metre of drywall in which joint filling compounds that are asbestos-containing material have been used.
Type 2 operations	Removing all or part of a false ceiling to obtain access to a work area, if asbestos-containing material is likely to be lying on the surface of the false ceiling.
Type 2 operations (ctd)	Removal or disturbance of one square metre or less of friable asbestos-containing material during the repair, alteration, maintenance or demolition of all or part of machinery or equipment or a building, aircraft, locomotive, railway car, vehicle or ship. Enclosing friable asbestos-containing material. Applying tape or a sealant or other covering to pipe or boiler insulation that is asbestos-containing material.

Installing or removing ceiling tiles that are asbestos-containing material, if the tiles cover an area of 7.5 square metres or more and are installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.

Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material, if the material is not wetted to control the spread of dust or fibres and the work is done only by means of non-powered hand-held tools.

Removing one square metre or more of drywall in which joint filling compounds that are asbestos-containing material have been used.

Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material if the work is done by means of power tools that are attached to dust-collecting devices equipped with HEPA filters.

Removing insulation that is asbestos-containing material from a pipe, duct or similar structure using a glove bag.

Cleaning or removing filters used in air handling equipment in a building that has sprayed fireproofing that is asbestos-containing material.

An operation that is not mentioned previously and may expose a worker to asbestos and is not classified as a Type 1 or Type 3 operation.

Type 3 operations

The removal or disturbance of more than one square metre of friable asbestos-containing material during the repair, alteration, maintenance or demolition of all or part of a building, aircraft, ship, locomotive, railway car or vehicle or any machinery or equipment.

The spray application of a sealant to friable asbestos-containing material.

Cleaning or removing air handling equipment, including rigid ducting but not including filters, in a building that has sprayed fireproofing that is asbestos-containing material.

Repairing, altering or demolishing all or part of a kiln, metallurgical furnace or similar structure that is made in part of refractory materials that are asbestos-containing materials.

Type 3 operations (ctd)

Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material, if the work is done by means of power tools that are not attached to dust-collecting devices equipped with HEPA filters.

Repairing, altering or demolishing all or part of any building in which asbestos is or was used in the manufacture of products, unless the asbestos was cleaned up and removed before March 16, 1998.

Conditions

Because of its fire-resistant properties, asbestos was extensively used in buildings as insulation around pipes and boilers, in sprayed-on fireproofing, in thermal/acoustic insulating boards, in ceiling and floor tiles, and in cement pipes.

The Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations (Ontario Regulation 278/05), made under the Occupational Health and Safety Act, outlines requirements for the management of asbestos (friable and non-friable) in buildings and safe work measures and procedures during construction and renovation. The requirement to incorporate non-friable asbestos-containing materials in building management programs comes into effect as of November 1, 2007.

Where the City of Toronto is the facility owner, all requirements of the regulation apply and must be complied with. Any City of Toronto division responsible for acquiring and maintaining City facilities [e.g. divisions who maintain their own facilities (e.g. Toronto Water, Parks, Forestry and Recreation); Facilities and Real Estate who acquire and maintain a number of City-owned facilities] in which asbestos-containing material is present must assume asbestos-related “owner” obligations under the Occupational Health and Safety Act and the Regulation respecting Asbestos on Construction Projects and Repair Operations.

When a City division is the tenant only, divisional management continues to assume the employer responsibility for protecting the health of employees. However, responsibilities are more limited as building management (whether external or another City division) assumes owner responsibilities.

On projects that are carried out on City-owned facilities, even where the City has not been deemed to be the constructor, the City maintains owner responsibilities and employer responsibilities for protecting the health of any employees located on-site.

Responsibilities

Division heads responsible for maintaining City-owned facilities will ensure that:

- responsibilities for asbestos management are clearly established and communicated for all plants/facilities/complexes/buildings, including multi-tenanted locations.

Management of divisions which acquire and maintain City-owned facilities will establish a system to ensure the following steps are taken:

- A list of buildings, indicating whether asbestos is present, is prepared and maintained.
- Funds are budgeted for preparing a building record (where previously none was required) or for updating an existing building record (to ensure compliance with current legislative requirements).
- Funds are budgeted for updating asbestos records at least annually.
- Funds are budgeted for asbestos remediation projects, as deemed necessary during asbestos inspections. If maintaining a facility where abatement is required for another City division, that division’s senior manager is advised of the need to budget for abatement.

In addition to the above, management of divisions which acquire and maintain City-owned facilities will also ensure the following actions are taken:

Building Acquisition or Lease

- When purchasing, leasing or otherwise acquiring facilities, every reasonable effort is made to ensure that acquired buildings are asbestos-free. In circumstances where this is not feasible or achievable, building asbestos records are obtained, wherever possible. At a minimum, if building asbestos records are not obtained during the acquisition process, asbestos inspections are performed by competent persons and building asbestos records are prepared prior to building occupancy.

Asbestos Record

- Evaluate the need for a building record according to new legislative requirements (whether friable or non-friable material containing 0.5% asbestos or greater is present). Should a record now be required, ensure building record is prepared by November 1, 2007.

- Review existing building record and revise as required to include non-friable in addition to friable asbestos-containing material by November 1, 2007.
- Review existing building records to ensure minimum number of bulk samples as defined by legislation have been collected by a competent person from an area of homogenous material and analyzed using specified method.
- Retain the master copy of each building asbestos record.
- Provide a copy of each building asbestos record to the corporate Occupational Health, Safety and Workers' Compensation Unit.
- Provide a copy of each building asbestos record to the senior manager(s) responsible for the work location and updates, as necessary. These senior managers are to ensure that a copy of the building asbestos record is available and maintained on site and that business unit health and safety staff are advised of the location of these records.

Asbestos Management Program

- Periodic routine inspections of asbestos-containing materials are performed by competent persons in facilities in which asbestos is present to determine its condition and results of these inspections are incorporated into building asbestos records. Reports are made accessible to the joint health and safety committee/health and safety representative for that location.
- Asbestos records are updated at least annually and if new information is available.
- Any incidents of accidental disturbance of asbestos-containing material are promptly abated.
- Repair orders, generated as a response to recommendations of joint health and safety committees/health and safety representatives, building users, health and safety staff and/or those employees who conduct periodic routine inspections, are promptly addressed.
- Employees, who work in the vicinity of asbestos-containing material, including employees of contractors, are advised of its presence.
- If friable material has fallen and is being disturbed such that exposure is likely, no further work is done until it is determined whether it is asbestos-containing material. The fallen material is cleaned up, removed and appropriately disposed of. If it is likely that the material will continue to fall, then it is repaired, sealed, removed or permanently enclosed.

Before Requesting Tenders or Arranging Work

- A detailed building asbestos assessment and report is provided to prospective contractors prior to asking for tenders, this is in addition to the building asbestos record.
- If the work of service providers may result in disturbance of asbestos-containing materials, they are advised of the existence of such materials, as well as required work protocols and procedures.
- Employees who perform work, which may disturb asbestos-containing material, are advised of the need to consult building asbestos records for work locations prior to beginning work.
- Arrangements for removal of asbestos-containing material as part of major renovations are made, whenever possible. At a minimum, all damaged or deteriorating material is removed during renovations.
- In the case of demolition work, remove to the extent practicable any asbestos-containing material that may be disturbed during the work.

Asbestos Work

- Written notification is provided to senior on-site managers prior to initiation of scheduled asbestos-abatement work. When work is of an emergency nature, E-mail or fax notification is provided.
- Asbestos remediation work is classified as Type 1, 2 or 3 as specified in Regulation 278/05 and appropriate work procedures are developed and implemented.
- The Ministry of Labour (MOL) is notified in advance by telephone and in writing of all Type 3 work and all glove bag work exceeding 1 square meter.
- Outside contractors retained for asbestos abatement work and their staff are competent and possess all

necessary registrations and permits before undertaking any work. As of November 1, 2007 all workers and supervisors involved in Type 3 work must have successfully completed an Asbestos Abatement Worker training program and Asbestos Abatement Supervisor training program, respectively, approved by the Ministry of Training, Colleges and Universities.

- Project managers who oversee the work of asbestos abatement contractors are appropriately trained and competent.
- Project managers are to review and revise, as appropriate, contract language to ensure that contractors hired by the City to conduct asbestos abatement are competent. Project managers are to seek confirmation (e.g. written documentation), as appropriate, that contractors hired by the City to conduct asbestos abatement are in compliance with legislative requirements (e.g. staff have successfully completed approved asbestos training programs as of November 1, 2007, staff wear appropriate respiratory protection and have been successfully fit-tested, specified work procedures are followed, required clearance air monitoring is conducted etc.). Project managers are to take immediate corrective action, either directly or indirectly, depending on constructor status, if any violations of safe working procedures are noted.
- Asbestos waste is transported and disposed of in accordance with regulatory requirements.
- If, in the course of work, material is discovered which was not identified in the asbestos assessment and report but which may be asbestos-containing material, work is stopped and the material is analyzed for asbestos content. The MOL and joint health and safety committee or health and safety representative are immediately advised by telephone and in writing.
- Written notice is provided in advance to the joint health and safety committee or health and safety representative if varying a measure or procedure from legislation. Varied measures or procedures must afford at least equal protection to workers.

Additional Requirements if Asbestos Work Conducted by City Staff

- All employees likely to be engaged in asbestos-related work are trained in (i) asbestos hazards, (ii) personal hygiene and appropriate work practices and (iii) use, care and disposal of respirators and protective equipment, including limitations, inspection and maintenance, proper fitting, respirator cleaning and disinfection. Training records are maintained. Retraining is completed on a routine and as-needed basis.
- Advise joint health and safety committee/health and safety representative of time and place that the above worker training is to be carried out.
- As of November 1, 2007, all workers and supervisors engaged in Type 3 work must have completed training programs approved by the Ministry of Training, Colleges and Universities.
- Asbestos work reports are completed for any workers engaged in Type 2 or Type 3 operations at least once every 12 months and immediately on termination of employment, or, for any employees who experience accidental exposure to asbestos. Reports are submitted to Employee Health staff with responsibility for the asbestos biomedical surveillance program.
- All workers engaged in cleaning and/or removing filters used in air handling equipment in a building with asbestos-containing sprayed fireproofing must have been trained in and follow Type 2 procedures.
- Ensure workers follow legislatively required procedures.
- Ensure workers are provided with appropriate personal protective equipment. For respiratory protective equipment, ensure these are provided within the context of a written respiratory protection program (which includes respirator fit testing).
- For type 3 work, ensure that a copy of clearance air test results are posted in the workplace and in a common area (if the building contains other workplaces) and a copy is provided to the joint health and safety committee/health and safety representative within 24 hours after the test results are received. The owner shall keep a copy of the clearance air test results for at least one year.

Management of all divisions that occupy buildings where asbestos is present will:

- Obtain and maintain the building asbestos record in an accessible location on-site.
- Supply a copy of the building asbestos record to the joint health and safety committee/health and safety representative responsible for the location and notify workers potentially exposed.
- Develop, in consultation with health and safety staff, job-specific safe working procedures for asbestos-related work.
- Schedule with health and safety staff asbestos training of (i) workers who may work in close proximity to asbestos-containing material and who may disturb this material and (ii) joint health and safety committee members/health and safety representatives who visually inspect accessible asbestos materials of which they are aware.
- Notify building management when they suspect damaged asbestos-containing material, requesting investigative and/or corrective action.
- Report and seek immediate corrective action if any violations of safe working procedures are noted.
- Advise employees and tenants of any scheduled or emergency asbestos-related work.

The Occupational Health, Safety and Workers' Compensation Unit's occupational hygiene staff will:

- Lead in the development of procedures, guidelines and training programs to facilitate compliance with this policy.
- Retain copies of building asbestos records, as provided by divisions, and maintain database of locations.
- Provide, or assist in provision of, asbestos training for those employees potentially exposed to asbestos.
- Assist in addressing employee asbestos-related concerns.
- Assist divisions in asbestos-related communications with the Ministry of Labour.

Health and Safety Consultants will:

- Monitor frequency of management's inspections.
- Based on joint health and safety committee/health and safety representative inspection reports and/or occupational health and safety staff inspections, recommend appropriate remedial actions or seek an occupational hygiene assessment.
- Assist in the provision of training and development of safe work procedures.

Employee health staff in Human Resources' Employee Health, Rehabilitation and Employee Assistance Unit will:

- Develop and assist City divisions in implementing an asbestos biomedical surveillance program.
- Co-ordinate asbestos-related health assessments with appropriate health care practitioners, in response to needs identified by departments.
- Review and communicate results of these assessments to employees and, to the extent legislatively required, with departments.
- Submit asbestos work report forms to the Ministry of Labour at the frequency required by legislation.

Joint health and safety committees/health and safety representatives representing employees at locations with identified asbestos-containing materials will:

- Inspect readily visible asbestos-containing material as part of their routine workplace inspections
- Bring deficiencies, if any, to the attention of area supervisors and occupational health and safety staff.

Workers will:

- Follow asbestos safe work procedures applicable to the work they perform.
- Advise their supervisors of any asbestos-related occupational health and safety issues or concerns.

- For workers engaged in Type 2 or 3 work, voluntarily participate in biomedical surveillance program.

The Occupational Health and Safety Co-ordinating Committee will:

- Monitor the implementation and effectiveness of this policy

Authority

The Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations
(O. Reg. 278/05)

Hazardous Waste Regulation (O. Reg. 347 as amended)

Corporate Asbestos Management Program

**ENDORSED BY: Occupational Health & Safety Co-ordinating Committee, (OHSCC),
June 6, 2007**

**APPROVED BY: City Manager
July 23, 2007**

City of Toronto

Asbestos Management Plan

ASBESTOS MANAGEMENT PLAN



Prepared by:
City of Toronto

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ASBESTOS MANAGEMENT PLAN



Prepared by:
City of Toronto

GLOSSARY OF TERMS

Amended Water	Water with wetting agent added for purpose of reducing surface tension to allow thorough wetting of ACM.
Asbestos-Containing Material(s) (ACM)	A material that contains 0.5% or more asbestos as measured by U.S. Environmental Protection Agency Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials, June, 1993.
Asbestos	Any of the following fibrous silicates: Actinolite; Amosite; Anthophyllite; Chrysotile; Crocidolite; Tremolite.
Asbestos Plan Manger	Also known as the District Manager of Operations, or Director of Operations or designated City of Toronto employee.
Asbestos Work Area	Area where work is being performed which will or may disturb ACM including overspray and fallen material or settled dust that may contain asbestos.
Building	means any structure, vault, chamber or tunnel including, without limitation, the electrical, plumbing, heating and air handling equipment (including rigid duct work) of the structure, vault, chamber or tunnel.
City	City of Toronto
Competent Worker	<p>In relation to specific work, means a worker who,</p> <ul style="list-style-type: none">• is qualified because of knowledge, training and experience to perform the work• is familiar with the Occupational Health & Safety Act and with the provisions of the regulations that apply to the work, and• has knowledge of all potential or actual danger to health or safety in the work.
Encapsulation	The application of a liquid sealant to asbestos-containing materials; the sealant may penetrate and harden the material (penetrants) or cover the surface with a protective coating (bridging sealants). Also called encasement. This is generally not advisable.

GLOSSARY OF TERMS

Enclosure	<p>Enclosure of ACM means the construction of solid enclosure (walls, ceiling, bulkhead etc.) around ACM, or</p> <p>An Enclosure means the site isolation including hoarding walls, polyethylene sheeting and seals that isolates an Asbestos Work Area.</p>
Facility Manager	Also known as the Property or Building Manager. May be a City of Toronto employee or an employee of City of Toronto's Facility Management Service Provider.
Friable Material	<p>Material that:</p> <ul style="list-style-type: none">• when dry, can be crumbled, pulverized or powdered by hand pressure or• is crumbled, pulverized or powdered.
Glove Bag Removal	A method of removing friable insulation from a piping system using a prefabricated bag which isolates the section of insulation being removed. This is a Type 2 Procedure.
HEPA Filter	High Efficiency Particulate Aerosol filter that is at least 99.97 percent efficient in collecting a 0.3 micrometre aerosol.
HEPA Filtered Negative Pressure Unit:	Portable air handling unit which extracts air directly from the Asbestos Work Area and discharges the air to the exterior of the building after passing through a HEPA filter.
JHSC	<p>Joint Health and Safety Committee.</p> <ul style="list-style-type: none">▪ a joint health and safety committee established under section 9 of the Act,▪ a similar committee described in subsection 9 (4) of the Act, or▪ the workers or their representatives who participate in an arrangement, program or system described in subsection 9 (4) of the Act;
MOE	Ontario Ministry of the Environment.
MOL	Ontario Ministry of Labour.

GLOSSARY OF TERMS

Phase Contrast Microscopy (PCM)	A method which uses an optical microscope to determine airborne fibres, normally in an occupational setting. Particles are observed for shape and size. Results are presented as a number of fibres per cubic centimetre or millilitre of air (f/mL). The method of analysis in Ontario is based on the US National Institute for Occupational Safety and Health (NIOSH) Manual of Analytical Methods, Method 7400, issue 2, Asbestos and Other Fibres by PCM (August 15, 1994).
Transmission Electron Microscopy (TEM)	A method which uses an electron microscope to determine airborne asbestos fibres. Results are presented in fibres per cubic centimetre of air (f/cc). The method of analysis in Ontario is The U.S. National Institute of Occupational Safety and Health (NIOSH) Manual of Analytical Methods, Method 7402, Issue 2: Asbestos by TEM (Aug 15, 1994).
Type 1, 2 and 3 Procedures	Procedures defined under Ontario Ministry of Labour Regulation 278/05. The specific operations and their classification into these procedures are described under the Classification of Work Section.
US EPA	United States Environmental Protection Agency.

SECTION 1.0

1.0 INTRODUCTION

Asbestos is a designated substance in Ontario, governed by legislation under the Occupational Health and Safety Act, Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*. This Asbestos Management Plan (AMP) has been prepared to ensure that asbestos containing materials (ACM) found in the building are not disturbed without taking appropriate precautions to protect the health and safety of City of Toronto staff, tenants and the general public. The AMP identified in this document will formally outline the current administration of the program, training requirements, detail safe guards and work procedures for asbestos in any of the buildings associated with City of Toronto. This AMP in present or revised form must remain in effect until all ACM have been removed from the building.

The substance “Asbestos” is one component of a group of dangerous chemical substances and biological agents that are customarily addressed in an overall Health and Safety program. The presence of asbestos in a building does not mean that the health of building occupants is necessarily endangered. As long as ACM remains in good condition and is not disturbed, exposure is unlikely. Where the material is handled or removed in an appropriate manner with safe guards to contain airborne fibre and protect the work force, exposure to the work force and to building occupants is also minimal.

It should be understood that the following are fundamental in the management of asbestos in buildings:

- Although asbestos fibres are hazardous, the risk of asbestos-related disease depends upon inhalation exposure to airborne asbestos fibres.
- Based upon available data the average airborne asbestos levels in buildings seem to be very low where ACM are not being actively disturbed. Accordingly, the health risk to most building occupants also appears to be very low. However it should be noted that personnel engaged in asbestos related work or those nearby suffer the greatest risk to exposure.
- Removal is often not a building owner's best course of action to reduce asbestos exposure. In fact an improper removal can create a dangerous situation where none previously existed. Full scale asbestos removal is only required in order to prevent significant public exposure to airborne asbestos fibres during building demolition or renovation activities.

Refer to Appendix A for further information regarding asbestos.

1.1 PURPOSE AND SCOPE

The AMP provides information and procedures for Asbestos Management in various City owned buildings. It applies to all categories of property with the exception of vacant lands. The AMP applies to all City of Toronto staff as well as all service providers and contractors performing work in City of Toronto facilities.

The AMP outlines the responsibilities of City staff in their roles as the Owner of buildings containing Asbestos-Containing Material (ACM), as tenants of a building with ACM and outlines requirements

for City personnel involved in acquisition of property which may contain ACM.

The AMP is a management system to control disturbance of asbestos-containing materials during demolition, renovation, alteration, maintenance, repair or other activities.

The AMP incorporates the following elements:

- Asbestos Assessments and Reassessments. These documents are part of the AMP and can be found at each facility and in Facility Manager's Office.
- Regulatory Requirements and the City of Toronto Policies.
- Roles and Responsibilities.
- Notifications.
- Training Requirements.
- Emergency Reaction and Procedures.
- Work Practices (Type 1, 2 and Glove Bag work).
- Record Keeping.
- Contractor Requirements.

1.2 PROGRAM STATEMENT

The City of Toronto's first concern is the health and safety of all tenants, employees and everyone who enters a City of Toronto property. City of Toronto is also committed to operate in compliance with the Ontario Ministry of Labour Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations* made under the Occupational Health and Safety Act and all other applicable regulations.

The City has established certain policies which exceed the minimum requirements of O. Reg. 278/05 as follows:

- Due to future management issues and additional costs incurred over the life of the material, if practical, the City will not utilize any ACM in new construction or installations.
- When remedial action is undertaken on friable sprayed ACM, the City will generally opt for removal of the ACM. Encapsulation or encasement will not be undertaken unless removal is not practicable in specific locations.
- When remedial action is undertaken on friable mechanical insulation both removal and repair (re-jacketing or encapsulation of mechanical insulation) will be considered depending on the extent of work required.

- Prior to leasing properties, (if practical) the City will have asbestos assessments performed in buildings constructed prior to 1986.
- Prior to leasing properties, if practical, the City requires that the Landlord remove all friable ACM at the Landlords sole expense.
- At existing properties when ACM is discovered during any improvement, addition, renovation, demolition, maintenance, repair of any kind, or at any other time, the City shall promptly remove the ACM from the Premises or the Building.
- No City staff shall undertake any asbestos operations as defined as Type 3 in O. Reg. 278/05 other than as required by an emergency situation.
- All Type 3 asbestos operations shall be undertaken by an Asbestos Abatement Contractor.
- Type 1 and Type 2 work may be undertaken by either City staff (if they have employees with appropriate training, as per the City of Toronto's asbestos management policy dated July 2007, on site) or an Asbestos Abatement Contractor.

1.3 PROGRAM ELEMENTS

1.3.1 Asbestos Inventory

A record of the locations of friable and non-friable ACM has been established for the building in a Hazardous Materials Survey. This document is to be made available to all persons that enter the building and are likely to work in close proximity, disturb or handle ACM.

The Asbestos Survey will be available in the building with the Building Manager or Maintenance office. Additionally, the document will be maintained by the Asbestos Plan Manager in the main offices of City of Toronto.

A description of ACM in this facility is included in Designated Substance Survey that is available in the Facility Manager's Office. If assessments have not been performed for a building (and hence is not in compliance with Regulation 278/05), use the information in this section as a minimum for an asbestos assessment.

All City Facilities shall have an asbestos assessment report that includes friable and non-friable ACM. The survey shall be conducted on a room by room basis and shall indicate the location, condition, friability, accessibility and type of asbestos present in the Facility as outlined below.

As the survey will be typically performed for maintenance purposes it will not usually include destructive sampling that may destroy the material or damage the building. Typical materials that will not be part of the assessment include: roofing felts, drywall, window caulking and mechanical gaskets.

The survey must include the information gathered on a room-by-room basis together with recommendations for asbestos management, control or removal for each material detected in each location. The location of materials suspected to contain asbestos but shown by analysis to be non-

asbestos shall be reported. The original laboratory report of all analyses shall be provided as part of the report. Samples are to be collected at a rate that is in compliance with the requirements of O.Reg. 278/05, which states a minimum number of samples are to be collected and analyzed from each area of homogeneous material for the material to be considered non-asbestos. This frequency is indicated in the table below. A homogeneous sampling area is defined by the US EPA as containing 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.

Type of Material	Size of Homogeneous Material	Minimum Number of Bulk Samples
Surfacing material, including without limitation material that is applied to surfaces by spraying, by troweling or otherwise, such as acoustical plaster on ceilings, fireproofing materials on structural members and plaster	Less than 90 square metres	3
	90 or more square metres, but less than 450 square metres	5
	450 or more square metres	7
Thermal insulation, except as described below	Any size	3
Thermal insulation patch	Less than 2 linear metres or 0.5 square metres	1
Other materials	Any size	3

1.3.2 Administration

The administration of the AMP is provided in Section 2.0 of this document and includes various flow charts.

1.3.3 Operations and Maintenance

This segment of the AMP deals with the day-to-day operations where the ACM will remain in the building. An Operations and Maintenance Program will remain in effect until all ACM are removed from the building.

Elements of the Operation and Maintenance Program, found in Section 3.0 of this document, includes:

- a) Periodic Building Inspection and Annual Assessment of ACM,
- b) Notification of Tenants,
- c) Training,
- d) Employee Protection,
- e) Medical Surveillance,
- f) Work Authorization,
- g) Waste Disposal
- h) Air Monitoring,
- i) Equipment.

It is City of Toronto's intent at this time that no employees will be required to handle or remove any Type 3 Abatement of ACM. Those employees who may be required to work in close proximity to ACM will undergo awareness-training sessions. The Asbestos Plan Manager, Building Manager and Maintenance Supervisors may be required to have additional training as detailed in Section 3.9.

An Asbestos Training Manual has been developed to reflect the content of the training sessions. In addition the Occupational Health and Safety division will maintain a list of personnel having received in-house training.

1.3.4 Work Procedures

Prescribed procedures for the handling and removal of ACM are provided in Section 4.0 of the AMP. Appendix G addresses major and minor removal projects undertaken by an abatement contractor. .

1.4 REGULATORY REQUIREMENTS

At present three regulations govern the control, handling, transport and disposal of asbestos in Ontario.

Refer to Appendix B for further reference materials regarding regulatory requirements.

TABLE 1.1 – Summary of Legislation

STATUTE AND REGULATION	REGULATION REFERENCE	REGULATION AMENDMENTS
Occupational Health and Safety Act - R.S.O. 1990, c.O.1 <ul style="list-style-type: none"> <i>Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations</i> http://www.elaws.gov.on.ca/DBLaws/Regs/English/050278_e.htm 	R.O. 278/05	No amendments.
Environmental Protection Act - R.S.O. 1990, c.E.19 <ul style="list-style-type: none"> <i>General – Waste Management</i> http://www.elaws.gov.on.ca/DBLaws/Regs/English/900347_e.htm 	R.R.O. 347	Regulation of Ontario 183/92, 240/92, 501/92, 555/92, 457/93, 507/93, 105/94, 190/94, 298/94, 299/94, 512/95, 128/98, 157/98, 191/98, 460/99, 558/00, 501/01, 323/02, 326/03, 461/05.
Dangerous Goods Transportation Act - R.S.O. 1990, c.D.1 <ul style="list-style-type: none"> <i>General</i> http://www.tc.gc.ca/acts-regulations/GENERAL/T/tdg/regulations/tdg001/part_1.htm 	R.R.O. 261	Regulation of Ontario 269/92, 190/95, 252/02.

1.4.1 *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*

The AMP outlines procedures to maintain compliance with Ontario Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*, made under the Occupational Health and Safety Act. Ontario Regulation 278/05 applies to maintenance, renovation or demolition work where ACM is or may be disturbed.

The major requirements to building owners under this regulation include:

1. Provision of establishing an asbestos survey report outlining the locations, quantity, condition and content of asbestos in material in the building to all prospective

contractors who are likely to handle or disturb the material.

2. The asbestos survey report shall contain the following information,
 - The location of material,
 - Whether the material is friable or non-friable,
 - In the case of friable sprayed-on material, for each location, i) if the material is known to be ACM, the type of asbestos, if known, or ii) in any other case a statement that the material will be treated as though it contained a type of asbestos other than chrysotile.
3. Advising workers of the building owner who may work in close proximity to ACM and who may disturb the material.
4. Periodic inspection of the material to determine its condition, including an annual update of the asbestos survey report.
5. Implementation of appropriate control measures, where required, following the precautions and procedures prescribed by the Regulation (Type 1, Type 2 or Type 3 operations). The classification of the work depends on the type of material, procedures used and the quantity of material to be disturbed. Refer to Table 1.2 Classification of Asbestos Work for further information.
6. Establishment of a training program for employees of the owner who are likely to handle ACM.
7. Annual submission of an asbestos work report form for each employee working in a Type 2 or Type 3 operation.
8. Removal of ACM, to the extent practicable, prior to demolition of a building, or part thereof.

There are more than 3,000 uses of asbestos reported in the literature; most of these are hard or non-friable materials. Ontario Regulation 278/05, effective November 1, 2007, does require that the location of non-friable materials be included in the report. Work on non-friable materials including installation, removal, breaking, cutting, drilling, abrading, grinding, sanding and vibrating is covered in the Regulation and procedures for such work are specified. Before any major renovation work or demolition is performed, non-friable materials suspected of containing asbestos (roofing materials, floor tile, ceiling tile, etc. which have not previously been identified) which could be disturbed should be analysed for asbestos content.

The assessments did not include a number of non-friable materials that may contain asbestos (vinyl floor tiles, plaster surfaces, roofing felts, window caulking, elevator brakes, etc.) nor did it include demolition of walls, ceilings etc. to check on concealed conditions. The City of Toronto requires that all non-friable materials are to be assumed to contain asbestos unless sampling indicates otherwise. The City of Toronto recommends that prior to renovations, maintenance work or building demolition, materials that

may potentially contain asbestos, which have been sampled for the purpose of the survey report, must be sampled and analyzed to determine the asbestos content.

1.4.2 Environmental Protection Act, General - Waste Management

Ontario Regulation 347, as amended, under the *Environmental Protection Act, General - Waste Management*, regulates asbestos waste from the location of generation, transportation to and acceptance at an approved land fill site.

The major requirements to the building owner are as follows:

- To ensure that all asbestos waste is packaged and labelled as prescribed;
- That the transport vehicle is placarded as prescribed; and
- That the asbestos waste arrives at the landfill site on the same day as received by the waste transporters and by the most direct route.

1.4.3 Dangerous Goods Transportation Act

The Dangerous Goods Transportation Act, R.S.O. 1990, Chapter D.1, governs the packaging mode of transport labelling, placarding and documentation of the asbestos waste while in transport. These requirements are in addition to Ontario Regulation 347.

The building owner is also responsible for the waste while in transport.

SECTION 2.0

Administration

2.0 USE OF THIS MANUAL

This manual contains the information and procedures required for administering, implementing and maintaining an effective AMP for any building.

Procedures for the safe handling, repair, and removal of ACM are detailed for staff, outside contractual forces and service personnel. All parties involved in the program should review those sections of the document appropriate to their level of work and thoroughly understand their requirements and responsibilities. Additional procedures for employee protection and waste disposal are provided and referenced in numerous locations in the repair/removal procedures. When this information is referenced, it should be reviewed before proceeding with the work so that the correct safety procedures are followed.

The detailed Asbestos Survey document must be referred to prior to doing any work, if there is any doubt concerning the location of ACM. Sections of the manual may be issued as instructions to service or maintenance personnel or asbestos abatement contractors to ensure compliance with City of Toronto procedures. The program itself is dynamic in that the manual can be modified and altered to reflect changes in regulatory requirements, administration or work procedures.

2.1 ADMINISTRATION OF THE ASBESTOS MANAGEMENT PLAN

An effective management system is essential to ensure that all planned and unplanned disturbances of ACM are handled according to established procedures. This AMP consists of three distinct facets as follows:

- Asbestos location documentation delineating where asbestos is found within the building;
- An Operation and Maintenance Program to deal with the ACM that are left in place until removal is contemplated; and
- Procedures for major abatement projects where the ACM are removed from all or major segments of the building due to deterioration, for renovation or for other reasons.

The AMP for City of Toronto will be administered by an assigned site representative who will be responsible for the co-ordination and effectiveness of the Program. The co-ordinator for the Program will be referred to as the “Asbestos Plan Manager” in this document.

The following City personnel have responsibilities for establishing and maintaining the AMP.

2.1.1 Personnel Involved in Acquisition or Leasing to the City of Toronto

Personnel involved in Acquisition or Leasing to the City shall:

- 3 Prior to leasing or acquiring properties, City staff will have asbestos assessments performed in buildings.
- 4 Prior to leasing properties, if practical, City staff requires that the Landlord remove all friable ACM at the Landlords sole expense.
- 5 Prior to occupying acquired properties, City selected Abatement Contractor will remove ACM in any spaces renovated by City, or will negotiate to have vendor remove ACM prior to purchase. Preference is that asbestos abatement work be done under City supervision to ensure thoroughness.

2.1.2 Personnel Leasing To City Of Toronto Tenants:

Personnel involved in Leasing to City Tenants shall:

1. Ensure all leases signed by tenants of City include reference to this AMP and that tenants are to follow the requirements of the AMP.
2. City will remove accessible ACM that may be disturbed, from spaces to be leased, prior to tenant occupying space and performing renovations.

2.1.3 Facility Manager

The Facility Manager shall:

1. Ensure that an asbestos assessment has been performed for all facilities constructed or occupied prior to 1986. Where such a survey has not been performed in pre-1986 facilities, arrange for a room-by-room survey of the facility. For facilities constructed after 1986, asbestos assessment will be performed for all non-friable materials that may be present (i.e. transite rain water leaders and sheets, gaskets and roofing materials). Notify the JHSC representatives and employer in the building to ensure that all aspects of committee involvement are complied with.
2. Ensure the asbestos assessment report is available on site.
3. Notify in writing all existing and new Tenants of City (Management Representatives) at the location of asbestos, of the information in this record (modify and issue Tenant Notification Letter as appropriate – Appendix C).
4. Notify staff and outside contractors or service providers who may work with or may disturb the material in the record of its presence and location (issue Contractor Notification Letter as appropriate – Appendix D).
5. Measures are implemented to prevent accidental disturbance or further damage to ACM;

6. Arrange for the reassessment of asbestos-containing materials at regular intervals and ensure the asbestos assessment report is updated at least annually, or when new information is obtained as ACM is removed or it's condition changes.
7. He or she is informed of all upcoming work;
8. Arrange for the abatement of deteriorated ACM reported in the asbestos assessment report or in reassessment reports using the appropriate procedures (Type 1, Type 2 or Type 3 procedures).
9. The work is properly arranged for and scheduled;
10. Ensure all Project Managers, Architects, Engineers and others arranging for or planning work in the Facility are provided with necessary information on ACM and a copy of the Asbestos Survey or record. Ensure that an intrusive pre-construction assessment for friable and non-friable ACM is performed prior to any renovation, alteration or demolition. Ensure this information is provided to Constructor in plans, drawings or specifications. Such assessments shall include destructive investigation where necessary.
11. The person(s) scheduled to perform the work are trained (as per approved training developed by the Ministry of Training, Colleges and Universities or equivalent in the case of Type 3 work), and in the case of a Contractor, that the firm is qualified;
12. The person(s) responsible for overseeing the work has/have been advised;
13. Ensure that Tenant Management Representatives, JHSC and/or building occupants are informed in advance of projects which will require asbestos abatements.
14. Arrange for training for City staff (refer to Training Section 3.9).
15. Proper procedures are being followed for the handling, storage and disposal of ACM waste;
16. Arrange for awareness training on asbestos for building occupants as required to respond to concerns over the presence of asbestos or planned asbestos work when required.
17. Ensure that procedures are in place in the Facility to respond to emergencies involving asbestos by using City Personnel or an Asbestos Abatement Contractor.
18. Maintain all documentation required by this program, including but not limited to: Asbestos Management Program, Asbestos Assessment Reports and Reassessments, Tenant Notification Letters, Contractor Notification Forms, Asbestos Project Work Records, Training Certificates and Respiratory Protection Programme – i.e. records of fit testing.
19. Upon unexpected discovery of suspect ACM, or upon an uncontrolled asbestos spill or disturbance, follow the emergency procedures of Appendix E. Ensure all City personnel

that may report an emergency are aware of contact names and numbers.

20. Arrange for the inspection and air monitoring of asbestos work in the facility as required by O. Reg. 278/05 and this AMP, when contracted by Facility Manager.
21. At the completion of the work, to allow updating of the asbestos assessment report to reflect altered location and condition of ACM, complete the Asbestos Project Work Record in Appendix F for each project during which asbestos is removed that is managed by the Facility Manager.
22. Inform JHSC committee of any sampling or testing as they have a right to be present during testing if desired.
23. When major renovations or demolitions are undertaken, the procedures outlined in Figure 2.4 should be followed. Asbestos documentation may include but not be limited to the following:
 - Periodic Inspection Reports,
 - Damage Reports,
 - Emergency Response Reports,
 - Record of Asbestos Repair or Removal,
 - Asbestos Bulk Sample Reports,
 - Air Monitoring Reports,
 - Ministry Correspondence,
 - Contractor Correspondence,
 - Requests for Information,
 - Asbestos Contracts and Specifications,
 - Training Courses,
 - Joint Health and Safety Committee Reports.

2.1.4 *Project Manager*

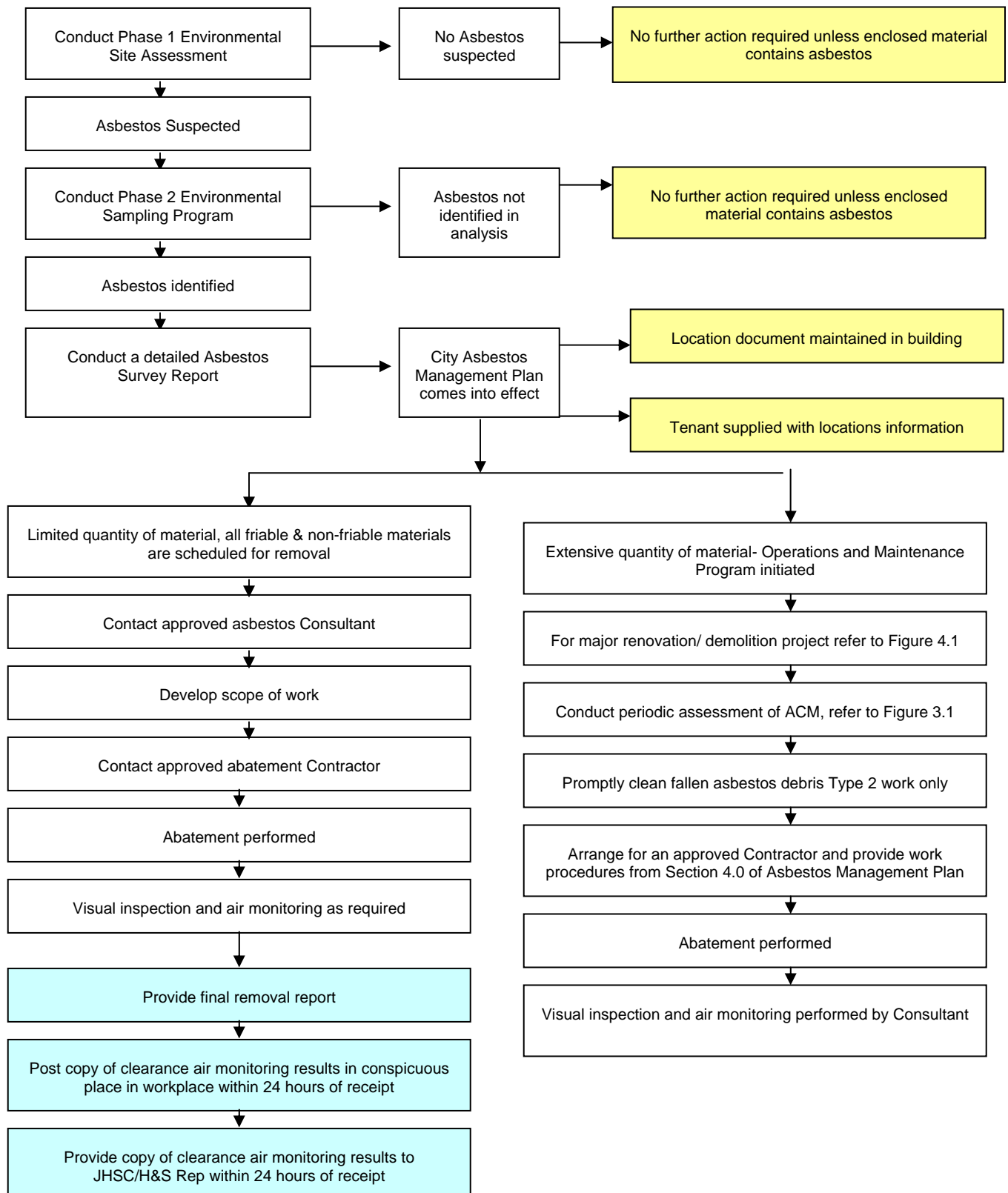
Project Managers (may also include Building Maintenance Managers) who plan, arrange for or oversee work in the facility shall:

1. Ensure that an intrusive pre-construction assessment for friable and non-friable ACM is performed prior to any renovation, alteration or demolition. Ensure this information is provided to Constructor in plans, drawings or specifications. Such assessments shall include destructive investigation where necessary.
2. Based on the results of the pre-construction assessment report, provide or arrange for the provision of appropriate specifications (Type 1, 2 or 3 operations) to Constructor to remove ACM from the work area.
3. Ensure all asbestos work in the facility is performed by Consultants and Asbestos Abatement Contractors who specialize in asbestos work and who have appropriate experience, equipment and insurance.
4. Arrange for the inspection and air monitoring of asbestos work in the facility as required by O. Reg. 278/05 and this AMP, when contracted by Project Manager.
5. Notify the Facility Manager of work requiring asbestos abatement precautions sufficiently in advance of work to allow Tenant notification.
6. Ensure all necessary notification of the Ministry of Labour for Type 2 and 3 Projects have been performed by the contractor prior to start of work and that all necessary forms are posted on site.
7. At the completion of the work provide information to Facility Manager to allow updating of the asbestos assessment report to reflect altered location and condition of ACM. Complete Asbestos Project Work Record in Appendix F for each project during which asbestos is removed or disturbed and submit to Facility Manager. The local JHSC must also be notified.

2.1.5 Facility Occupants And Tenant Representatives

All persons in the Facility who may arrange for maintenance or alteration of the Facility are to be made aware of the presence of ACM and shall:

1. Ensure all personnel who may work near the location of ACM are aware of its presence and follow the procedures outlined in this AMP.
2. Avoid unnecessary contact with or disturbance of ACM.
3. Report any disturbance, damage or deterioration of ACM to the Facility Manager.

FIGURE 2.1 – OVERVIEW OF ASBESTOS MANAGEMENT PLAN

2.2 RECORD KEEPING AND DOCUMENTATION OF AMP

The following records are to be kept by the Facility Manager for all sites with ACM:

- Asbestos Assessment Reports.
- Reassessment Reports.
- Tenant Notification Letters.
- Contractor Notification and Acknowledgement Forms.
- Asbestos Project Work Records.
- Inspection reports during abatement from Hazardous Materials Consultants.
- Bulk sample analytical results from any sampling.
- Abatement or emergency response project records.
- Air monitoring reports. Note clearance air monitoring reports must be retained for a minimum of one year.

This AMP is to be re-evaluated each time there is a substantial change to the Asbestos Regulation (O.Reg. 278/05).

2.3 CONTRACTOR REQUIREMENTS

Contractors hired by City are to meet the following minimum requirements:

- Must maintain a Comprehensive General Liability Policy, provided on an “occurrence” basis, for a minimum of \$5,000,000 in coverage.
- Must maintain an Asbestos Liability or Pollution Liability Policy, provided on an “occurrence” basis, for a minimum of \$5,000,000 in coverage.
- Must maintain an Automobile or Fleet Policy, and Non-owned Automobile Policy for a minimum of \$2,000,000 in coverage.
- Maintain a valid Workplace Safety and Insurance Board Clearance Certificate.
- All supervisors and workers performing Type 3 work are to have attended an approved Ministry of Training, Colleges and Universities, or equivalent, course regarding asbestos, as of November 1, 2007.

- All workers are to be fit tested for respirators and trained in respirator care.
- If City is signatory to any of the Labourers Union, Insulators Union or Painters and Allied Trades Unions, union labour must be provided by the contractor.
- For large projects, the Project Manager may wish to ask for references for 5 previous projects of similar scope and cost.

2.4 CUSTODIAL WORK

Where exposed asbestos-containing sprayed fireproofing is present, or exposed and badly damaged asbestos-containing materials are present, Custodial Staff are not to clean the area by dry sweeping. Instead, Custodial Staff are to call Facility Manager and arrange to have the Asbestos Abatement Contractor use a HEPA vacuum to clean floors. This is not an asbestos procedure, but a precautionary procedure to fully protect Custodial Staff from unexpected disturbance in the event that debris is present and unseen. Mopping is acceptable.

2.5 LOCATION OF ACM DOCUMENTATION

2.5.1 Introduction

City of Toronto will maintain up to date asbestos survey documents of their facility. Initial and subsequent surveys of the building will be performed using safe procedures that will not unnecessarily disturb existing ACM. The survey documents for the building will be maintained on site together with the AMP. Survey documents will be updated at least annually or more frequently where the condition or extent of ACM has changed and will continue to remain in effect until all ACM are removed from the building.

It is required that each property managed by City of Toronto be surveyed for the presence of friable and non-friable ACM. The findings of the survey shall be maintained in the form of a report, which will be kept on the premises and at the City of Toronto main offices.

The document will be provided in various forms to serve the various needs of the building or specific targeted group's special needs. The various document forms may include any of the following:

1. A master copy which details all known ACM in the building;
2. An overall floor plan, which indicates those locations in the building that have some kind of ACM; and
3. A summary of each individual Commercial or Residential Rental Unit for submission to the tenant or lessee whose premises will not be managed and maintained by City of Toronto.

The Asbestos Plan Manager shall administer the inventory of ACM in the building. The Program Manager shall be responsible for maintaining the inventory of the location of all ACM contained in the building. They will also schedule, co-ordinate, and authorize action necessary to complete initial and interval inspections of all buildings.

The reports will be modified and updated to reflect changes in the presence of ACM in the building as a result of removal, repair, damage, maintenance, construction, demolition, etc. The inventory shall be made available for inspection to Ontario Ministry of Labour Inspectors and to any building occupants as required by legislation.

The Asbestos Plan Manager may appoint the services of a Consultant specialized in the inspection of buildings for ACM as the need arises to provide building audits or to update existing surveys.

2.6 ASBESTOS SURVEYS

Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*", made under the *Occupational Health and Safety Act*, requires building Owners to identify materials which may contain asbestos by either analysis or manufacture's documentation. The analysis is required only where work will be performed on building materials or where material is deteriorating and falling. Where asbestos is identified in building materials the building owner is required to implement a program to manage the ACM. Part of this program includes asbestos sampling to identify ACM and implementation of procedures for the periodic assessment, control, handling and disposal of the ACM. Asbestos identification in building materials is also a component of a designated substance list that must be issued to Contractors or service personnel prior to performing work.

2.7 BULK SAMPLE COLLECTION PROCEDURES

Bulk samples collected during the initial survey and all samples collected for future testing shall be collected following the procedures provided in Ontario Regulation 278/05. Following these procedures, samples can be collected by City staff, or by an Asbestos Consultant, under the direction of the Facility Manager or Project Manager.

2.8 BULK ANALYSIS

Bulk samples will be analysed for asbestos in accordance with O. Reg. 278/05 section 3(1)1. All analyses shall be performed by laboratories accredited in the US National Voluntary Laboratory Accreditation Program (NVLAP) or the American Industrial Hygiene Association (AIHA) asbestos in bulk sample programs.

2.9 OVERALL SITE FLOOR PLAN

Purpose

The purpose of the individual floor plan is to allow the Asbestos Plan Manager and the Maintenance Staff immediate recognition if a particular location in the building has ACM. For the type of material, location and asbestos content the information will have to be referenced in the “Asbestos Survey Report”.

Document Format

Individual floor plans will be provided for each floor of the building in standard building plan size. All areas where ACM are found will be shaded to clearly show where the asbestos is present in a room or area. The location of the ACM will be approximated as close to the location where it is found in the building as is reasonably permitted by visual observation. Legends will be developed depending on need and materials present.

Document Location

Copies of the floor plan will be maintained in the City of Toronto offices, with the Asbestos Plan Manager and with each Property Manager and with each building manager. Additional copies will be distributed on an as required basis.

Alternate Documentation

In the absence of a floor plan drawing, the Asbestos Survey Report will document the location of ACM in a clear and descriptive manner.

2.10 TENANT SUMMARY DOCUMENTATION

Purpose

The tenant summary document for individual commercial retail units or residential tenants will provide notification to all small commercial or residential tenants that will be managed and maintained by the tenant. This information is required under the Regulations so that the tenant can readily recognize the location of ACM and safeguard their staff against possible exposure to asbestos fibres. The tenants in turn must establish their own AMP for the leased space. For those units that City of Toronto maintain, the tenants are expected to operate under the City of Toronto AMP. Additionally this will permit City of Toronto staff to provide service personnel, maintenance personnel and contractors with detailed information as to the location of ACM in each rental unit.

Document Format

The information for each tenant unit shall consist of a single page entry on the floor plan including adjacent properties marked with coloured overlays showing the location of each of the ACM present. Key wording will describe the particular location of the material (i.e., a particular material may be found in the room space or concealed above solid plaster ceiling, etc.). Summary information in tabular form will compliment the drawing.

Document Location

Copies of this document shall be provided to each tenant and a master set maintained with the Asbestos Plan Manager. Additional copies may be distributed as required.

2.11 MASTER LOCATIONS DOCUMENT***Purpose***

The purpose of the master document is to consolidate all information on ACM for each individual building. This document will be available to the Asbestos Plan Manager, each Property Manager and Maintenance staff of the building.

Document Format

The document shall be arranged in two distinct sections, one to address the locations of ACM and the second to provide an assessment of the condition of the material with recommendations for appropriate corrective measures where required. The use of layout floor plans shall form an integral part of the report

Location Information Portion of Document

The document will include the following for the locations of ACM section of the document:

1. A survey methodology indicating limitations of the survey and whether destructive investigation was performed;
2. Bulk sampling and analysis methodologies used;
3. A site description with drawings showing the location and building additions; and
4. A summary of the location results, which shall include the following:
 - a) A room-by-room summary of ACM in the building. If applicable, the summary is also to be divided based upon building additions.
 - b) Separate floor plans showing the location of each ACM differentiating between friable and non-friable materials.

- c) A summary of analysis of bulk samples collected specifying the analytical method used and including floor plans showing the location where the bulk samples were collected.
- d) The type of asbestos and concentration within the material.

Once ACM has been removed, the Asbestos Plan Manager will update the locations document with the changes.

Assessment Information Portion of Document

The document will include the following for the assessment of the condition of the ACM section of the document:

1. A description of the assessment of ACM methodology.
2. A rationale for corrective action with a description of the options including:
 - Cleaning,
 - Repairing or sealing,
 - Enclosing, and
 - Removal.
3. A summary of assessment with recommendations for corrective action where required.
4. Individual recommendations for repair and any restrictions until repairs are completed will be listed with floor plans showing the location of each item.

Document Location

The master document for each facility shall remain with the Asbestos Plan Manager in the Administration office for City of Toronto and a site-specific document with each Property Manager or in the Maintenance Department office of each facility.

2.12 DISTRIBUTION OF ASSESSMENT RECORD AND REASSESSMENT

The Facility Manager is responsible for maintaining a copy of records, assessment reports and reassessment reports on site. In addition, the Facility Manager will ensure the following are provided with access (not additional copies) to these reports:

- JHSC representative.
- Tenant (in premises with ACM).
- Project Managers or Managers planning or performing work in a City Building.

SECTION 3.0
OPERATIONS AND MAINTENANCE
PROGRAM

3.0 OPERATIONS AND MAINTENANCE PROGRAM

3.1 INTRODUCTION

The identification, documentation and confirmatory analysis of ACM within a facility, is the first step in controlling building occupant exposure to asbestos fibres. Information generated from the building survey is then used by the Asbestos Plan Manager to control work that will be performed on or may likely disturb ACM. The purposefully managed and controlled work on ACM in buildings is known as the Operations and Maintenance Program.

The Operations and Maintenance Program is a set of specific procedures and practices applied to building cleaning, maintenance, renovation and general operation to reduce exposure to asbestos fibres to ambient levels (i.e. the outdoor environment). The Operations and Maintenance Program is initiated after the building survey is completed and draws heavily on information generated during that survey and any ongoing evaluations of the ACM. The Operations and Maintenance Program shall remain in effect until all ACM are removed from the facility.

The principal objective of an Operations and Maintenance Program is to minimize exposure to all building occupants from asbestos fibres. To accomplish this objective an Operation and Maintenance Program includes work practices to:

1. Maintain ACM in good condition,
2. Monitor the condition of ACM for deterioration,
3. Ensure a proper cleanup of asbestos fibres previously released, and
4. Prevent further uncontrolled releases of asbestos fibres.

The Operations and Maintenance Program is not a permanent abatement option. It should be implemented as part of an overall AMP that has a goal of eventual elimination of ACM within a building. The intent of the Operations and Maintenance Program is to manage the ACM on a daily basis including any repairs or minor removals. Large removal projects that require extensive planning and technical expertise are beyond the scope of the Operations and Maintenance Program.

The Operations and Maintenance Program includes the following elements:

1. The administration of the program, as discussed in Section 2.0, including assessing the impact of maintenance or renovation work on ACM and ensuring appropriate protective measures are implemented;
2. Conducting building inspections for renovations or demolition, periodic assessments (commonly referred to as Surveillance Programs) to evaluate the condition of the ACM to document any changes in the materials (i.e., deterioration) and to assess any spill episodes;
3. Providing building occupants (tenants and staff) with notification advising them on the locations of ACM in the building, as well as how and why uncontrolled disturbance of the material should be avoided;

4. Implementing control measures and procedures to limit building occupant exposure. Specialized work practices intended to avoid or minimize fibre release will include the following:
 - Cleaning procedures,
 - Work practices for maintenance activities,
 - Work practices for renovation, and
 - Emergency response procedures.
5. Record keeping documenting any operations and maintenance activities;
6. Training for the Asbestos Plan Manager, appointed designates, building managers, supervisory staff, custodial staff and maintenance personnel; and
7. Providing worker protection where staff is required to handle ACM and include:
 - A respiratory protection program, and
 - A medical surveillance program.

Additional work procedures may be included in the Program as determined by future needs. This will result in additions to the documented program.

3.2 PERIODIC BUILDING INSPECTION AND ASSESSMENT OF ACM

Periodic review of the Operations and Maintenance Program is essential to ensure that the program objectives are being met. A key feature of the review is re-inspection of all ACM in the building. Combined with ongoing reports of changes in the condition of the ACM made by service workers, the re-inspection will ensure that any damage or deterioration of the ACM will be detected and corrective action taken.

Inspection of the condition of the friable ACM will occur at three levels as required by legislation:

3.2.1 Routine Inspection

To be performed by maintenance staff and/or other qualified personnel, during their normal course of work. This is a casual inspection where deterioration or damage to an application or material shall be recorded and reported to the Building Manager who in turn will report the damage to the Asbestos Plan Manager. Necessary arrangements will then be made for remedial action where it is confirmed through documentation or additional bulk sampling and analysis that the material in question contains asbestos.

Upon discovery of damage the Damage Report (Figure 3.2) shall be filled in and arrangements can be made by the Asbestos Plan Manager, or designate, for repair if limited to a small disturbance. An outside firm specializing in asbestos inspection and abatement shall provide assistance where the disturbance is significant. All damage reports should be retained with the location report to assist in the formal inspection as described in the following.

3.2.2 *Formal Inspection*

An annual inspection (at least once in each 12-month period) will be made of the condition of all ACM in the building for all locations identified in the Asbestos Survey. The frequency of the inspection may be increased if the previous assessment indicates rapid deterioration or uncontrolled damage due to vandalism.

Formal inspections should be undertaken by a consulting firm, specialized in asbestos inspection and abatement. The auditor performing the inspection shall be qualified with a minimum of 5 years experience performing such inspections on projects of similar size and complexity.

Various assessment factors must be taken into account to evaluate each type of material. The assessment factors are:

- ACM condition (deterioration, physical damage, and water damage),
- Potential for disturbance (accessibility of the ACM, sources of vibration near the ACM, and potential for air and/or water erosion), and
- Location of the ACM in or near air plenums, airshafts, or elevator shafts.

For each time the formal inspection is performed the following should be recorded:

- Inspector's name,
- Date of inspection, and
- Notation of change (or lack of) in the condition of the ACM.

When an inspection reveals that remedial action is necessary due to deterioration, or that a situation exists that could result in deterioration, or that there is a risk of exposure to asbestos fibres, the Asbestos Plan Manager is to be informed. The need for corrective action is to be recorded in a similar format as per the initial assessment of the Building.

3.2.3 *Pre-Renovation or Construction Inspection*

An inspection of a building or section of a building is required prior to conducting any building renovation or construction to evaluate whether any ACM will be impacted. The inspection shall require intrusive methods to determine if concealed ACM is present. Additional sampling and analysis may also be required on any concealed materials or other materials not previously sampled. Confirmation of asbestos content can be determined by analytical results from visually similar material sampled in other locations.

3.3 REASSESSMENT OF ACM AND UPDATE OF SURVEY RECORD

The Facility Manager will arrange for a regular reassessment of all accessible areas identified by the survey to contain ACM. The reassessment will be performed at least annually if ACM is present. If a specific area is subject to any change of use, frequent maintenance which may disturb the material, or if any report of damaged or deteriorated ACM is brought to the attention of the Facility Manager, the reassessment of materials in the specific area shall be performed on a more frequent basis. Reassessment shall always be performed of specific materials when damage or deterioration is reported. The JHSC shall be notified of the reassessment and be invited to attend.

The reassessment of ACM will be documented in writing using the forms provided in Appendix H. The survey record should be updated based on these forms.

In Facilities which are entirely leased and in which neither City nor Facility Management Service Provider are responsible for maintenance, renovation or alteration of the initial survey and the reassessment are the responsibility of the landlord. Copies of the initial survey and reassessments shall be provided by the landlord to the Facility Manager and maintained on site.

3.4 DISTRIBUTION OF ASSESSMENT RECORD AND REASSESSMENT

The Facility Manager is responsible for maintaining a copy of records, assessment reports and Reassessment reports on site. In addition, the Facility Manager will ensure the following are provided with access (not additional copies) to these reports:

- JHSC representative.
- Tenant (in premises with ACM).
- Project Managers or Managers planning or performing work in a City Building.

3.5 PRE-CONSTRUCTION ASBESTOS SURVEY (SECTION 10 OF O. REG. 278/05)

Prior to the commencement of any renovation, construction or demolition project (including buildings built up to 1986/the present time), the building or specific areas of the building which are to be affected by the work, shall be assessed for friable and non-friable ACM. However, if the owner already knows that the materials within the building or specific areas which are to be affected by the work is not ACM, or if the owner already knows that the materials are ACM and knows the type of asbestos, or the building or specific areas have already been assessed, an asbestos survey is not required prior to the commencement of the renovation, construction or demolition. The survey must be performed by a specialized asbestos consultant and include destructive or intrusive testing of enclosed areas which will be affected by the work.

Upon completion of the pre-construction survey, if asbestos is present in the area, specifications for removal shall be prepared (Type 1, 2 or 3 as appropriate) and provided to the Constructor in the work specifications.

FIGURE 3.1 - PERIODIC INSPECTION OF ASBESTOS-CONTAINING MATERIALS

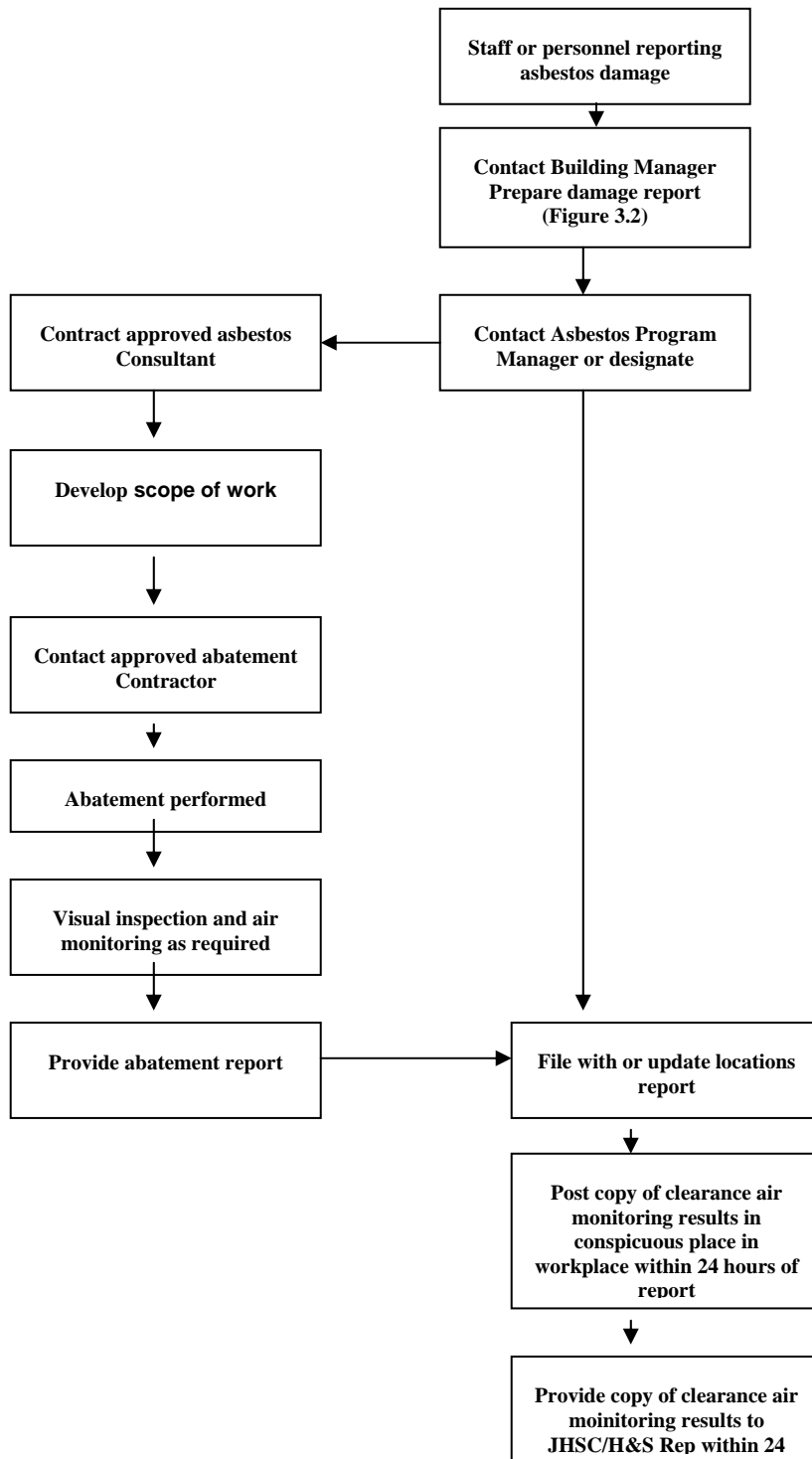


FIGURE 3.2 - ASBESTOS CONTROL PROGRAM DAMAGE REPORT

Reported By: _____ Date: _____

LOCATION DETAILS:

Building Name: _____

Building Section: _____

Room Name: _____ Room Number: _____

DAMAGE DETAILS:

Description of Damage:

Cause of Damage (If known):

Immediate Action Required:

YES _____ NO _____

Area Isolation Required:

YES _____ NO _____

SUBMISSION TO ASBESTOS PLAN MANAGER:

Name: _____ Position: _____ Date: _____

FOLLOW UP ACTION:

Asbestos Plan Manager: _____ Date: _____

Copies to: _____

This level of inspection is to be performed by a firm specializing in asbestos inspection and abatement. The auditor performing the inspection shall be qualified with a minimum of 5 years experience performing such inspections on projects of similar size and complexity. The locations document shall be updated following performance of the project.

Upon completion of the inspection, a report shall be generated and submitted to the Asbestos Plan Manager for submission to Contractors outlining the extent of asbestos that will be disturbed. The report shall use drawings to clearly delineate the extent of asbestos present in the construction/renovation area and the material requiring removal prior to conducting any other construction. NOTE: As per legislation, all ACM must be removed before renovations or construction can occur.

3.6 NOTIFICATION

Once the presence of ACM has been established in a building, a notification program is required by legislation. The purpose of the notification and warning program is to inform employees, tenants, service personnel, maintenance personnel, or others *with the potential* to come in contact with ACM, that ACM material is present.

The notification and warning program serves two purposes:

1. It alerts affected parties to a potential hazard in the building; and
2. It generates a broad involvement in the Operations and Maintenance Program.

Building occupants who are aware of the presence of ACM are less likely to disturb the material and cause fibre release. The notification to building occupants (i.e. staff and tenants) may include:

- Distribution of notices outlining the locations of ACM accompanied with a fact sheet on asbestos (Appendix A); and
- By holding awareness or informational seminars as outlined in the awareness training section of this manual.

All concerns relating to the condition of asbestos applications, reports or questions regarding the AMP are to be directed to the Asbestos Plan Manager. Notification will be initiated by the Asbestos Plan Manager and distributed in the following manner to targeted parties:

3.6.1 *City of Toronto Staff*

Individuals who have a potential to come into direct contact with ACM will receive formal training dealing with general asbestos awareness and recognition of potentially or hazardous situations and have full access to the master locations document for the building(s) under their responsibilities.

3.6.2 *Notification To Tenants*

Upon completion of the asbestos assessment, the Facility Manager will inform all Tenant Representatives of the presence of asbestos within their leased space and provide them with access to portions of the record regarding their premises and common areas. The letter of notification to Tenants regarding asbestos (Appendix C) shall be used for this purpose. This notice will be provided to all existing and new tenants as required.

3.6.3 *Service Personnel and Maintenance Personnel or Contractors*

All contractors and City employees who perform work at facilities where ACM is present must be notified of the presence of the ACM if their work may bring them into contact or close proximity to the ACM and they may disturb it. This notification may include janitorial, security, telephone, computer cabling suppliers, mechanical maintenance contractors, etc. This notification shall be performed by the Facility Manager or Project Manager.

All contractors and City employees who perform work at City facilities, where asbestos-containing sprayed fireproofing is present above ceilings, including telephone, computer cabling suppliers, electrical and mechanical contractors, etc., are to be notified that Type 2 Procedures are required for any entry to, or work within the ceiling space (visual inspection excepted, Type 1 Work). This notification shall be performed by the Facility Manager or Project Manager.

Upon completion of the asbestos assessment, the Facility Manager will inform Maintenance Personnel (including Physical Plant Personnel) of the presence of asbestos within the building and ensure they have access to the asbestos assessment report.

3.7 NOTIFICATION OF ASBESTOS ABATEMENT

Contractors are to:

- Notify orally and in writing, an inspector at the office of the Ontario Ministry of Labour nearest the project site (Notice of Project), as per Regulation 278/05, prior to commencing Type 3 abatement, Glove Bag abatement or any abatement project that exceeds \$50,000.00 in cost.
- Notify Sanitary Landfill site as per Ontario MOE Regulation 347 as amended.
- Inform all sub trades of the presence of ACM identified in the contract documents.
- Notify the Project Manager if suspect ACM not identified in the contract documents are discovered during the course of the work. The contractor is to notify the MOL and the JHSC if the friable material is asbestos containing, as required by Regulation 278/05.
- The Project Manager is to notify the JHSC of any testing or sampling that is

proceeding.

- The Project manager is to notify the Facility Manager, which in turn, is to notify tenants of any abatement work within their space or that will impact their operations. This is a procedural requirement, not a regulated requirement.

3.8 EMERGENCY PROCEDURES AND CONTACTS

3.8.1 *Fallen Debris Or Damaged Material*

City staff may encounter fallen material that is suspected to contain asbestos. This may occur in locations where asbestos has been documented or in areas not included in the Assessment due to limited accessibility, etc.

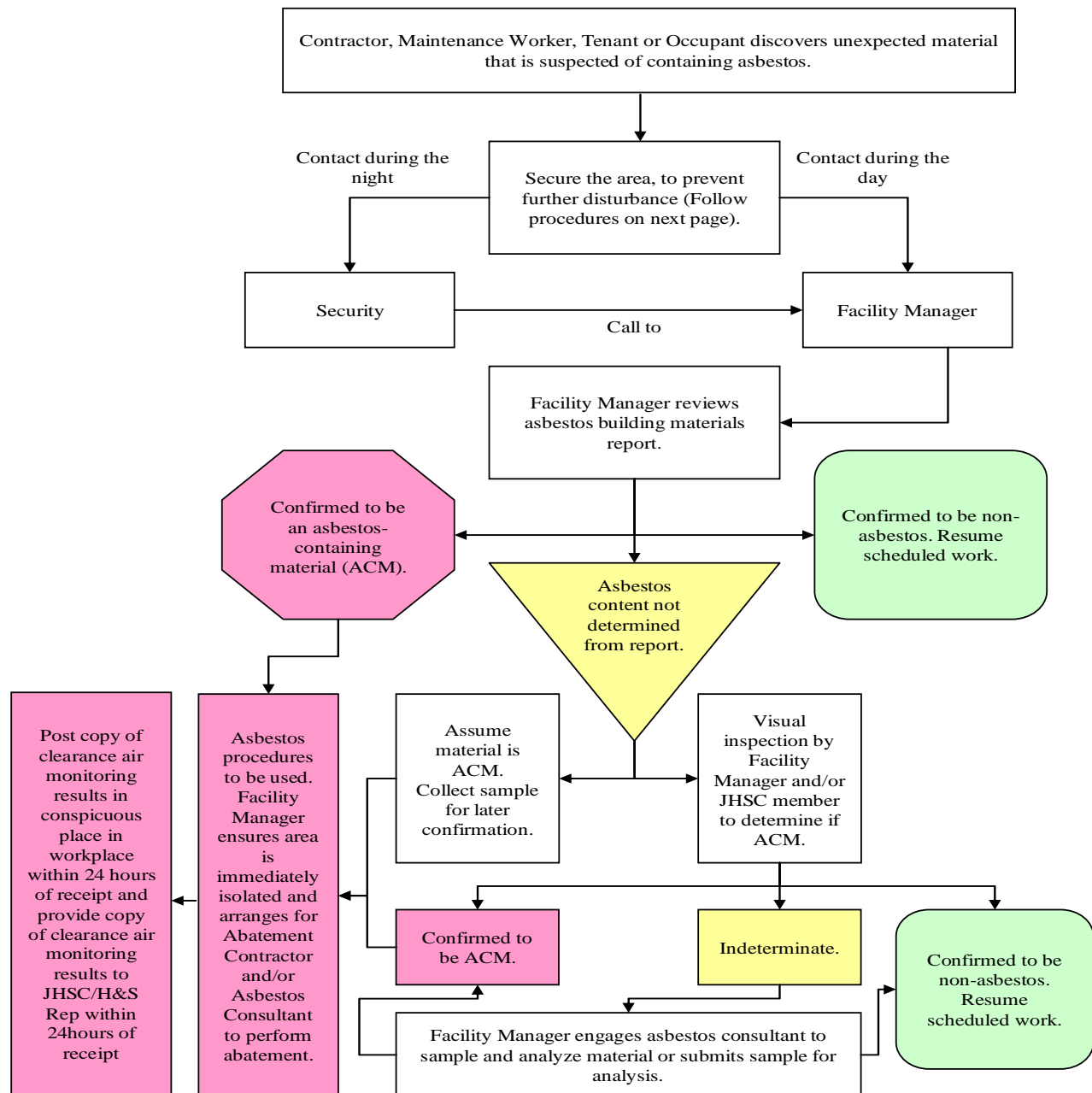
Facility Management shall follow the protocol “Emergency Reaction in the Event of a Suspected Asbestos Spill” (Appendix E).

In the event that Emergency Work must be undertaken, follow the procedures outlined in Appendix E – Work Practices for Emergency Work. All emergency situations shall be reported to the Facility Manager as soon as possible.

Emergency Contacts:

- Security: Emergency: 416 392 6666
- Security: Non- Emergency: 416 397 0000
- FRED: 416 338 3733
- Help Desk: 416 392 7995
- District Operations Manager: contact manager within the district
- Abatement Consultant:
 - ECOH Management: 905 195 2800
 - Fisher Environmental: 905 475 7755
- Abatement Contractor:
 - Furcon Environmental: 905 672 8314

FIGURE 3.3 - ASBESTOS EMERGENCY OR DAMAGE REPORTING



3.9 DISTURBANCE OF PREVIOUSLY UNIDENTIFIED FRIABLE MATERIAL

Previously unidentified friable materials may also be uncovered during demolition of finishes, walls etc. during construction. The Project Manager shall follow the protocol “Emergency Reaction in the Event of a Suspected Asbestos Spill” (Appendix E).

If the material contains asbestos, the Project Manager is to notify the local Ministry of Labour Office of the discovery. This is a regulated requirement.

3.9.1 Module 1: General Awareness Training

The "awareness seminar" is intended for all building occupants and other affected parties. It serves the purpose of occupant notification described in the previous notification section. The objective of the training is to provide a general awareness of the hazards of ACM. This module would also be suitable for building occupants other than employees who are concerned about the presence of asbestos in the building.

Session Content – Estimated duration of 2 hours

1. Health Effects of Asbestos Exposure;
 - Types and properties of asbestos,
 - Routes of entry,
 - Asbestosis, cancer, other health effects,
 - Effects of concentration and exposure duration.
2. Uses of Asbestos;
 - Products made from asbestos,
 - Risks of different types of materials (friable/non-friable),
 - Recognition of asbestos-containing building materials,
 - How asbestos in buildings can be a hazard.
3. Overview of Regulatory requirements;
 - Application to buildings,
 - AMP.
4. The AMP;

- Purpose of management program,
 - Elements of management program,
 - Person responsible for the program in a building.
5. Questions to Demonstrate Understanding.

3.9.2 *Module 2: Type 1 Work Training*

This session is designed for workers who are expected to be involved in Type 1 asbestos work only. The objective of the training is to enable the workers to identify work that requires Type 1 work procedures, understand the asbestos exposure hazard associated with the work, and to be able to carry out the work accordingly.

Session Content - Estimated duration of 7 hours

1. All of Module 1.
2. Overview of Regulatory requirements;
 - Requirements for testing insulation,
 - Classification of work,
 - Work procedures based on classification,
 - Medical surveillance.
3. Principles of Remedial Measures;
 - Enclosure, encapsulation, and removal,
 - Limitations of remedial measures.
4. Use and Interpretation of the Asbestos Record;
 - Should allow individual workers to identify where they may come into contact with friable asbestos material.
5. Limitations of Training;
 - Type of work that training allows worker to perform,
 - Who to contact in event of emergency.
6. Classification of Work;

- As prescribed by the regulation (Type 1 work procedures),
 - Work that employee may be required to perform.
7. Respirator Training;
- Theory of respirators,
 - Limitations of equipment,
 - Inspection, maintenance, and storage of equipment,
 - Selection, fitting and use of respirators,
 - Positive and negative pressure fit check,
 - Respirator cleaning and disinfection,
 - Record of worker training and fit testing,
8. Use, Care and Disposal of Protective Clothing,
9. Questions to Demonstrate Understanding.

3.9.3 *Module 3: Type 2 Work Training*

This session is designed for workers who are expected to be involved in both Type 1 and 2 asbestos work. The objective of the training is to enable these workers to distinguish between each work type. To understand the asbestos exposure hazards associated with the work, and to apply the appropriate procedures as prescribed by the Regulation.

Session Content – Estimated duration of 8 hours

Training should be related to actual jobs that each worker would be expected to perform. It is recommended that training for this module include hands-on experience in the use of respirators, protective clothing, portable enclosures, HEPA filter vacuums, etc.

1. Modules 1 and 2.
2. Asbestos Work Reports.
3. Type 2 Work Procedures;
 - As prescribed by the regulation,
 - Work that employee will be required to perform.
4. Biomedical Surveillance Program

5. Questions to Demonstrate Understanding.

3.9.4 *Module 4: Evaluating the Impact of Asbestos in a Facility*

This session is designed for building workers who are expected to inspect buildings for friable ACM or to evaluate whether the work will impact on ACM. The objective of the training is to enable these workers to survey buildings for and to assess the exposure potential of such materials.

Session Content – Estimated duration of 21 hours

1. Inspecting Buildings for Asbestos;
 - Reviewing building records,
 - Surveying building for ACM,
 - Where to look,
 - When to sample,
 - Precautions to be taken,
 - Sampling materials for analysis,
 - Preparing record of location of ACM.
2. Addressing the Risk of Asbestos Exposure;
 - Significance of the type of insulating material,
 - Significance of percentage of asbestos friability,
 - Effect of age and deterioration,
 - Evidence of physical or water damage,
 - Location and accessibility: potential for future disturbance,
 - Control options.
3. Workers carrying out inspections must also complete Module 3 training.
4. Questions to Demonstrate Understanding.

3.9.5 *Module 5: Outside In-depth Training*

Additional training may be required, on an as needed basis, for work beyond those described in the training packages presented in the AMP. The training may include attendance by City of Toronto personnel at seminars and courses presented by others pertaining to asbestos management or abatement. Course content may include detailed training for asbestos abatement or general information seminars. The Asbestos Plan Manager must authorize attendance in these programs. Asbestos workers must meet the requirements for Type 3 training as established by the Ministry of Training, Colleges and Universities and must also achieve a passing grade.

3.10 TRAINING

City employees will not undertake asbestos work other than for Type 1 and Type 2 work or in emergency situations in Type 3 projects. Therefore training shall be limited to the following:

Maintenance personnel and supervisors shall receive training in asbestos including identification of ACM, uses and hazards of asbestos, regulations applying to asbestos work and Type 1 and Type 2 work practices and safety procedures.

Facility and Project Managers shall receive training in asbestos management and removal and the AMP of sufficient content to allow them to implement the policies outlined in the AMP and to enable City to remain in compliance with O. Reg. 278/05.

Tenant Representatives and Building Occupants shall receive (upon request only) Asbestos Awareness Training. Such training may be provided in advance of a project incorporating Type 2 or 3 operations or if concern over asbestos is expressed by employees.

City requires all service providers, contractors, etc. to provide appropriate training to all workers who perform Type 1, 2 or 3 work in City Facilities.

In accordance with the Regulations, every employee working with ACM, or working in close proximity to ACM, and in a manner that may disturb the ACM, must partake in an information and training program. The program must be designed to instruct each employee in work procedures necessary to prevent exposure to asbestos fibres. Asbestos training is a continuous process with updates and reviews. The program will allow for re-training of current employees as well as ensuring that new hires are also given the proper training. Workers and supervisors conducting/overseeing Type 3 work must have proof of having attended training approved by the Ministry of Training, Colleges and Universities.

Training of building occupants and other affected parties is an integral aspect of an effective Operations and Maintenance Program. Training serves to establish the basis for proper awareness and work practices that will result in the effective implementation of the Operations and Maintenance Program. Training must be adequately developed and offered, on several levels, depending on the audience's particular participation in the program. Therefore, it is usually preferable to develop several training programs tailored to individual needs.

Asbestos training will be offered and provided on the needs of specific buildings as authorized by the Asbestos Plan Manager. At this time, City of Toronto staff are not permitted to conduct any Type 3 asbestos related work, and as such, a specialist Abatement Contractor will complete this work. The following training modules have been prepared as an outline to assist building owners in establishing

training requirements that will comply with the Regulations. The appropriate level of training will be selected based upon a person's role, function or responsibilities within the AMP. The Joint Health and Safety Committee/Health and Safety Representative must be advised of the time and place of any training provided.

3.11 PERSONAL PROTECTIVE EQUIPMENT PROGRAM

Any employee or building occupant with a significant potential for exposure to airborne asbestos should be involved in a personal protective equipment program. This is particularly relevant for custodial and maintenance workers who encounter ACM during the course of their duties. Additionally, outside maintenance personnel, service personnel and Contractors will be required to show proof of employee training in asbestos control procedures including a respiratory protection program.

City of Toronto have decided at this time that an experienced and qualified Abatement Contractor pre-selected by the Asbestos Plan Manager will perform all Type 3 work involving ACM for City of Toronto. No City of Toronto employee will be assigned Type 3 friable asbestos related work.

The information in this section is provided for reference only and not applicable at this time. Should this position change and selected employees will be required to conduct any type of work as specified in the Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*, then training will be provided by a qualified Occupational Health and Safety Consultant. No work will be performed until specific training has been provided and the employee comprehension of the work has been evaluated by the Asbestos Plan Manager, and accepted as adequate. When initiating the Personal Protective Equipment Program, employee training shall include training with respirators and other personal protective equipment.

3.11.1 Respiratory Equipment

Respiratory requirements for work with asbestos are covered by Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*. The requirements for use, selection, fit testing and storage of respirators are outlined in the following sections.

3.11.2 Requirement

1. Type 1 Operation - Respirator use is optional. If an employee requests a respirator while performing a Type 1 operation, the employee must wear the respirator. The specified respirator must be a half face or full face (for falling debris), air-purifying respirator with replaceable high-efficiency particulate filters.
2. Type 2 Operations - Respirator use is mandatory. This applies to all operations specified in this category. Depending on the nature of the work being performed, the following types of respirators may be required.

- Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter,
 - Air purifying full-face piece respirator with N-100, R-100 or P-100 particulate filter,
 - Or one of the following;
 - Powered air purifying respirator equipped with a tight-fitting face piece (half or full-face piece) and a high efficiency filter or N-100, P-100 or R-100 particulate filter,
 - Negative pressure (demand) supplied air respirator equipped with a full-face piece, or
 - Continuous flow supplied air respirator equipped with a tight fitting face piece (half or full-face piece).
 - NOTE: An Occupational Health & Safety Consultant must verify respirator requirements for specific asbestos removal work.
3. Type 3 Operations – Respirator use is mandatory. Different respirators are required depending on type of Asbestos and whether the ACM are removed wet or dry. Depending on the nature of the work being performed, the following types of respirators may be required.
- Pressure demand supplied air respirator equipped with a half mask.
 - Pressure demand supplied air respirator equipped with a full face piece.
 - Or one of the following;
 - Air purifying full-face piece respirator with N-100, R-100 or P-100 particulate filter,
 - Powered air purifying respirator equipped with a tight-fitting face piece (half or full-face piece) and a high efficiency filter or N-100, P-100 or R-100 particulate filter,
 - Negative pressure (demand) supplied air respirator equipped with a full-face piece, or
 - Continuous flow supplied air respirator equipped with a tight fitting face piece (half or full-face piece).
 - NOTE: An Occupational Health & Safety Consultant must verify respirator requirements for specific asbestos removal work.

In all cases the respirators provided must be approved by the US National Institute for Occupational Safety and Health (NIOSH).

Note: NIOSH publishes a certified equipment list. The approval number on the respirator and filter cartridge should be checked against the list to ensure that they are certified for use with asbestos. All respirators must properly fit the employee to afford adequate protection. The NIOSH certified equipment list link is <http://www.cdc.gov/niosh/94-104.html>.

3.11.3 *Fit-Testing*

The respirator must be fit-tested to ensure an effective seal on the face. The procedures, as outlined below, are to be followed when fit-testing a respirator.

1. Qualitative or Quantitative Fit Testing. Qualitative Fit Testing involves use of a challenge agent (either sweet or bitter).

This test is applicable to all respirator types and is performed at the following intervals:

- When a respirator is initially issued,
- Upon changing style, model or size of respirator, and
- Following any significant changes to the facial structure.
- Retraining is conducted at least every 2 years with a review conducted annually to confirm whether the respirator user remains qualified.

After the initial fit testing, the following are User Checks to be conducted by the respirator user before each use of the respirator:

1. Negative Pressure Test: This test is performed before each use of the respirator and is applicable to the negative pressure respirators only. Covering one or two filter inlets depending on type of respirator configuration with the palms of the hands and inhaling performs the negative pressure test. The face piece should collapse on the face with no air leakage around the mask.
2. Positive Pressure Test: This test is performed in conjunction with the negative pressure test before each use of the respirator and is applicable to the negative pressure respirators only. The positive test is conducted by covering the exhalation valve, usually located at the bottom centre of the respirator body, with the palm of the hand and exhaling gently. The face piece should puff slightly away from the face without allowing air to escape.

3.11.4 Maintenance

It is important to take proper care of a respirator in order to provide maximum protection. This requires regular maintenance and cleaning of the respirator and associated parts. Under no circumstances should a respirator with defective parts be used. Proper maintenance must include a visual inspection of the items listed in the following respirator checklist:

1. Examine the face piece for:
 - Excessive dirt,
 - Cracks, tears or holes,
 - Distortion and inflexibility, and
 - Cracks or breaks in filter holders, worn threads and missing gaskets.
2. Examine the head straps for:
 - Breaks or tears,
 - Broken or malfunctioning buckles and attachments, and
 - Excessively worn serrated edges on head harness, which might permit slippage (full-face pieces only).
3. Examine valves for:
 - Dust or other material on valves or valve seats,
 - Cracks, tears or distortion in the valve material, and
 - Missing or defective valve covers.
4. Examine filter cartridge for:
 - Proper filter for protection against asbestos (HEPA),
 - Incorrect installation, loose connections, missing or worn gaskets or cross threading, and
 - Cracks or dents in filter housing.

3.11.5 Cleaning

Respirators must be cleaned and disinfected after each use. Respirators shall be assigned to a person for their exclusive use, if practicable. The procedure listed below is to be followed when cleaning reusable full or half-face piece respirators:

- When removing mask from contaminated area of work, external surfaces must be cleaned by

damp wiping or with a High-efficiency filtered vacuum. Filter inlets should be sealed with either a protective cap, duct tape or disposed of,

- Remove the filter cartridges and damp wipe again placing them separately from the respirator body,
- Separate the parts of the respirator under water,
- Wash the face piece and components in warm water using a mild detergent,
- Rinse the face piece and components thoroughly in warm water,
- Place the respirator on a paper towel in a clean area to dry,
- Where disinfecting is required, for use by more than one person, a solution of 2 millilitres of laundry bleach to 1 litre of water will suffice or use manufacturers prepared disinfecting soap, and
- The respirator should then be place in a sealed container after it is dry.

3.11.6 *Storage*

Following cleaning of the respirator, it must be stored in a proper manner to ensure that it is kept clean and free of exposure to contamination from dirt, moisture and chemicals. After cleaning:

- Place the face piece and cartridges in a sealable plastic bag or container,
- Seal device, and
- Store the bag in a clean environment, away from any source of contamination, excessive heat or humidity and in an area where the respirator will not be crushed by any article or thing.

3.11.7 *Training*

Employees required to wear respirators during work involving asbestos will receive training in the use of respirators, covering:

- Theory of respirators,
- Limitations of equipment,
- Inspection, maintenance, and storage of equipment,
- Selection, fitting and use of respirators,

- Positive and negative pressure fit check,
- Respirator cleaning and disinfection, and
- Record of worker training and fit testing.

3.11.8 Protective Clothing

Each employee must be provided with and wear protective clothing when carrying out work involving ACM. This clothing shall consist of:

- Full body coveralls, and
- Suitable footwear.

The coveralls shall:

- Be made of a material which does not readily retain nor permit the penetration of asbestos fibres,
- Consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing, and
- Be repaired or replaced if torn.

The protective clothing must be put on in a suitable area away from the asbestos work area prior to beginning the work for Type 1 or 2 operations or in an attached change room adjacent to Type 3 work areas. The clothing is also to be decontaminated at the completion of the work prior to leaving the work area then disposed. Decontamination of clothing can be accomplished by either damp wiping or using a HEPA vacuum prior to removal.

3.12 MEDICAL SURVEILLANCE PROGRAM

The purpose of the medical surveillance program for Type 2 and 3 works is to establish an employee's fitness for duty (to wear a respirator, etc), and to detect any changes in the gastrointestinal and cardiopulmonary systems. Such changes may indicate the presence of an asbestos related disease.

City of Toronto has decided at this time that an experienced and qualified Abatement Contractor pre-selected by the Asbestos Plan Manager will perform all Type 3 work, with the exception of emergency Type 3 work, involving asbestos-containing building materials for City of Toronto. No City of Toronto employee will be assigned Type 3 friable asbestos related work, with the exception of emergency Type 3 work.

The information in this section is provided for reference only and is not applicable at this time. Should this position change and selected employees be required to conduct any type of work as specified in the

Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*, then training will be provided by a qualified Occupational Health and Safety Consultant. No work will be performed until specific training has been provided and the employee comprehension of the work has been evaluated and accepted, by the Asbestos Plan Manager, as adequate. When authorized to proceed the employee and supervisory staff will comply with the requirements of this section of the Operations and Maintenance Program.

The main requirements of the medical surveillance program include:

- A physical examination, with emphasis on the cardiovascular and gastrointestinal systems, and
- A pulmonary function test, which includes the forced vital capacity (FVC) and the forced expiratory volume in one second (FEV).
- Chest X-ray

On the recommendation of the Ministry of Labour, Provincial Physician, a worker may volunteer to undergo the above tests initially and subsequently as recommended by his/her physician at least 2 years after the most recent exam. However, it is recommended that an initial chest x-ray be used in order to establish baseline conditions for the employee.

3.12.1 Employee Exposure Records

Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations* requires that an Asbestos Work Report form (see Figure 4.2) be maintained for each employee working on a Type 2 or Type 3 operation.

These work reports are to be submitted to the Provincial Physician; Ministry of Labour annually and when the employment of an employee is terminated. A copy of the form must also be given to the employees.

The procedure outlined below for recording the information and submission of reports is to be followed:

1. Employees;
 - Report the number of hours per day of working with ACM, as required, to his/her immediate supervisor.
2. Maintenance and Trades Supervisor;
 - Maintain a monthly log, as illustrated in Figure 4.3 for each employee involved in asbestos operations and include the following,
 - Number of hours daily,
 - Type of work performed (according to the classifications listed in the Asbestos Work Report),

- Employee information including Name, Address (home), Date of Birth and Social Insurance Number, and
 - Forward a copy of the individual employee log on a monthly basis to the Asbestos Plan Manager.
3. Asbestos Plan Manager;
- Maintain a file for each employee, containing the information forwarded by the employees supervisor,
 - Complete an Asbestos Work Report, containing all of the appropriate information for each employee and forward to the City's Employee Health and Rehabilitation section who will then forward to the Chief Physician, Occupational Health Branch, Ministry of Labour, on an annual basis. Medical surveillance would be coordinated through the City's EH&R section and
 - Forward a copy of the work report to each respective employee annually and on termination of employment.

FIGURE 3.4 – ASBESTOS WORK REPORT
Occupational Health and Safety Act/Loi sur la
santé et la sécurité au travail

For the Period/Pour la période
From/du **To/au**

This form is required under Section 21 of the Regulation for Asbestos on Construction Projects and in Buildings & Repair Operations.

Ce formulaire est requis en vertu de l'article 21 du règlement sur le travail avec l'amiante dans les projets de construction et de réparations d'édifices.

Asbestos Work Report/Rapport sur le travail avec l'amiante

Name of Employer/Nom de L'employeur			Employer's Address/Adresse de L'employeur	
Employee's Surname/Nom de l'employé	Given Name/Prénom	Init/Init.	Employee's Address/Adresse (Street No., Street, City, Postal Code/N° de rue, Rue, Ville, Code postal)	
S.I.N. /N° d'ass. Sociale	Date of Birth/Date de naiss. Y/A M/M D/J		Family Physician's Name and Address/Nom et adresse du médecin de famille	
Hours of Work/Heures de travail	Type 2		Type 3	
Return to: Provincial Physician Occupational Health & Safety Branch Ministry of Labour 655 Bay St 14 th Floor Toronto, ON M7A 1T7		Renvoyer au: Médecin provincial Direction de la sante et de la securite au Travail Ministère du Travail 655, rue Bay 14 th étage Toronto (ON) M7A 1T7		Signature of Employer/Signature de l'employeur Date
Distribution Part 1 Provincial Physician Part 2 Worker Part 3 Employer		Distribution Partie 1 médecin provincial Partie 2 travailleur Partie 3 Employeur		

FIGURE 3.5 - EMPLOYEE EXPOSURE RECORD

Employee: _____ Clock #: _____

Building & Department: _____

Period Starting: _____ Period Ending: _____

Employee Identification

Surname: _____

Given Names: _____

Address: _____

Date of Birth: _____

Social Insurance
Number: _____**Exposure Information**

Date of Exposure	Type of Work	Number of Hours
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3.13 WORK AUTHORIZATION

This section of the Operations and Maintenance Program deals with the authorization and issuing of work for the daily activities and occurrence in any specific building. All asbestos related work shall be authorized by the Asbestos Plan Manager in accordance with the following sections.

3.13.1 Maintenance/Renovation Permit System

An informal permit system will be initiated through the Asbestos Plan Manager or his designate for any maintenance or renovation work. All work that may potentially disturb ACM shall be funnelled through the Asbestos Plan Manager.

In the permit system, all requests for maintenance/renovation activities are given to the Asbestos Plan Manager prior to permitting the work to proceed. The Manager will check the building's asbestos records (files, computerized database, etc.) for information about the presence of ACM where work is to be performed. Additional testing for concealed or non-friable ACM in the actual area of work may also be necessary.

1. Where no asbestos is present, the work order is issued and the planned actions can proceed.
2. If ACM are present but will not be affected the work may proceed.
3. Where asbestos is present and the amount of material that will be disturbed is minimal, procedures appropriate to the work will be issued from Section 4 of this Manual, as applicable to the work, for service personnel, maintenance personnel or Contractor if adequately trained.
4. Where asbestos is present and impact will be extensive, an outside Consultant will be retained to prepare work procedures. In worst-case situations (e.g. large amounts of asbestos containing material, non-critical maintenance/renovation) work would be deferred until the ACM in the area can be dealt with in the proper manner.

3.13.2 Work Practices For Renovation and Remodelling

3.13.2.1 Renovation

Building renovation or building system replacement can cause major disturbance of ACM. Moving walls, adding wings, and replacing heating or air conditioning systems involve breaking, cutting, or otherwise disturbing ACM that may be present. Prior to renovation the removal of ACM is required. It is required by the Regulations to differentiate between Type 2 and 3 procedures for the quantity of material that will be disturbed. The following criteria should be used to guide the classification between the two work types. Type 2 work is the removal or disturbance of one square meter or less of friable ACM during the repair, alteration, maintenance or demolition of all or part of machinery or equipment or a building. Greater quantities than these values require the work to be considered a major removal

project and not part of the Operations and Maintenance Program.

3.13.2.2 Remodelling

Remodelling or redecorating implies less dramatic structural alteration. However, disturbance of ACM or materials contaminated with asbestos fibres is still possible. Where the remodelling involves direct contact with ACM all of the procedures and precautions specified would apply.

3.13.2.3 Specialized Cleaning Procedures

Four work criteria exist where specialized cleaning may be required. They consist of sections:

Appendix G – G-7: Cleaning, Stripping Wax from and Waxing Asbestos-Containing Floor Tiles - Type 1 Work in particular for tenants who may have extensive sections of vinyl tile;

Appendix G – G-8: Cleaning of Asbestos-Containing Debris – Type 2 Work;

Appendix G – G-9: Access and Cleaning above Suspended Ceilings – Type 2 Work where ACM may be found in a damaged condition; and

Appendix G – G-10: Cleaning Out Of HEPA Filtered Vacuum Cleaners, Asbestos Waste Storage and Disposal - Type 2 Work.

Studies have shown that cleaning, stripping or minor movement adjacent to ACM can, under some situations, release fibres and become hazardous. The following procedures are outlined to inhibit fibre release.

3.13.2.4 Special Work Practices for Maintenance Activities

Normal maintenance activities can disturb ACM and raise levels of airborne asbestos. Maintenance workers should be cautioned against conducting any maintenance work in a manner that may disturb ACM. Four work criteria are specified for handling various situations:

Appendix G – G-11: Work with Non-friable Materials and Manufactured Products – Type 1 Work generally involving removal of vinyl floor tile or removal of pipe gasket;

Appendix G – G-12: Repairing Thermal Insulation with non-powered tools – Type 2 Work where damaged thermal insulation applications are noted;

Appendix G – G-13: Asbestos Removal Using Glove Bags – Type 2 Work; and

Appendix G – G-14: Minor Asbestos Removal – Type 2 Work when the ACM must be removed.

3.13.2.5 Emergency Response Procedures

As long as ACM remains in the building, a fibre release episode could occur. Custodial and maintenance workers should report to the Building Manager, who in turn will report to the Asbestos Plan Manager, the presence of debris on the floor, water or physical damage to the ACM, or any other evidence of possible fibre release. Fibre release episodes can also occur during maintenance or renovation projects. The Asbestos Plan Manager should call an abatement contractor to clean up debris

and make repairs as soon as possible. If an outside contractor is to be used, the company should be retained for quick response action.

One procedure is provided for handling these episodes as follows:

Appendix G – G-15: Emergency Spill or Repair Response – Type 2 Work.

3.13.2.6 Minor Episodes

Minor episodes, such as a small section of insulation (less than 1 linear meter) falling from a pipe or a careless worker bumping into a beam and dislodging a small amount of fireproofing ACM (less than 1 square meter), can be treated with standard wet cleaning and HEPA-vacuum techniques.

3.13.2.7 Major Episodes

Major fibre release episodes are serious events. Large amounts of ACM falling from heights of several feet may contaminate an entire building with asbestos fibres. If 1 square meter or more of surfacing ACM or 1 linear meter or more of thermal system insulation delaminates or is dislodged from its substrate, the episode should be considered major. A large breach in a containment barrier for a maintenance or abatement project should also be considered a major episode.

3.14 WASTE DISPOSAL

City of Toronto has decided at this time that an experienced and qualified Abatement Contractor pre-selected by the Asbestos Plan Manager will perform all Type 3 work, with the exception of emergency work, involving asbestos-containing building materials for City of Toronto. No City of Toronto employee will be assigned Type 3 friable asbestos related work, with the exception of emergency Type 3 work.

The information in this section is provided for reference only and is not applicable at this time. Should this position change and selected employees be required to conduct any type of work as specified in the Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*, then training will be provided by a qualified Occupational Health and Safety Consultant. Asbestos waste will not be stored in any building at this time except as part of a project.

Waste disposal requirements for work with asbestos are covered by the Revised Regulation of Ontario 1990, Regulation 347, as amended, under the *Environmental Protection Act General Waste Management*.

The abatement contractor will initiate shipment of the waste and will forward all records to the Asbestos Plan Manager. The Asbestos Plan Manager maintains all completed records of all shipments, as illustrated in Figure 3.6, of asbestos-containing waste and attachments. This record includes information on:

- date of shipment,
- number of drums / bags (estimated when in large quantities),
- destination,

- shipper, and
- shipment manifest/waybill number (include copy of the shipping manifest).

Reference must be made to the actual regulation in order to ensure that all of the requirements are being met.

FIGURE 3.6 - RECORD OF WASTE DISPOSAL

Building Name: _____

Address: _____

Date of Shipment: _____ Time of Departure: _____

Type of Waste: _____ Type of Container: _____

Number of Containers Shipped: _____

Waste Haulage Company: _____

Address: _____

Provisional Certificate of Authorization or
Certificate of Authorization Number of Hauler: _____

Waste Disposal Site: _____

Address: _____

Provisional Certificate of Authorization or Certificate
of Authorization Number of Disposal Site: _____

Date of Receipt: _____ Arrival Time: _____

Number of Containers Received: _____

Condition of Containers: _____

Copy of Shipping Documents and Bill of Lading on File: Yes _____ No _____

Signatures:

City of Toronto

Shipper: _____ Date: _____

Building Manager: _____ Date: _____

Asbestos Plan Manager: _____ Date: _____

3.15 AIR MONITORING

When a building is known to contain friable ACM, air monitoring may be carried out at the discretion of the Asbestos Plan Manager in order to reassure concerned staff or occupants, that the concentration of airborne-asbestos fibres does not exceed acceptable levels. In addition, air monitoring may also be performed during and at conclusion of abatement activities to verify that the work was performed in accordance with project specifications. Clearance air monitoring is required at the end of Type 3 abatement work.

In Canada, all existing legislation and environmental guidelines concerning permissible airborne asbestos fibre concentration are expressed in terms of fibres having lengths exceeding 5 micrometers. Table 3.1 lists the general permissible airborne asbestos fibre concentration criteria.

Table 3.1 – Asbestos Air Quality Criteria in Ontario

DESCRIPTION		FIBRE CONCENTRATION (fibres/cubic centimetre of air)
Time weighted average exposure of worker to airborne asbestos for an 8 hour day:		
All forms of airborne asbestos fibres ⁽¹⁾		0.1
Ambient Air Quality Criterion Over 24 Hours (average) ⁽²⁾		0.04
Clearance Value on Type 3 Work		0.01
Notes:	<p>(1) Ontario Regulation 278/05, as amended, – Designated Substance – Asbestos, made under the <i>Occupational Health and Safety Act</i>.</p> <p>(2) <i>Summary of Point of Impingement Standards, Point of Impingement Guidelines and Ambient Air Quality Criteria</i> (AAQCs), Standards Development Branch, Ontario Ministry of the Environment, December, 2005.</p>	

Air samples can be analysed by three methods: Phase Contrast Microscopy or Transmission Electron Microscopy by a laboratory specialized in the identification of asbestos in air samples following recognised methodologies. Although there are two methods, for Type 3 clearance testing, only the first two are outlined as methods to be used in the Regulation. Clearance air sampling at the completion of Type 3 abatement shall be conducted in compliance with Regulation 278/05 including the required number of samples and using forced air as per EPA Method 560/5-85-024. Clearance air sampling results must be posted in a conspicuous workplace location within 24 hours of receipt and a copy also provided to the JHSC/H&S Rep within 24 hours of receipt.

Acceptable Phase Contrast Light Microscope methodologies is:

1. Asbestos Fibres, NIOSH Method 7400 – Asbestos fibre counting rules (Latest Edition).

Acceptable Transmission Electron Microscope methodologies is:

1. Asbestos Fibres, NIOSH Method 7402 (Latest Edition)

3.15.1 *Air Sampling Program*

Air Monitoring will be performed by an outside Occupational Health & Safety Consulting firm specializing in this type of work with appropriate equipment and qualified personnel. Air monitoring requirements are broken down into two levels:

3.15.1.1 *Occupied Building*

Air quality checks in an occupied building where there may have been an asbestos disturbance or a need to establish fibre levels as established by the Asbestos Plan Manager.

Whenever feasible, City of Toronto will use the PCM method of air monitoring unless special circumstances indicate another method is preferable as determined by the Asbestos Plan Manager.

3.15.1.2 *Abatement Projects*

Abatement projects may require air sampling (is required in the case of Type 3 work), which will be authorized by the Asbestos Plan Manager.

3.16 EQUIPMENT

City of Toronto has determined that a qualified, experienced contractor will perform all asbestos abatement work and that no employee will be assigned Type 3 asbestos related work (see previous comment).

The information in this section is provided for reference only and is not applicable at this time.

3.16.1 *Asbestos Equipment Room*

The Asbestos Equipment Room is a room in the Maintenance Department of one or more buildings set-aside for the storage of the equipment and supplies required to perform any repair and/or minor removal of ACM. A copy of the Operations and Maintenance Program is also kept in the room for reference purposes.

In addition to equipment storage, the room may also be used for the temporary storage of sealed asbestos waste and emptying of the HEPA vacuum. Refer to the correct procedures listed in Section 3.16.5 for the emptying of the vacuum cleaner.

At the end of asbestos-related work all supplies are to be returned to the room and material used up during the work recorded on the equipment usage list. The Asbestos Plan Manager or designate will be responsible for maintaining adequate supplies of the equipment in the room.

3.16.2 List of Equipment

The supplies and protective equipment, presented in the list below, are required to perform the work outlined in Section 4.0, if and when, procedures are established. All required equipment shall be stored in the Asbestos Equipment Room.

A) PROTECTIVE EQUIPMENT:

1) Respirators;

- Half-face air purifying respirators (minimum for Type 1 and limited Type 2 work),
- HEPA Cartridge Filters,
- Qualitative or Quantitative Fit Testing Equipment
- Disinfectant.

2) Clothing;

- Disposable Coveralls with integral hood, boot covers and elasticized cuffs (Tyvek or equivalent).

B) REPAIR/REMOVAL EQUIPMENT:

1) Cleaning Equipment;

- HEPA Vacuum,
- Buckets and Sponges,
- Scrub Brush (Non-metal Bristles), and
- Mop (Long-Handled).

2) Asbestos Repair/Removal:

- Glove bags in the following configurations manufactured by Safe-T- Strip or equivalent;
 - 6",10" straight,
 - 6",10" vertical, and
 - 6",10" valve,
- Flexible Saw,
- Retractable Knife,

- Wire Cutters,
- Garden-style Airless Sprayer For Amended Water,
- Water containing one ounce/gallon of a 50/50 mixture of polyoxyethylene ester and polyoxyethylene ether (i.e. Aqua-Gro),
- Separate Garden-style Airless Sprayer For Encapsulant,
- Encapsulant (Approved) Ocean 666, or Decadex Fire Check,
- Lagging Adhesive (Approved) Bakelite 120-19 or 120-20,
- 6-ounce canvas cloth,
- Paint Brushes - 4",
- Warning Signs (Displaying Information Below),

CAUTION-ASBESTOS HAZARD

Breathing Asbestos Dust May Be

Hazardous to Your Health

ACCESS RESTRICTED TO PERSONS WEARING

PROTECTIVE CLOTHING AND EQUIPMENT

- Rope for Barricades,
- Duct Tape,
- Polyethylene Sheeting - 6 mil, Clear, and
- Polyethylene Sheeting - 6 mil, Dark.

3) Waste Disposal;

- Waste Disposal Bags - Yellow, Pre-labelled,
- Bag Ties, and
- Fibre Drums with sealable lids.

3.16.3 Special Equipment - HEPA Vacuum Cleaners

Vacuums equipped with a High-Efficiency Particulate Aerosol (HEPA) filters find wide use in asbestos-related work. A HEPA filter must be 99.97% efficient in collecting a 0.3 micrometer aerosol. Each filter is individually tested and certified. Important points to be considered in the

selection, use and care of HEPA vacuums include:

- HEPA vacuums are available in different sizes; some run on different voltages. Selection of the appropriate unit must be made after assessing all of the relevant factors.
- Manufacturers' instructions regarding filter life, use and care of the vacuum etc., should be followed. Because the HEPA filter is expensive to replace, every effort should be made to extend its service life by maintaining and replacing the less expensive and less sophisticated earlier stages of filtration (pre-filters).
- The changing of filters and emptying of waste from the vacuum require care and diligence to ensure that potential airborne fibre contamination is confined (refer to procedures, Appendix G).
- The outsides of HEPA vacuum cleaners must also be kept clean and free of dust and debris. Vacuum hoses are to be inspected regularly to ensure their cleanliness.

3.16.4 Requirement for Use

The Regulation respecting Asbestos requires that cleaning is performed in various stages of the operations involving asbestos. This cleaning must be performed either by:

- 1) Damp mopping / wiping; or
- 2) Vacuuming using a HEPA vacuum cleaner

3.16.5 Handling and Cleaning HEPA Vacuums

The changing of filters and emptying of waste is to be performed in the specially designated area (Asbestos Control Room) which is isolated from other occupied areas. The following procedure is to be used:

Work Procedure:

- 1) Identify the room with the proper warning signs and restrict access to those employees performing the work.
- 2) Wear a non-powered air-purifying respirator approved for use with asbestos and suitable protective clothing. Only persons wearing protective clothing and equipment shall be allowed to enter the work area.
- 3) Disable the ventilation system servicing the room if possible; seal ventilation ducts to and from the room.
- 4) Cover the floor with a large sheet of 8 mil. rip-proof polyethylene sheeting.
- 5) Place the HEPA vacuum in the centre of the polyethylene sheeting and slowly

remove the top lid.

- 6) Seal the waste bag in the vacuum cleaner and transfer to the waste disposal bag.
- 7) Seal the waste disposal bag and replace the lid on the vacuum cleaner.
- 8) Damp wipe the HEPA vacuum and the waste disposal bag.
- 9) HEPA vacuum the polyethylene sheeting on the floor and dispose of as asbestos waste. Clean the floor using the HEPA vacuum or by damp wiping.
- 10) Before leaving the work area, decontaminate protective clothing (including boots) and dispose of as asbestos waste; damp wipe the respirator and store in a proper place.
- 11) Wash hands and face at the completion of the job.
- 12) Ensure that the daily asbestos work report has been completed.

SECTION 4.0
ASBESTOS WORK PROCEDURES

4.0 ASBESTOS WORK PROCEDURES

The following sections briefly describe the standard operating procedures adopted for asbestos-related work. These meet or exceed the requirements of O. Reg. 278/05 and other regulatory requirements in effect on November 1, 2005.

These procedures are provided as a minimum standard for all asbestos work in City Facilities. No scheduled (non-emergency) Type 3 asbestos work will be undertaken by City employees.

4.1 CLASSIFICATION OF SCHEDULED WORK

The Ministry of Labour Regulation classifies asbestos work into Types 1, 2, and 3 procedures, depending on the type of disturbance, the material being disturbed, and the extent of work. The Ministry of Labour also allows the use of Glove Bags for removal of asbestos-containing pipe insulation as a Type 2 operation.

The following is the classification of work for materials known to exist in City Facilities.

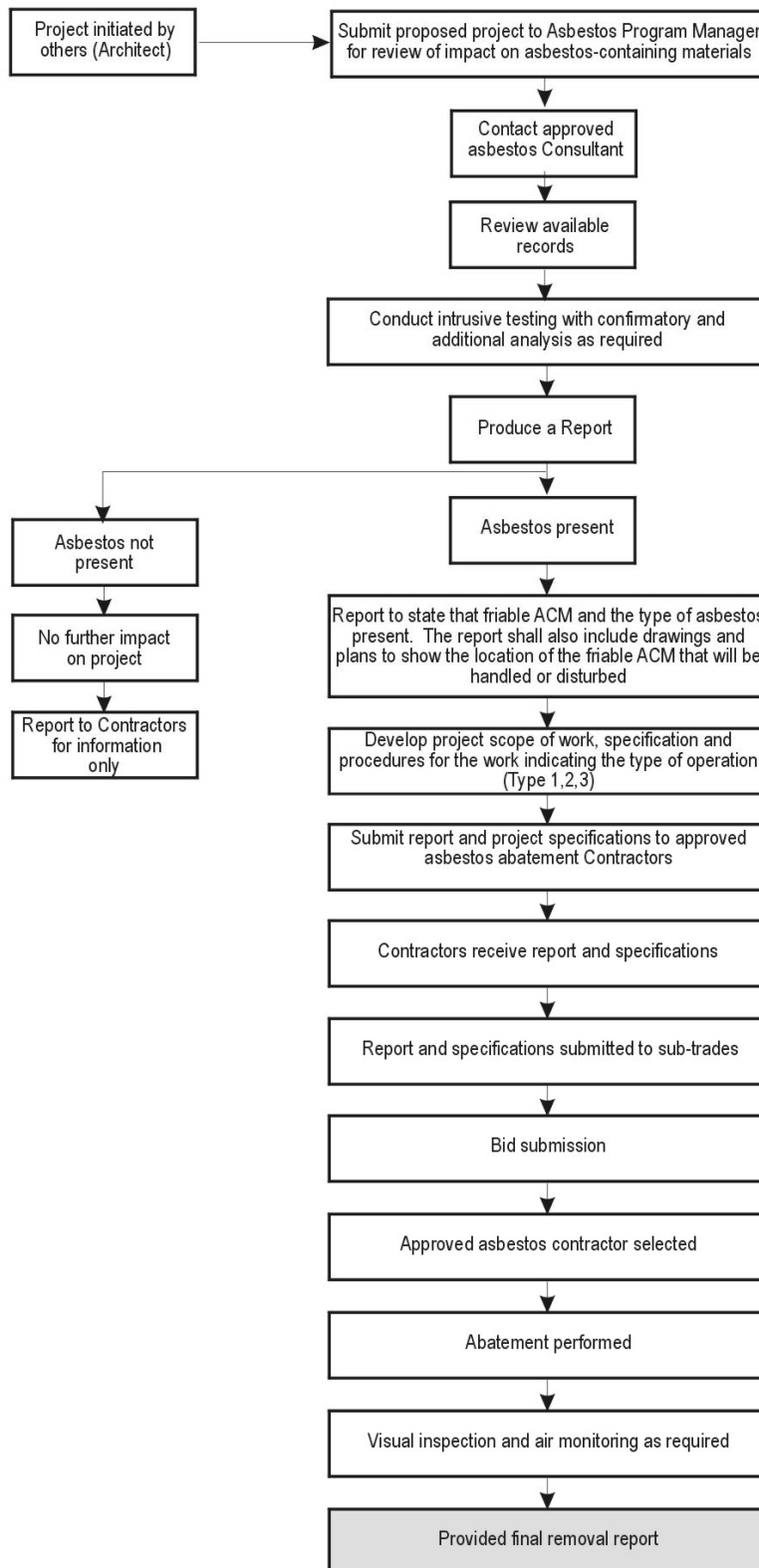
Note: Refer to Appendix G for further details

TABLE 4.1 – Classification of Asbestos Work Types

CLASSIFICATION	DESCRIPTION OF WORK
TYPE 1 OPERATIONS	Installing or removing ceiling tiles that are asbestos-containing material, if the tiles cover an area less than 7.5 square metres and are installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.
	Installing or removing non-friable asbestos-containing material, other than ceiling tiles, if the material is installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.
	Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material if, <ul style="list-style-type: none"> i. the material is wetted to control the spread of dust or fibres, and ii. the work is done only by means of non-powered hand-held tools.
	Removing less than one square metre of drywall in which joint-filling compounds that are asbestos-containing material have been used.
TYPE 2 OPERATIONS	Removing all or part of a false ceiling to obtain access to a work area, if asbestos-containing material is likely to be lying on the surface of the false ceiling.
	The removal or disturbance of one square metre or less of friable asbestos-containing material during the repair, alteration, maintenance or demolition of all or part of machinery or equipment or a building, aircraft, locomotive, railway car, vehicle or ship.
	Enclosing friable asbestos-containing material.
	Applying tape or a sealant or other covering to pipe or boiler insulation that is asbestos-containing material.

CLASSIFICATION	DESCRIPTION OF WORK
	Installing or removing ceiling tiles that are asbestos-containing material, if the tiles cover an area of 7.5 square metres or more and are installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.
	Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material if, <ul style="list-style-type: none"> i. the material is not wetted to control the spread of dust or fibres, and ii. the work is done only by means of non-powered hand-held tools.
	Removing one square metre or more of drywall in which joint filling compounds that are asbestos-containing material have been used.
	Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material if the work is done by means of power tools that are attached to dust-collecting devices equipped with HEPA filters.
	Removing insulation that is asbestos-containing material from a pipe, duct or similar structure using a glove bag.
	Cleaning or removing filters used in air handling equipment in a building that has sprayed fireproofing that is asbestos-containing material.
	An operation that, <ul style="list-style-type: none"> i. is not mentioned in any of paragraphs 1 to 10, ii. may expose a worker to asbestos, and iii. is not classified as a Type 1 or Type 3 operation.
GLOVE BAG WORK	The use of glove bags to remove insulation from a pipe duct or similar structure is classed as Type 2 work but it requires notification of the MOL if more than 1 square metre of ACM is removed.
TYPE 3 OPERATIONS	The removal or disturbance of more than one square metre of friable asbestos-containing material during the repair, alteration, maintenance or demolition of all or part of a building, aircraft, ship, locomotive, railway car or vehicle or any machinery or equipment.
	The spray application of a sealant to friable asbestos-containing material.
	Cleaning or removing air handling equipment, including rigid ducting but not including filters, in a building that has sprayed fireproofing that is asbestos-containing material.
	Repairing, altering or demolishing all or part of a kiln, metallurgical furnace or similar structure that is made in part of refractory materials that are asbestos-containing materials.
	Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material, if the work is done by means of power tools that are not attached to dust-collecting devices equipped with HEPA filters.
	Repairing, altering or demolishing all or part of any building in which asbestos is or was used in the manufacture of products, unless the asbestos was cleaned up and removed before March 16, 1986.

CLASSIFICATION	DESCRIPTION OF WORK
NOTES TO CLASSIFICATION	Work on ceiling tiles, drywall or friable asbestos-containing material is classified according to the total area on which work is done consecutively in a room or enclosed area, even if the work is divided into smaller jobs.
	The following provisions apply if a dispute arises as to the classification of an operation under this section:
	<ol style="list-style-type: none">1. A party to the dispute may notify an inspector at the office of the Ministry of Labour nearest the workplace of the dispute.2. The party who notifies the inspector shall promptly inform the other parties that the inspector has been notified.3. Work on the operation shall cease until the inspector has given a decision under paragraph 4.4. The inspector shall, as soon as possible, investigate the matter and give the parties a decision in writing.
	Nothing in subsection (6) affects an inspector's power to issue an order for a contravention of this Regulation.

FIGURE 4.1 - MAJOR PROJECT PROTOCOLS FOR RENOVATION OR DEMOLITION**Notes:**

1. All general contractors performing asbestos related work should be chosen from the Asbestos Plan Manager's approved list.
2. Where the general contractor for the work subcontracts part of the work, they shall supply a list of subcontractors who must be approved by the Asbestos Plan Manager.
3. If a major project results in the removal of all known ACM in the building, the AMP can be terminated.

NOTE: The term "Friable asbestos" must be interpreted to include non-friable materials.

Post copy of clearance air monitoring results in conspicuous place in workplace within 24 hours of receipt

Provide copy of clearance air monitoring results to JHSC/H&S Rep within 24hours of receipt

APPENDIX A
ASBESTOS FACT SHEET

ASBESTOS FACT SHEET

What Is Asbestos?

"Asbestos" is the name given to a group of naturally occurring minerals composed of tiny fibres, which become easily airborne. There are five major mineral forms in the asbestos group, only two of which, chrysotile and amosite, have been commonly used in Canada. These tiny fibres are flexible, fire-resistant and almost indestructible- qualities which have made asbestos very useful commercially.

Where Is It?

There have been more than 3,000 asbestos-containing products, some of which are currently in use. These are mostly in the form of hard materials. Soft materials of particular interest include thermal and acoustic insulation and fireproofing. Some of the more common products that may contain asbestos include:

Pipe insulation	Duct insulation
Cement products	Fireproofing
Plasters	Vinyl floor tiles
Floor felts in sheet floors	Floor mastics
Roofing shingles	Roofing tars
Roofing felts	Ceiling panels

In most commercial products, asbestos is combined with a binding material, so that it does not become readily released into the air. However, if the asbestos should become airborne, and if it is inhaled, it can remain in the lungs for a long period of time, possibly causing severe health problems that do not appear for many years.

Commencing in the mid-1970's, many ACM were banned from use, especially in the construction industry. Those products already in use were made subject to regulations governing their handling and disposal.

What Are The Problems?

Asbestos is rarely used alone, and it is generally safe when it is combined with other materials with strong bonding properties. Occasionally, asbestos fibres become loose and airborne, this is referred to as a "fibre-release." This happens most often when they are contained in soft, easily crumbled (friable) materials, such as sprayed-on fireproofing. Even in well-bonded materials such as floor tiles and painted surfaces, asbestos can become airborne when materials are cut, drilled, scraped, filed, sanded or otherwise abraded.

What Are The Health Effects?

If asbestos fibres are inhaled or swallowed, they can have serious effects on your health. These effects may not appear for 15 to 30 years after exposure. Asbestos can cause asbestosis, also known as "white lung", a scarring of the lungs that leads to severe breathing problems and heart failure. This disease is usually seen in workers who manufacture or use asbestos products, and is associated with high exposure levels.

Asbestos can also cause cancer of the lungs, as well as a very rare cancer of the chest and abdominal linings known as mesothelioma. It may also be linked with some cancers of the stomach, intestines,

kidneys and rectum.

There is much controversy in the scientific community over what constitutes a safe exposure level to asbestos fibres, and many factors determine whether an individual will develop an asbestos related disease. It is known that smokers exposed to asbestos are at a greater risk of developing lung cancer. Individual susceptibility is another factor. Also, different asbestos minerals have a different effect on the body, the fibres most often associated with mesothelioma are very rarely used.

Children and young adults are a special concern for asbestos exposure, since they carry asbestos fibres in their lungs for many years. It is for this reason that proper asbestos management is so important, particularly in schools.

Determining If There Is A Problem

To determine whether or not an asbestos problem exists, it must first be established if the material in question contains asbestos fibres. The only sure way to determine the presence of asbestos is to have a sample of the material analyzed at a testing laboratory using high-resolution microscopy techniques. A reputable company must always do the analysis.

What Are The Government Regulations?

There are three regulations that govern the control of asbestos and ACM in buildings in Ontario as follows:

Under the Occupational Health and Safety Act, Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*.

Under the *Environmental Protection Act: General - Waste Management Regulation*: R.R.O. 1990, Regulation 347, as amended.

Under the *Dangerous Goods Transportation Act*: R.S.O. 1990. c.D.1

Under the *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations* under the *Occupational Health and Safety Act*, the major requirements to building owners under this regulation include:

1. Provision of establishing an asbestos survey report outlining the locations, quantity, condition and content of asbestos in material in the building to all prospective contractors who are likely to handle or disturb the material.
2. The asbestos survey report shall contain the following information.
 - The location of material,
 - Where the material is friable or non-friable,
 - In the case of friable sprayed-on material, for each location, i) if the material is known to be ACM, the type of asbestos, if known, or ii) in any other case a statement that the material will be treated as though it contained a type of asbestos other than chrysotile.
3. Advising workers of the building owner who may work in close proximity to ACM and who may disturb

the material.

4. Periodic inspection of the material to determine its condition, including an annual update of the asbestos survey report.
5. Implementation of appropriate control measures, where required, following the precautions and procedures prescribed by the Regulation (Type 1, Type 2 or Type 3 operations). The classification of the work depends on the type of material, procedures used and the quantity of material to be disturbed. Refer to Table 4.1 Classification of Asbestos Work for further information.
6. Establishment of a training program for employees of the owner who are likely to handle ACM.
7. Annual submission of an asbestos work report form for each employee working in a Type 2 or Type 3 operation.
8. Removal of ACM, to the extent practicable, prior to demolition of a building, or part thereof.

What Is The City of Toronto Doing To Meet These Regulations?

1. Worker Training

The City of Toronto has a policy that no employees will actually be performing Type 3 asbestos related work but will receive asbestos awareness training courses for those who have the potential to come in contact with ACM during the performance of their duties so that they can recognize potential problems. All training meets the legislative requirements established by the Ontario Ministry of Labour. In addition managers of tenants whose rental units are tended to by City of Toronto will also be invited to the information sessions. The JHSC/H&S Rep will be advised of the time and place of the sessions.

2. Comprehensive Building Survey

The City of Toronto enlisted the services of a consulting firm specializing in asbestos surveys. The firm conducted a comprehensive inventory of the ACM present in the building, assessed the condition of these materials, and established the risk they pose to building occupants. The firm also recommended any required asbestos control measures.

3. AMP

The City of Toronto has in place a long-term plan to manage our ACM. It includes work procedures for trained service personnel, maintenance personnel and contractors who may be required to work in the facility so that their work actions will not increase the risk potential of asbestos exposure to building occupants.

4. Operations and Maintenance Program

The City of Toronto has implemented a program of procedures for the proper handling and maintenance of our ACM. It includes preventative measures to reduce the probability of damage to ACM as well as procedures for routine maintenance, cleaning, emergency responses to fibre releases, renovation and periodic re-inspection (surveillance) of these materials.

APPENDIX B
REFERENCE MATERIALS

1. Ontario Regulation 278/05: Designated Substance — Asbestos on Construction Projects and in Buildings and Repair Operations, made under the Occupational Health and Safety Act.

http://www.e-laws.gov.on.ca/DBLaws/Regs/English/050278_e.htm

2. Revised Regulations of Ontario 1990, Regulation 347, as amended: General — Waste Management, made under the Environmental Protection Act.

http://www.e-laws.gov.on.ca/DBLaws/Regs/English/900347_e.htm

3. Revised Statutes of Ontario 1990, Chapter D1: Dangerous Goods Transportation Act.

http://www.e-laws.gov.on.ca/DBLaws/Statutes/English/90d01_e.htm

4. Asbestos Information Sources and Governmental Sources (Canadian and US)

<http://www.chrysotile.com/>

<http://www.ccohs.ca/>

<http://www.cdc.gov/search.do?action=search&queryText=asbestos>

<http://www.ashrae.org/template/AdvancedSearchResult.jsessionid=aaa-u1J4MK-DY>

<http://www.labour.gov.on.ca/moved/index.html>

http://www.hc-sc.gc.ca/iyh-vsv/environ/asbestos-amiante_e.html

<http://www.osha.gov/SLTC/asbestos/index.html>

APPENDIX C

LETTER OF NOTIFICATION TO TENANTS REGARDING ASBESTOS IN PREMISES

LETTER OF NOTIFICATION TO TENANTS REGARDING ASBESTOS IN PREMISES

To Tenant Management Representative

This letter is being provided as notification of the presence of asbestos within the building at [address], Ontario. City has recently had an asbestos survey performed of the entire building and have established a program to manage all asbestos in a safe and prudent fashion. O.Reg. 278/05 requires notification of the building's tenants of the location of such material, as well as notification of workers who may work in close proximity to the material and who may disturb it.

Our consultant inspected all areas of the building and made recommendations, where necessary, for removal or repair of asbestos. All such work [has been completed/will be completed shortly] with appropriate inspection and supervision. All asbestos remaining is subject to the Asbestos Management Program as required by our own due diligence. A copy of the survey and Asbestos Management Program are available locally on site, or at Metro Hall, 55 John Street, Toronto, Ontario for review.

The continuing presence of the remaining asbestos does not pose a risk of exposure to your employees as long as it remains under this management program. Staff that may disturb these materials has been given appropriate training and are aware of its presence. If you are planning maintenance or renovation work please notify the Facility Manager who will determine if the planned work will affect the asbestos in any way and provide information regarding necessary work practices and obligations to maintain a safe and healthy environment for your staff and contractors.

Please ensure that your staff and sub-contractors are aware of the above information. If you have any concerns please contact the facility management office at _____.

APPENDIX D

**CONTRACTOR NOTIFICATION AND
ACKNOWLEDGEMENT FORM**

CONTRACTOR NOTIFICATION AND ACKNOWLEDGEMENT FORM

City has identified the presence of various friable and non-friable asbestos-containing materials in the Building. An asbestos inventory report showing the locations and amounts of these materials is available for viewing from the Facility Manager.

Ontario Regulation 278/05 (*Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations*) applies to workers that may disturb asbestos materials. The disturbance of asbestos building materials are only to be undertaken by Asbestos Abatement Contractors that maintain the appropriate insurance coverage and meet the requirements set out in the AMP. The following activities may disturb asbestos materials. The Facility Manager must be notified prior to performing the following:

- Removal or repair of asbestos mechanical insulation or sprayed asbestos.
- Ceiling entry which may disturb sprayed fireproofing or pipe insulation.
- Any other operation which may generate airborne asbestos from friable asbestos.
- Any removal, cutting or other disturbance of non-friable asbestos material.
- Disturbance of any material excluded from the survey.

Declaration by Contractor

The Contractor and their sub-contractors shall follow the work procedures as specified by City's Asbestos Management Program (AMP) and shall not disturb ACM without using proper procedures in accordance with Regulation 278/05 and this AMP..

We agree that our staff will not disturb asbestos-containing materials without prior notification to the Facility Manager. This firm and our staff will follow all procedures specified by the City Asbestos Management Program and/or O. Reg. 278/05. All asbestos waste will be packaged and disposed of in accordance with Ministry of the Environment requirements.

Notification of Asbestos Abatement

All contractors and City employees who perform work at facilities where ACM is present should be notified of the presence of the ACM if their work may bring them into contact or close proximity to the ACM and they may disturb it. This notification may include janitorial, security, telephone, computer cabling suppliers, mechanical maintenance contractors, etc. This notification shall be performed by the Facility Manager or Project Manager.

All contractors and City employees who perform work at City facilities, where asbestos-containing sprayed fireproofing is present above ceilings, including telephone, computer cabling suppliers, electrical and mechanical contractors, etc., are to be notified that Type

2 Procedures are required for any entry to, or work within the ceiling space (visual inspection excepted, Type 1 Work). This notification shall be performed by the Facility Manager or Project Manager.

Contractors are to:

- Notify orally and in writing, an inspector at the office of the Ontario Ministry of Labour nearest the project site (Notice of Project), as per Regulation 278/05, prior to commencing Type 3 abatement, Glove Bag abatement or any abatement project that exceeds \$50,000.00 in cost.
- Notify Sanitary Landfill site as per Ontario MOE Regulation 347 as amended.
- Inform all sub trades of the presence of ACM identified in the contract documents.
- Immediately notify the Project Manager and stop work if friable materials not identified in the contract documents are discovered during the course of the work. Ensure that the MOL and the Joint Health and Safety Committee are immediately notified if the friable material is asbestos containing, as required by Regulation 278/05.

Building (Address): _____

Project: _____

Contractor: _____

Name and Title: _____

Signature: _____

Date: _____

APPENDIX E

WORK PRACTICES – EMERGENCY WORK

WORK PRACTICES – TYPE 2 EMERGENCY CLEAN UP

Emergency asbestos procedures shall be implemented, when required, in order to protect those undertaking the work, as well as to protect all others from, or limit exposure to, airborne asbestos. Procedures indicated shall be followed as closely as possible, in the event of an emergency situation.

Procedures for asbestos work, required as an immediate response to floods through asbestos fireproofing, accidental disturbance of ACM, ceiling collapses of asbestos-containing ceiling tiles, or other emergencies that affect asbestos materials, are as follows:

- Clear area of all occupants. In critical situations clear area of only non-essential personnel, and provide essential personnel with proper respiratory protection.
- Shut down ventilation systems serving area including supply, return and exhaust.
- Isolate the area by locking doors, if this can be done without blocking emergency or fire routes.
- If it is not possible to safely isolate the area, the Facility Manager will notify personnel not to enter the area. If possible, post security to prevent unnecessary access.
- Close access doors to area or construct enclosure around area if time permits. Do not obstruct emergency exits under any circumstances.
- Only trained workers or Abatement Contractors will perform the emergency clean up.
- Entrance to the area will now be limited to those wearing applicable respiratory protection, safety glasses with side shields, disposable Tyvek coveralls, and impermeable gloves. Half face NIOSH approved respirators with P100 (HEPA) filters are adequate.
- No eating, smoking or chewing in the Asbestos Work Area.
- Remove all debris within the area of the accidental disturbance of ACM using HEPA vacuums.
- Place polyethylene drop sheets under area of repair.
- Repair ACM pipe insulation, replace ceiling tiles or stabilize ACM as required with minimum disturbance to ACM. Prior to repair work, area must be wetted to control the spread of dust and fibres.
- Remove dust using HEPA vacuums or wet wiping from all surfaces within area of disturbance.
- Dispose of items that cannot be cleaned as asbestos waste.

- Clean all non-disposable tools and items (before leaving work area).
- Dispose of all cleaning supplies and drop sheets as asbestos waste.
- Remove coveralls and dispose of as asbestos waste.
- Proceed to washroom and wash face and hands.
- At their option, the Facility Manager may decide to employ an Asbestos Consultant to perform air monitoring and consulting, after clean-up to ensure airborne fibre levels are within acceptable limits to re-occupy the space.
- The Facility Manager must notify the Joint Health and Safety Committee of the results of air monitoring or testing.

APPENDIX F

ASBESTOS PROJECT WORK RECORD

ASBESTOS PROJECT WORK RECORD

Building: _____
(Building Address or Name)

Date: _____
(Today's Date)

Project Number: _____
(City Project Number or Purchase Order Number)

Project Type: ☐ Emergency ☐ Type 1 ☐ Type 2
 ☐ Planned Project ☐ Glove Bag ☐ Type 3

Area of Work: _____
(Room Name, Number, Floor etc.)

Description: _____
(Brief description of abatement, material, system, etc)

Tenant: _____
(Tenant name if any, department or group)

Project Start Date: _____
(Mobilization date)

Project End Date: _____
(After dismantling/clean-up)

Contractor: _____
(Contracting firm or employee)

Telephone: _____
(Contractor or employee telephone)

Consultant: _____
(Name of consulting firm/contact if any)

Telephone: _____
(Consultant telephone)

Pre-Construction Survey for ACM performed and report provided to Contractor?

☐ Yes ☐ No (Explain) _____

Air Sampling during abatement?

☐ Yes ☐ No

Clearance Air Monitoring performed (Regulated requirement after Type 3 abatement)?

☐ Yes ☐ No

Air Monitoring results to Joint Health and Safety Committee?

☐ Yes ☐ No

Asbestos Survey Updated to Reflect Changes in ACM Inventory?

☐ Yes ☐ No. No changes to ACM inventory resulted.

☐ No. Forward copies to Consultant prior to next re-assessment.

Asbestos waste removed from site and disposed of?

☐ Yes. Dump tickets attached. ☐ No. ACM waste not generated.

☐ No. ACM waste remains on site for later disposal.

Append the following information relating to asbestos abatement to this work record, if applicable, and file Asbestos Work Record and attachments with AMP. Check where attached.

Submittals including Insurance ☐ Yes ☐ No

Dump tickets, waybills, etc for waste. ☐ Yes ☐ No

Specifications, Change Orders, Drawings. ☐ Yes ☐ No

Consultant Inspection Reports. ☐ Yes ☐ No

Air Monitoring Results. ☐ Yes ☐ No

Analytical Certificates. ☐ Yes ☐ No

Correspondence as required. ☐ Yes ☐ No

APPENDIX G
ASBESTOS WORK PROCEDURES

G-1 ASBESTOS WORK PROCEDURES

City of Toronto has decided that all asbestos abatement work will be performed by qualified, experienced outside service personnel, maintenance personnel or authorized asbestos abatement contractor and that no City of Toronto employee will be assigned any Type 3 asbestos related work.

The information provided in this section is intended to give background to the Asbestos Plan Manager so that they may select an appropriately qualified abatement contractor.

Various sections of this manual will be made available to Service/Maintenance personnel or a Contractor describing the work required to be performed and authorization to proceed will be based on receipt of proof that the individual is qualified to perform the work and demonstrates so.

G-2 MAJOR ASBESTOS ABATEMENT WORK

Any work of this type is to be performed by firms specializing in asbestos abatement under contract to the building. A qualified consultant will inspect all removal work. The consultant will be required to provide an on site inspector with experience working on projects of similar size and complexity.

Where additional work is required in separate locations, appropriate procedures can be incorporated with the main work. Type 3 work involves the handling or removal of significant amounts of ACM. This type of work is only performed within a polyethylene enclosure for indoor operations by qualified abatement contractors. The checklist presented below is intended to provide guidance in the administration of work performed by qualified outside consultants and contractors.

1. Arrange to have Specifications prepared for the project.
2. Schedule work with input from all affected parties including but not limited to:
 - Affected City Division/Tenant,
 - Facilities Management,
 - Project Architect,
 - City of Toronto Administration,
 - City of Toronto H&S Consultant
 - JHSC/H&S Rep

3. Arrange for inspection and air monitoring services.
4. Prepare Tender Documents.
5. Pre-qualify contractors.
6. Hold a pre-bid meeting with contractors to explain the scope of work.
7. Notify staff who work in the immediate area of the asbestos removal work.
8. Notify JHSC/H&S Rep for the building.
9. Conduct a walk-through inspection of the work area with the contractor prior to starting the work to identify and document the condition of the area and any existing damage.

In addition to the above, the following items should be considered for implementation into the removal project specifications, supplementary to the regulatory requirements:

1. Inspection
 - Provides on-site monitoring of the removal work to ensure that proper work practices, waste disposal and cleanup procedures are being followed.
2. Waste and equipment decontamination enclosure system
 - Minimizes the potential for contamination due to improperly cleaned waste containers and removal equipment, especially in occupied areas.
3. Application of sealant to work area surfaces
 - Prevents any residual fibres from becoming airborne and contaminating the work area after final cleanup.
4. Settling period
 - Allows airborne fibres to settle to the ground and be removed during the final cleanup process.

These items should be considered in addition to the regulatory requirements to ensure that contamination of the area adjacent to the asbestos removal does not occur, especially in occupied areas.

G-3 EMPLOYEE TYPE 1 WORK PROCEDURES

City of Toronto has decided at this time that an experienced and qualified Abatement Contractor pre-selected by the Asbestos Plan Manager will perform all work involving ACM.

This section has been intentionally left blank, until such time that employees will be required to

conduct this level of work as specified in Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*. When it is decided that this type of work will be performed in-house, a qualified Occupational Health and Safety Consultant will provide training. No work will be performed until specific training has been provided and the employee's comprehension of the work has been evaluated and accepted as adequate.

G-4 EMPLOYEE TYPE 2 WORK PROCEDURES

City of Toronto has decided at this time that an experienced and qualified Abatement Contractor pre-selected by the Asbestos Plan Manager will perform all work involving ACM.

This section has been intentionally left blank, until such time that employees will be required to conduct this level of work as specified in Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*. When it is decided that this type of work will be performed in house, a qualified Occupational Health and Safety Consultant will provide training. No work will be performed until specific training has been provided and the employee's comprehension of the work has been evaluated and accepted as adequate.

G-5 EMPLOYEE TYPE 3 WORK PROCEDURES

City of Toronto has decided at this time that an experienced and qualified Abatement Contractor pre-selected by the Asbestos Plan Manager will perform all work involving ACM.

This section has been intentionally left blank, until such time that employees will be required to conduct this level of work as specified in the Regulation 278/05, *Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations*. When it is decided that this type of work will be performed, a qualified Occupational Health and Safety Consultant will provide training and the training will be equivalent to training approved by the Ministry of Training, Colleges and Universities. No work will be performed until specific training has been provided and the employee's comprehension of the work has been evaluated and accepted as adequate.

G-6 CONTRACTOR WORK PROCEDURES – MINIMAL ASBESTOS DISTURBANCES

As indicated in the following Sections, the following work procedures are provided as background to the Asbestos Plan Manager, to allow for the selection of a qualified asbestos abatement contractor. Procedures for the following work are provided:

Procedures

- | | |
|-----|--|
| G7 | Cleaning, Stripping Wax From and Waxing Asbestos-containing Floor Tiles – Type 1 Work |
| G8 | Cleaning of Asbestos-containing Debris – Type 2 Work |
| G9 | Access and Cleaning above Suspended Ceilings – Type 2 Work |
| G10 | Cleaning out of HEPA Filtered Vacuum Cleaners, Asbestos Waste Storage and Disposal – Type 2 Work |

- G11 Work with Non-friable Materials and Manufactured Products – Type 1 Work
- G12 Repairing Thermal Insulation – Type 2 Work
- G13 Asbestos Removal Using Glove Bags – Type 2 Work
- G14 Minor Asbestos Removal – Type 2 Work
- G15 Emergency Spill or Repair Response – Type 2 Work

G-7 *Cleaning, Stripping Wax From and Waxing Asbestos-Containing Floor Tiles - Type 1 Work*

Many of the floor tile (vinyl asbestos tile - VAT) applications contain asbestos fibre. The asbestos is held in place within the vinyl binding-matrix and no fibres are released during regular traffic conditions. Studies have shown that dry stripping of these applications can under some situations release fibres and become a hazard.

Work Procedure:

- 1) Avoid Frequent Stripping of Wax from Floors. Stripping of floors should be done as infrequently as possible -- no more than once a year, if at all.
- 2) Strip Wax from Floors or Clean while Wet. The floors are to be kept wet with detergent or water during the stripping operation. **DO NOT PERFORM DRY STRIPPING.** Prior to machine operation, an emulsion of chemical stripper and water is to be applied to the floor with a mop, which strips the wax and also controls fibre release during the work. The floor should be thoroughly cleaned while wet after stripping and before application of new wax.
- 3) Run Machine at Low Speed. If a variable speed control is present, the machine is to run at the lowest setting.
- 4) Select the Least Abrasive Pad. White and red colour buffing pads should be used in preference to the green coloured type. Black coloured pads should not be used under any circumstances.
- 5) Do Not Over Buff Floor. Stop stripping when the old surface coat is removed. Over stripping can damage the floor and may cause release of asbestos fibres. Do not operate a floor machine with an abrasive pad on unfinished floors.

G-8 *Cleaning Of Asbestos-Containing Debris - Type 2 Work*

Use provisions of this section when cleaning is to be performed in areas where ACM has been previously disturbed and there is visible evidence of dust and debris. This situation differs from an emergency spill, as this disturbance has occurred in an area that can be isolated.

Work Procedure:

- 1) Prior to commencing the work, notify all affected staff of the asbestos work that will

be taking place.

- 2) Perform this work during off-hours if at all possible.
- 3) Assemble all supplies and equipment necessary for performing the work.
- 4) Wear a non-powered air-purifying respirator approved for use with asbestos.
- 5) Wear disposable full body type coveralls that will not permit penetration by asbestos fibres equipped with tight fitting cuffs including head hood and rubber boots or disposable shoe covers.
- 6) Do not use compressed air.
- 7) Do not eat, drink, chew or smoke in the work area.
- 8) Disable the mechanical ventilation system servicing the work area and seal with polyethylene sheeting sealed with tape.
- 9) Separate the work area from the rest of the workplace using rope barriers. The extent of the work area will depend on the amount of work to be performed, potential for fibre release and the height of the work above floor level.
- 10) Identify the work area with clearly visible warning signs
- 11) Spray any visible pieces of ACM with a mist of amended water using a garden-type sprayer.
- 12) Place any large pieces of ACM directly into waste disposal bags.
- 13) Use a squeegee or wetted broom to gather waste debris together into a dustpan and place directly into waste disposal bag.
- 14) Clean with HEPA filtered vacuum, remaining debris and then wet clean the immediate area of the "spilled material".
- 15) Where practical (in pipe chases or porous surfaces), HEPA vacuum and wet clean the entire designated work area and spray a coat of encapsulant on surfaces in the work area.
- 16) Before leaving the work area, decontaminate protective clothing, including boots, and equipment using a HEPA vacuum or by damp wiping.
- 17) Clean all non-disposable tools and items (before leaving the work area).
- 18) Wash hands and face at the completion of the work (before leaving the work area). Damp wipe the respirator and store in a proper place.
- 19) Dispose of protective clothing and spent respirator filter cartridges as asbestos waste.

- 20) Shower at the completion of the work if contamination is suspected, before leaving work.

G-9 Access And Cleaning Above Suspended Ceilings -Type 2 Work

This section applies to work above suspended ceilings in buildings where there is likely to be a significant quantity of friable material (fireproofing or thermal pipe and duct insulation) lying on the upper surface of the ceiling tile. Significant is any visible amount of material found on the ceiling tile that can be identified as originating from the overlying or adjacent parent material.

This procedure is to be used to access ceiling spaces where fireproofing or thermal insulation has been noted to be present or where in performing routine work material is discovered on the tiles.

Work Procedure:

- 1) Perform this work during off-hours if at all possible.
- 2) Clear the immediate area of all personnel not assigned to the work.
- 3) Collect all supplies and equipment necessary for performing the work.
- 4) Wear a non-powered air-purifying respirator approved for use with asbestos.
- 5) Wear disposable full body type coveralls that will not permit penetration by asbestos fibres equipped with tight fitting cuffs including head hood and rubber boots or disposable shoe covers, safety glasses with side shields and impermeable gloves.
- 6) Do not use compressed air.
- 7) Do not eat, drink, chew or smoke in the work area.
- 8) Separate the work area from the rest of the workplace using rope barriers. The extent of the work area will depend on the amount of work to be performed, potential for fibre release and the height of the work above floor level.
- 9) Disable the mechanical ventilation system that services the work area and seal with polyethylene sheeting and tape.
- 10) Relocate moveable objects (chairs, tables, desks, coat racks, etc.) out of the work area if practical.
- 11) Cover the floor and remaining furniture and equipment in the work area with dark 8-mil rip-proof polyethylene sheeting.
- 12) Construct an enclosure with polyethylene sheeting, duct tape and/or clips from ceiling to floor to contain any disturbed materials. Work area shall be large enough to cover 1 to 3 ceiling tiles with polyethylene sheeting sealed with tape at floor and at suspended ceiling tile metal frame. Allow an adequate lap (1 metre) in the polyethylene sheeting to provide an entrance yet maintain the isolation.

- 13) For operations involving the removal of false ceilings where ACM debris is likely above or when removing 1 square meter, or less, of friable ACM, the enclosure shall include one or more transparent windows areas to allow observation of the entire work area from outside the enclosures, if the work area is not enclosed by walls.
- 14) Identify the work area with clearly visible warning signs.
- 15) Work shall proceed in a careful manner to ensure thoroughness and to minimize potential airborne contamination.
- 16) Carefully remove the minimum number of tiles required to provide employee access (usually one tile is sufficient), lift the tile straight up and slide across onto the surface of the adjacent ceiling tiles. Note that there may be interference from overhead piping, conduits, duct work, hanger wires or construction debris.
- 17) Large bulk material shall be wetted and bagged if it cannot be handled with the HEPA vacuum. Then use a HEPA vacuum to clean any remaining fallen debris or loose material on the tiles in the immediate vicinity of the opening.
- 18) After immediate tiles have been cleaned, remove carefully, one at a time, to provide access to the next row.
- 19) Clean, with HEPA vacuum or by damp wiping, ceiling tile track system and all other above-ceiling components that may retain or hold asbestos debris.
- 20) Proceed with cleaning in this manner until a sufficient number of ceiling tiles have been cleaned to allow for the work to be performed in the ceiling space.
- 21) At the completion of the cleaning work, replace the tiles, clean the area under the suspended ceiling, including polyethylene drop sheets and equipment used in the cleaning operation (ladders, scaffolding, HEPA vacuum, etc.) by HEPA vacuuming or damp wiping.
- 22) After wetting the polyethylene sheeting, dismantle the enclosure, dispose of all polyethylene sheeting and tape as asbestos waste, vacuum surfaces in the immediate area including the floor.
- 23) Before leaving the work area, decontaminate protective clothing (including boots) and equipment, etc., using a HEPA vacuum or by damp wiping.
- 24) Clean all non-disposable tools and items (before leaving the work area).
- 25) Wash hands and face at the completion of the work (before leaving the work area). Damp wipe the respirator and store in a proper place.
- 26) Dispose of protective clothing and spent respirator filter cartridges as asbestos waste.
- 27) Shower at the completion of the work if contamination is suspected, before leaving work.

G-10 *Cleaning Out Of HEPA Filtered Vacuum Cleaners, Asbestos Waste Storage and Disposal - Type 2 Work*

This section applies to any work force on the property.

Work Procedure:

- 1) Cleaning or emptying of contents of HEPA filtered vacuums is not permitted for minor work anywhere on the property including within vehicles parked on the premises. The contents of the vacuum shall be cleaned or emptied at the Contractor's, Maintenance Personnel's or Service Personnel's facility.
- 2) Asbestos waste may only be stored on site during the performance of the work. The waste shall be removed at the end of the job or operation.
- 3) Waste shall be placed in 6-mil polyethylene bags and sealed.
- 4) Waste bags shall be pre-labelled advising of the contents.
- 5) While handling sealed waste bags, wear a non-powered air-purifying respirator approved for use with asbestos.
- 6) While handling sealed waste bags, wear disposable full body type coveralls that will not permit penetration by asbestos fibres and is equipped with tight fitting cuffs including head hood and rubber boots or disposable shoe covers.
- 7) Transport waste to an approved and authorized land fill-site.

G-11 *Work With Non-Friable Materials and Manufactured Products - Type 1 Work*

This work category covers the installation, removal, breaking, cutting, drilling, abrading, grinding, sanding or vibrating of non-friable asbestos-containing building materials, other than ceiling tiles, or manufactured products containing asbestos. Typical examples of these types of materials include vinyl floor tiles, gaskets, seals, packing, friction products or cement products.

Note: Power tools, including those equipped with dust collecting devices connected to a HEPA filtration system, are not permitted in this type of work.

Work Procedure:

- 1) Collect all supplies and equipment necessary for performing the work.
- 2) Wear a non-powered air-purifying respirator approved for use with asbestos.
- 3) Wear disposable full body type coveralls that will not permit penetration by asbestos fibres equipped with tight fitting cuffs including head hood and rubber boots or disposable shoe covers, safety glasses with side shields and impermeable gloves.
- 4) Do not use compressed air.

- 5) Do not eat, drink, chew or smoke in the work area.
- 6) Before beginning work, clean visible dust from all surfaces in the work area using a damp cloth or HEPA vacuum cleaner.
- 7) Where applicable, place a drop sheet of rip-proof polyethylene sheeting on the floor of the work area to catch any dust created by the work.
- 8) Spray the material being worked on continuously with a mist of amended water to reduce dust (unless wetting creates an electrical hazard), using a garden type sprayer.
- 9) Clean dust and debris during, and at the end of the work, using a HEPA vacuum or by damp wiping.
- 10) Clean polyethylene drop sheets using a HEPA vacuum or by damp wiping. Drop sheets shall not be reused. At completion of work, drop sheets are to be wetted and disposed of as asbestos waste.
- 11) Clean all non-disposable tools and items.
- 12) Ensure that hands and face are washed at the completion of the job.
- 13) Clean the respirator by damp wiping and store in a proper manner.

G-12 Repairing Thermal Insulation - Type 2 Work

This category of work covers the repair of damaged asbestos-containing thermal insulation on ducts and piping systems only using lagging (canvas cloth) and mastic (paint adhesive i.e. glue). This does not include any removal whatsoever. Repair of thermal insulation is usually selected as the control option where damage is limited and of a minor nature (such that repair activities are not likely to cause significant disturbance to the underlying friable material) and is not likely to re-occur due to its accessibility or for other reasons.

Work Procedure:

- 1) Perform this work during off-hours if at all possible.
- 2) Clear the immediate area of all personnel not assigned to the work.
- 3) Collect all supplies and equipment necessary for performing the work.
- 4) Wear a non-powered air-purifying respirator approved for use with asbestos.
- 5) Wear disposable full body type coveralls that will not permit penetration by asbestos fibres and is equipped with tight fitting cuffs including head hood and rubber boots or disposable shoe covers, safety glasses with side shields and impermeable gloves.
- 6) Do not use compressed air.
- 7) Do not eat, drink, chew or smoke in the work area.

- 8) Separate the work area from the rest of the workplace using rope barriers. The extent of the work area will depend on the amount of work to be performed, potential for fibre release and the height of the work above floor level.
- 9) Identify the work area with clearly visible warning signs.
- 10) Disable the mechanical ventilation system that services the work area and seal with polyethylene sheeting and tape.
- 11) Relocate moveable objects (chairs, tables, desks, coat racks, etc.) out of the work area if practical.
- 12) Place a drop sheet of rip-proof polyethylene sheeting on the floor of the work area to catch any dust or debris created by the work.
- 13) Pre-clean insulation to be repaired and any dust or debris in the immediate area using a HEPA vacuum.
- 14) Spray a fine mist of amended water (using a garden-type sprayer) on the damaged area of insulation.
- 15) Do not remove any existing jacket material.
- 16) Apply approved encapsulant to one side of a piece of 6-ounce canvas.
- 17) Apply the piece of canvas to the damaged area. Paint the outside area of the canvas with encapsulant. Ensure that the area of repair and six inches on all sides are coated with encapsulant.
- 18) Following completion of repair work, clean polyethylene drop-sheets and surrounding area, by damp wiping or HEPA vacuuming.
- 19) After wetting the polyethylene drop sheets, repeatedly fold on to itself, whereby trapping any debris that may be present in the folds. Dispose of all polyethylene sheeting and tape as asbestos waste. Using a HEPA vacuum, clean surfaces in the immediate area including the floor.
- 20) Before leaving the work area, decontaminate protective clothing (including boots) and equipment, etc., using a HEPA vacuum or by damp wiping.
- 21) Clean all non-disposable tools and items (before leaving the work area).
- 22) Wash hands and face at the completion of the work (before leaving the work area). Damp wipe the respirator and store in a proper place.
- 23) Dispose of protective clothing and spent respirator filter cartridges as asbestos waste.
- 24) Shower at the completion of the work if contamination is suspected, before leaving work.

G-13 Asbestos Removal Using Glove Bags - Type 2 Work

Glove Bag use is appropriate for asbestos removal in easily accessible areas when the full enclosure method is not justified and the Glove Bags can be used in accordance to the procedures specified.

Work Procedure:

- 1) Glove bag Removal Method on work where one square metre or more of friable asbestos-containing material will be removed, requires a Notice of Project (NOP) signed by the Ontario Ministry of Labour. A copy of the signed NOP must be available on site prior to beginning the work. All materials and work are to conform to requirements as detailed on the NOP.
- 2) Perform this work during off-hours if at all possible.
- 3) Clear the immediate area of all personnel not assigned to the work.
- 4) Collect all supplies and equipment necessary for performing the work.
- 5) Wear a non-powered air-purifying respirator approved for use with asbestos.
- 6) Wear disposable full body type coveralls that will not permit penetration by asbestos fibres and is equipped with tight fitting cuffs including head hood and rubber boots or disposable shoe covers, safety glasses with side shields and impermeable gloves.
- 7) Do not use compressed air.
- 8) Do not eat, drink, chew or smoke in the work area.
- 9) Separate the work area from the rest of the workplace using rope barriers. The extent of the work area will depend on the amount of work to be performed, potential for fibre release and the height of the work above floor level.
- 10) Identify the work area with clearly visible warning signs.
- 11) Relocate moveable objects (chairs, tables, desks, coat racks, etc.) out of the work area if practical.
- 12) Disable the mechanical ventilation system that services the work area and seal with polyethylene sheeting and tape.
- 13) Shut off all sources of heat for pipe systems.
- 14) Only new Glove Bags without modification or defects may be used.
- 15) The glove bag shall be made of material that is impervious to asbestos and sufficiently strong to support the weight of material the bag will hold.
- 16) Glove bag shall be equipped with:

- Sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period,
 - Valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure,
 - A tool pouch with a drain,
 - A seamless bottom and a means of sealing off the lower portion of the bag, and
 - A high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.
- 17) A glove bag shall not be used to remove insulation from a pipe, duct or similar structure if,
- It may not be possible to maintain a proper seal for any reason including, without limitation,
 - The condition of the insulation, or
 - The temperature of the pipe, duct or similar structure, or
 - The bag could become damaged for any reason including without limitation,
 - The type of jacketing, or
 - The temperature of the pipe, duct or similar structure.
- 18) Immediately before the glove bag is attached, the insulation jacketing or coating shall be inspected for damage or defects, and if any damage or defect is present, it shall be repaired.
- 19) The glove bag shall be inspected for damage or defects,
- Immediately before it is attached to the pipe, duct or other similar structure, and
 - At regular intervals during its use.
- 20) If damage or defects are observed when the glove bag is inspected, the glove bag shall be disposed of.
- 21) If damage or defects are observed when the glove bag is inspected, prior to beginning removal work, or at any other time,
- The use of the glove bag shall be discontinued,
 - The inner surface of the glove bag and the contents, if any, shall be thoroughly

wetted,

- The glove bag and the contents, if any, shall be removed and placed in the asbestos waste container, and
 - The work area shall be cleaned by vacuuming with a vacuum equipped with a HEPA filter before removal work is resumed.
- 22) Glove Bags cannot be used to remove pipe insulation that has a jacketing made of aluminium with a thickness exceeding 0.51 mm (24 gauge) or a jacketing made of steel.
 - 25) Relocate moveable objects (chairs, tables, desks, coat racks, etc.) out of the work area if practical.
 - 23) Place a drop sheet of rip-proof polyethylene sheeting on the floor of the work area to catch any dust or debris created by the work
 - 24) Vacuum surfaces of insulating material using a HEPA vacuum. Pre-clean any dust or debris in the work area by damp wiping or using a HEPA vacuum.
 - 25) Friable material that will be disturbed or removed during the work shall be thoroughly wetted before the glove bag is attached and at regular intervals during the work.
 - 26) Remove all obstructions from pipes to allow sufficient access.
 - 27) Insure that any knife to be used inside the Glove Bag has a retractable blade and that any saw used is of the flexible wire type. Any brush used inside the Glove Bag must not have metal bristles.
 - 28) Place any tools necessary to remove insulation in the bottom of the Glove Bag. Zip the bag onto the pipe or duct and seal all openings with the straps (do not use duct tape to secure Glove Bags to pipe). For valve Glove Bags, seal valve cover with tape or equivalent.
 - 29) Insert nozzle of spray pump (containing amended water) into Glove Bag through the valve. Place hands into the gloves and place the tools into the tool pouch.
 - 30) Cut or remove exterior insulation covering where applicable to expose asbestos pipe covering. Wet exposed pipe covering with water to suppress any dust. Remove insulation and place in the bottom of the Glove Bag. Wash exposed portion of pipe or duct and top section of bag. Saturate exposed insulation on the pipe and contents of the bag using the amended water sprayer. Any jagged or sharp edges that have been produced during the removal of the metal jacketing shall be handled in such a way so as to minimize the possibility of ripping or puncturing the Glove Bag.
 - 31) Ensure that the pipe and other surfaces are clean of visual residue, dirt or dust prior to removal or relocation of the Glove Bag.

- 32) After cleaning of the pipe, spray encapsulant on the exposed ends of the insulation on the pipe and the contents of the Glove Bag.
- 33) To remove Glove Bag after completion of stripping, wash top section and tools thoroughly and place all tools into the tool pouch.
- 34) Place a labelled waste disposal bag under and around the bottom of the Glove Bag. Tools may be removed from the Glove Bag by placing them in the glove, taping the glove in two locations, cutting it off between the tape and placing in a bucket of water.
- 35) Place the Glove Bag into the waste disposal bag and seal the disposal bag. Dispose of as asbestos waste.
- 36) After removal of the Glove Bag, ensure that the pipe is clean of all residues. If necessary, vacuum all surfaces of the pipe using a HEPA vacuum.
- 37) Cover exposed ends of pipe insulation with tape.
- 38) Clean all surfaces in the work area and equipment using a HEPA vacuum or by damp wiping.
- 39) After wetting the polyethylene drop sheets, repeatedly fold on to itself whereby trapping any debris that may be present in the folds. Dispose of all polyethylene sheeting and tape as asbestos waste, vacuum surfaces in the immediate area including the floor.
- 40) Before leaving the work area, decontaminate protective clothing (including boots) and equipment, etc., using a HEPA vacuum or by damp wiping.
- 41) Clean all non-disposable tools and items (before leaving the work area).
- 42) Wash hands and face at the completion of the work (before leaving the work area). Damp wipe the respirator and store in a proper place.
- 43) Dispose of protective clothing and spent respirator filter cartridges as asbestos waste.
- 44) Shower at the completion of the work if contamination is suspected.

G-14 Minor Asbestos Removal ($\leq 1\text{ m}^2$) - Type 2 Work

Minor removal means planned removal of a small amount of ACM following established procedures. The removal of insulation from one pipe fitting (where the use of a glove bag is not possible) to gain access to a pipe or the removal of a small section of fireproofing to attach a fastening device are examples of minor removals.

This section of work requires the construction of an enclosure for minor removal work. Where an enclosure cannot be constructed to isolate the immediate work item it may be necessary to consider the whole room as the work area. If the room will serve as an enclosure then all openings will have to be sealed, the mechanical system servicing the room disabled and the ventilation ducts to and from

the work area will also have to be sealed. However, it may still be required to cover the floor, walls and ceiling with polyethylene sheeting.

Work Procedure:

- 1) Perform this work during off-hours if at all possible.
- 2) Clear the immediate area of all personnel not assigned to the work.
- 3) Collect all supplies and equipment necessary for performing the work.
- 4) Wear a respirator appropriate for the work being completed and that is approved for use with asbestos.
- 5) Wear disposable full body type coveralls that will not permit penetration by asbestos fibres and is equipped with tight fitting cuffs including head hood and rubber boots or disposable shoe covers, safety glasses with side shields and impermeable gloves.
- 6) Do not use compressed air.
- 7) Do not eat, drink, chew or smoke in the work area.
- 8) Separate the work area from the rest of the workplace using rope barriers. The extent of the work area will depend on the amount of work to be performed, potential for fibre release and the height of the work above floor level.
- 9) Identify the work area with clearly visible warning signs.
- 10) Disable the mechanical ventilation system that services the work area or if not possible, that would service the enclosure and seal with polyethylene sheeting and tape.
- 11) Relocate moveable objects (chairs, tables, desks, coat racks, etc.) out of the work area if practical.
- 12) Construct a frame for the enclosure from 2x4 wood studs or other suitable material (i.e. scaffolding).
- 13) If the potential exists for the disturbance of ACM during the construction of the enclosure, wear a respirator and suitable protective clothing. Ensure that the enclosure is of adequate size to permit the storage of equipment and waste.
- 14) Cover the walls, floor with 8-mil rip-proof polyethylene sheeting (if no debris is present on the floor surfaces) and ceiling of the enclosure with 6-mil clear polyethylene sheeting sealed with duct tape. Overlapping curtains of polyethylene sheeting must be fitted on each side of the entrance to the enclosure (curtain flaps may require weights at the bottoms to ensure proper closing).
- 15) Shut off or isolate electrical power within the enclosure.

- 16) Pre-clean any visible dust or debris in the enclosure using a HEPA vacuum or by damp wiping.
- 17) For thermal insulation applications, carefully cut the outer cover of thermal insulation on the section being worked on. Thoroughly wet the ACM with amended water using a garden sprayer.
- 18) For fireproofing applications, spray repeated fine mist applications of amended water using a garden sprayer. Limit wetting only to area to be removed.
- 19) Remove wetted asbestos material and covering jackets in small sections directly into a 6-mil labelled polyethylene bag.
- 20) Clean surfaces exposed by asbestos removal with a brush and wet sponge. Ensure that all surfaces of piping and other equipment are clean of all residues.
- 21) Immediately after removal of asbestos, clean all surfaces and equipment within the work area including, polyethylene sheeting, using a HEPA vacuum or by damp wiping.
- 22) Seal all surfaces of pipe or other equipment, and ends of exposed insulation which remains, with a suitable encapsulant.
- 23) After satisfactory completion of cleaning and before leaving the work area, decontaminate protective clothing (including boots) and equipment, etc., using a HEPA vacuum or by damp wiping.
- 24) Clean polyethylene drop-sheets and surrounding area, by damp wiping or HEPA vacuuming.
- 25) After wetting the polyethylene sheeting of the enclosure, repeatedly fold on to itself where by trapping any debris that may be present in the folds. Dispose of all brushes, sponges, polyethylene sheeting and tape as asbestos waste, vacuum surfaces in the immediate area including the floor.
- 26) Wash hands and face at the completion of the work (before leaving the work area). Damp wipe the respirator and store in a proper place.
- 27) Clean all non-disposable tools and items (before leaving the work area).
- 28) Dispose of protective clothing and spent respirator filter cartridges as asbestos waste.
- 29) Shower at the completion of the work if contamination is suspected, before leaving work.

G-15 *Emergency Spill or Repair Response - Type 2 Work*

Emergency Response refers to the cleanup of a limited, unintentional spill, of asbestos-containing insulation or spray application, which must be responded to immediately. An emergency would normally be the result of damage to a mechanical system with asbestos-containing thermal insulation or a water leak affecting a fireproofing or acoustic spray application where the friable material has dislodged. Typical examples include vandalism in a public area, or spillage due to water leaks (i.e. roof leak through fireproofing).

THIS PROCEDURE IS TO BE USED FOR EMERGENCY SITUATIONS ONLY AND NOT AS A RESULT OF POOR PLANNING.

Approval must be obtained from the Asbestos Plan Manager or an assigned designate prior to using the Emergency Repairs procedure.

Work Procedure:

- 1) Perform the work during off-hours if at all possible.
- 2) Clear the immediate area of all personnel not assigned to the work.
- 3) Insure that trained personnel are available to perform the work.
- 4) Building-staff are not to attempt a cleanup. Report to the Asbestos Plan Manager or an assigned designate after vacating the immediate area.
- 5) Assemble all supplies and equipment necessary for performing the work. Do not use Building Equipment for the clean up.
- 6) If possible, disable the mechanical ventilation system in the vicinity of the work area.
- 7) Separate the work area from the rest of the workplace using rope barriers. The extent of the work area will depend on the amount of work to be performed, potential for fibre release and the height of the work above floor level.
- 8) Identify the work area with clearly visible warning signs.
- 9) Wear a respirator appropriate for the work being completed and that is approved for use with asbestos.
- 10) Wear disposable full body type coveralls that will not permit penetration by asbestos fibres and is equipped with tight fitting cuffs including head hood and rubber boots or disposable shoe covers, safety glasses with side shields and impermeable gloves.
- 11) Do not use compressed air.
- 12) Do not eat, drink, chew or smoke in the work area.
- 13) Clean any loose or fallen material in the immediate vicinity of the spill by using a HEPA filtered vacuum cleaner or by damp wiping. Work from outside the spill area

to the centre. Do not walk through spill material.

- 14) Only perform work necessary to alleviate the immediate hazard.
- 15) If additional disturbance of ACM is possible during the cleanup then place a drop sheet of rip-proof polyethylene sheeting on the floor of the work area to catch any dust or debris.
- 16) For the limited removal of thermal insulation, carefully cut the outer layer of thermal insulation while spraying a mist of amended water on the section being worked on. Thoroughly wet ACM using garden sprayer equipment.
- 17) Remove wetted asbestos material and covering jackets in small sections directly into a 6-mil labelled polyethylene bag.
- 18) Maintain asbestos in wet condition at all times during removal and or handling operations. Dispose of material in waste bag and seal tightly.
- 19) Clean surfaces exposed by asbestos removal by brushing and wet wiping. Ensure that all surfaces of piping and other equipment are clean of all residues.
- 20) Immediately after removal of insulation, clean all surfaces and equipment within the work area, including polyethylene drop sheet, using HEPA vacuum or by damp wiping.
- 21) Seal all surfaces of pipe and exposed ends of the insulation or other remaining equipment with a suitable encapsulant.
- 22) Refer to other assigned procedures should more extensive work be required.
- 23) Remove polyethylene floor covering, fold inward, and place in 6-mil polyethylene waste bags. Seal bags tightly and dispose of as asbestos waste.
- 24) Before leaving the work area, decontaminate protective clothing (including boots) and dispose of as asbestos waste.
- 25) Clean all non-disposable tools and items (before leaving the work area).
- 26) Wash hands and face at the completion of the work (before leaving the work area). Damp wipe the respirator and store in a proper place.
- 27) Dispose of protective clothing and spent respirator filter cartridges as asbestos waste.
- 28) Shower at the completion of the work if contamination is suspected.

APPENDIX H
REASSESSMENT OF ACM

REASSESSMENT OF ACM

Upon completion of Reassessment, fill out the following form in its entirety and file in this facility's AMP and survey.

Building Name/Address: _____

Dates of Reassessment: _____

Organization completing Asbestos Reassessment:_____

Name of surveyor:_____

Name of surveyor: _____

Others present: _____

Signature of surveyor:_____

Signature of surveyor: _____

Summary of findings: (If no deterioration noted, indicate here – Specifically indicate only areas requiring action).

[illegible]

Room or Location	Material	Comments regarding condition – Disturbed/Undisturbed (if other, explain)	Action Required

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- .2 Read this Section in conjunction with the following Sections:
 - .1 Section 03 20 00: Concrete Reinforcing
 - .2 Section 03 30 00: Cast-In-Place Concrete
 - .3 Section 03 35 00: Concrete Floors and Finishing

1.2 **REFERENCES**

- .1 Conform to the latest edition of the following:
 - .1 CAN/CSA-S136 - North American Specification for the Design of Cold-Formed Steel Structural Members
 - .2 CSA-A23.1 - Concrete Materials and Methods of Concrete Construction
 - .3 CSA O121 - Douglas Fir Plywood
 - .4 CSA S269.1 - Falsework and formwork
 - .5 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **SUBMITTALS**

- .1 Shop Drawings: Submit Shop Drawings showing spacing of form ties for architectural concrete walls in accordance with Section 01 33 00. Show size of tie hole, plastic plug and plug recess.

1.4 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Store materials on Site in a manner to prevent damage thereto. Protect from the weather. Comply with CSA-A23.1.
- .2 Protect Work of this section from damage. Protect other Work from damage resulting from this Work. Replace damaged Work which cannot be satisfactorily repaired.

1.5 **TOLERANCES**

- .1 Construct forms to produce plumb and level concrete, and true to linear building lines. Maximum variations (not accumulative) shall conform to CSA-A23.1.
- .2 A permitted variation in one part of the construction or in one section of the Specification shall not be construed as permitting violation of more stringent requirements for any other part of the construction, or in any other Specification section.

2 Products

2.1 **MATERIALS**

- .1 Forms

- .1 Plywood: CSA O121, G1S; Douglas fir plywood, sheets as large as practical, exterior grade, waterproof glue, edges sealed with oil-based sealer.
- .2 Prefabricated steel forms: CAN/CSA S136-M; free of irregularities, dents, sags, rust, and materials that can discolour concrete finish.
- .3 Used formwork may be used for surfaces which will be concealed.
- .2 Form ties: Adjustable snap ties, formed to break 25 mm from surface of concrete after form removal, with a minimum working strength of 13 kN. Do not use wire ties.
- .3 Falsework materials: To CSA S269.1. Where patented accessories, fabricated forms, shoring or scaffolding units are to be used, follow manufacturer's instructions for load carrying capacity and bracing.
- .4 Plywood form liner: Medium density overlaid plywood marked "COFI Form Plus"; "Ultraform" by Richmond Plywood Corporation, or "Pourform 107" by Ainsworth Lumber Company Ltd.
- .5 Form tape: Pressure sensitive plastic film.
- .6 Form ties: Threaded internal disconnecting, spreader type, adjustable in length, minimum working strength of 13 kN when fully assembled. Ties to have maximum break-back of 38 mm from concrete surface. Ties shall incorporate removable tapered plastic spreader cones, with a setback of 38 mm. (Taper of spreader shall match taper of tie hole plugs).
- .7 Tie hole plugs: Plastic set back plugs, grey to match concrete, 38 mm setback, to fit tightly into tie holes. Include for tie hole plug quantity on the basis of 750 mm each way plug spacing pattern.
- .8 Bar type waterstops: Preformed bentonite and butyl rubber-based waterstop, "Waterstop RX 101" (others, see above) by DRE Industries Inc. or approved equivalent. Adhesive for concrete, steel, or PVC: water based "WB-Adhesive" by DRE Industries Inc. or approved equivalent.
- .9 Rubber waterstops: "Durajoint" by Sika, hot fused joints, type 4B, complete with factory welded corner and intersecting pieces.
- .10 Bar type waterstops: Preformed water-swelling elastic rubber, "Adeka Ultraseal MC-2010M" as distributed by Form and Build Supply Inc. Securement to substrate shall be either adhesive or concrete nail with packing depending on substrate, as recommended by waterstop manufacturer.
- .11 Tubular forms: Sonoco Products Ltd. "Sonotube" spirally wound fibre forms free of dents and other irregularities, treated internally with release material.
- .12 Tubular forms: Newark Paperboard Products "Poli-NewForm" fibre forms with seamless plastic liner.
- .13 Chamfer strips: 13 x 13 mm triangular fillets milled from clear, straight-grain pine, surfaced each side, or extruded vinyl type.
- .14 Formwork release agent: Imperial Oil "Filmo No 40", Goodco "Noxcrete", W.R. Meadows "Duogard", Euclid "Super Slip", CPD Chemical Form Release Agent or Dayton Superior "Clean-Strip (J-1)". (For formed concrete Work in contact with the soil, use a material that does not alter sulphate resistant qualities of the concrete).
- .15 Dovetail anchor slots: Minimum 0.6 mm thick Z275 galvanized steel with temporary insulation fill in slots; slots sized to receive dovetail anchors specified in Section 04 22 00.

3 Execution

3.1 **FORMWORK**

- .1 Construct formwork in accordance with CSA-A23.1, except where shown otherwise. Do not leave lumber in concrete.
- .2 Construct falsework in accordance with CSA S269.1.
- .3 Obtain Consultant's approval in writing for use of earth cuts as forms for vertical sides of footings and other Work not exposed to view. If approved, hand trim sides and bottoms and remove loose earth before placing concrete.
- .4 Assume full responsibility for the complete design and engineering of formwork including shoring and bracing to resist loads due to wet concrete, forms, wind, etc., and other forces arising from use of equipment to place concrete.
- .5 Do not set shoring and scaffolding on frozen subgrade. Continuously monitor safety of scaffolding.
- .6 Apply formwork release agent by spray in accordance with manufacturer's recommendations. Ensure surfaces of form receive a uniform coating.
- .7 Align form joints and make watertight. Keep form joints to a minimum.
- .8 Form for depressions, recesses, chases, reglets, anchorages and keys required in concrete.
- .9 Set floor screeds with true and straight top edge to proper elevation.
- .10 Form 13 mm x 13 mm minimum chamfered edges on exposed concrete corners unless shown otherwise. Set chamfer strips to achieve a smooth finish and consistent chamfer size throughout length of concrete.
- .11 Construct forms for concrete exposed in the finished Work to achieve the following:
 - .1 Grout-tight forms at corners, panel joints, recesses, arrises and at construction joints to prevent cement paste from leaking.
 - .2 Accurate alignment of concrete surfaces.
 - .3 Surfaces without indentations other than those shown.
 - .4 Sharp and straight corners.
- .12 Use full-size contact form sheeting panels wherever possible. Carefully install contact surfaces of formwork to produce neat and symmetrical joint patterns. Joints shall be either vertical or horizontal and, where possible, stagger so as to maintain structural continuity. Back vertical joints solidly and nail edges of abutting sheets to same stud. Likewise solidly back horizontal joints. Take care to ensure adjacent form panels fit accurately, tight and flush. Use straight lumber.
- .13 Align forms to ensure no visible defects appear on finished Work.
- .14 Locate wall form ties in accordance with reviewed Shop Drawings; align on a particular member both vertically and horizontally. Arrange reuse of forms so tie holes are also reused. Tighten form ties, particularly at corners.
- .15 Form slab soffits using full size panels where possible. Keep number of smaller size panels to a minimum.

- .16 Take particular care in forming corners and openings. Ensure formwork is tight and braced so no movement occurs.
- .17 Cleaning and tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.2 **CONSTRUCTION JOINTS**

- .1 Form construction joints where required and where shown. Construction joints shall conform to CSA-A23.1.
- .2 Form 50 mm x 100 mm bevelled shear keys full length on construction joints, unless detailed otherwise.

3.3 **WALL CONTROL JOINTS**

- .1 Form "vee" groove control joints to details shown.

3.4 **INSTALLATION OF BAR TYPE BENTONITE WATERSTOPS**

- .1 Install continuous waterstops in all pour joints (i.e. wall-to-slab joint) of a concrete structure that is waterproofed by a bentonite clay waterproofing system or as shown.
- .2 Brush clean debris, dirt, and rocks from dry concrete surface. Verify surfaces are dry.
- .3 Ensure proper waterstop placement for sufficient concrete coverage. Install waterstop along interior side of the outer row of steel reinforcement to allow for minimum concrete cover.
- .4 Apply adhesive by roller or brush to 125 microns thick x width of waterstop to prepared concrete surfaces.
- .5 Allow adhesive to dry ten to fifteen minutes or until adhesive appears black in colour.
- .6 Remove release paper from waterstop and press firmly into dried adhesive. Apply pressure for minimum fifteen seconds to ensure adhesion.
- .7 Butt coil ends of waterstop together to form continuous installation. Do not overlap ends.

3.5 **INSTALLATION OF RUBBER WATERSTOPS**

- .1 Using a trowel, finish smooth that portion of concrete where waterstop is to be placed before concrete has set.
- .2 Install swelling type rubber waterstops in accordance with manufacturer's directions. Join edges minimum 50 mm.
- .3 Fix the waterstop close up against the substrate, without leaving any gap between the surface and the waterstop.

3.6 **STRIPPING FORMWORK**

- .1 Strip (regular) formwork in accordance with CSA-A23.1. Forms may be removed any time after three days from date of placing concrete or otherwise as directed by Consultant. (Remove plastic spreader cones from architectural form ties in preparation for installation of tie hole plugs or grouting application).
- .2 Strip formwork for soffits of beams, slabs and other spanning members which support weight of concrete only when concrete has reached 70% of its compressive strength, but

under no circumstances shall formwork be stripped before seven days after pouring. Reshore concrete for fourteen additional days concurrently.

- .3 Strip formwork for beam and slab sides and other concrete not supporting weight of concrete only when no damage will result from stripping operations.
- .4 Strip fibre forms off architectural concrete two days after pouring, using power operated saw. To strip form, set power saw blade slightly less than thickness of the form, make two vertical cuts and remove form. Then, using a broad bladed tool, carefully pry form off with short strokes by pushing handle toward column. Exercise extreme care so not to mar concrete surface. After stripping, replace form halves on column and wire in place to protect column during construction. Leave around columns until after scaffolding and other formwork have been removed at end of construction to ensure column protection.
- .5 Be responsible for the safety of structure, both before and after removal of forms until concrete has reached its specified twenty-eight day compressive strength.
- .6 Take particular care when removing forms to ensure no damage occurs at corners, arris and the like.
- .7 To help avoid colour variations in architectural concrete, ensure length of time between concrete placing and form removal is approximately the same for each portion of Work.
- .8 In hot weather, wood forms remaining in place are not adequate for curing purposes. Instead, loosen forms as soon as practical without damage to the concrete, and run a water sprayer such as a soil soaker hose on the inside face of forms so as to keep concrete moist. In any case, loosen forms only following time frames specified for stripping.
- .9 In cold weather, defer removal of formwork or replace formwork with insulation blankets, to avoid thermal shock and consequent cracking of concrete surface.
- .10 Install tie hole plugs immediately following removal of spreader cones. Install to a snug fit, maximum setback from concrete surface as specified.
- .11 When concrete is dry, install temporary polyethylene rope in reglets to prevent contamination of same.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

.1 Read this Section in conjunction with the following Sections:

.1 Section 03 11 00: Concrete Forming

.2 Section 03 30 00: Cast-In-Place Concrete

.3 Section 03 35 00: Concrete Floors and Finishing

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

.1 CSA-A23.1 - Concrete Materials and Methods of Concrete Construction

.2 CAN/CSA G30.18-M - Billet-Steel Bars for Concrete Reinforcement

.3 OPSS 905 - Ontario Provincial Standard Specification Construction Specification for Steel Reinforcement for Concrete

.4 OPSS 1443 - Ontario Provincial Standard Specification Material Specification for Organic Coatings for Steel Reinforcement

.5 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **SUBMITTALS**

.1 Shop Drawings

.1 Submit Shop Drawings in the form of bar lists and placing drawings for review in accordance with Section 01 33 00.

.2 Draw placing drawings to a scale not smaller than 1:50 and include plans, elevations, sections and details. Drawings shall be in accordance with the latest edition of Reinforcing Steel Institute of Canada's (RSIC) "Manual of Standard Practice".

.3 Show openings in walls as to position and size. Cooperate with trades requiring openings to ascertain necessary information.

.4 Show embedded items including conduits.

.2 Test Reports

.1 Submit certification from reinforcing steel manufacturer confirming compliance of supplied Products to specified CSA standard.

1.4 **PRODUCT DELIVERY, STORAGE AND HANDLING**

.1 Store materials on Site in a manner to prevent damage thereto. Protect from the weather. Comply with CSA-A23.1, clause 9.

- .2 Protect Work of this section from damage. Protect other Work from damage resulting from this Work. Replace damaged Work which cannot be satisfactorily repaired.

1.5 TESTS OF REINFORCING

- .1 Refer to "Quality Control" in Section 01 10 00 – General Requirements.

2 Products

2.1 MATERIALS

- .1 Reinforcing steel: Conforming to CAN/CSA G30.18-M, Grade 400 (350).
- .2 Mesh reinforcing: Conforming to CSA G30.5-M, flat sheets (rolls not acceptable).
- .3 Chairs and spacers: As manufactured by Drummond and Reeves Ltd., Acrow Richmond, Superior Concrete Accessories Ltd. or Max Frank GmbH & Co., of sufficient strength to rigidly support weight of reinforcement and construction loads.
 - .1 Use non-corrosive type over metal floor deck.
 - .2 Use chairs with flat plate base for reinforcing over rigid insulation.
- .4 Epoxy grout for dowels/rebars: conforming to ASTM C-881, 100% solids high modulus high strength epoxy gel adhesive; J-51 by Dayton Superior or Anchor Fix 3/Sikadur 35 by Sika Canada Inc

2.2 STRUCTURAL SYNTHETIC MACRO FIBER REINFORCEMENT

- .1 Polypropylene/polyethylene synthetic fiber complying with ASTM C 1116, minimum 2 inch length, aspect ratio 50 to 90. Contractor shall submit to specifier documentation from fiber manufacturer that their proposed fiber dosage will provide a minimum R_{e3} (R_{T150}) as specified on contract drawings or designed by fiber manufacturer per ASTM C 1609 in the specified concrete.
 - .1 Basis of Design:
 - .1 Euclid Chemical Company (The); Tuf-Strand SF;
www.euclidchemical.com
 - .2 Or approved equal
 - .2 Fiber manufacturer shall have ISO 9001 certification

2.3 CONCRETE MIXES

- .1 Use Structural Synthetic Macro Fiber Reinforcement for slabs-on-grade, toppings, and shotcrete at dosage rate documented by fiber manufacturer to meet or exceed the R_{e3} value specified above.

2.4 FABRICATION OF REINFORCING STEEL

- .1 Fabricate reinforcing steel in accordance with reviewed Shop Drawings.
- .2 Bend steel cold; no heating will be permitted. Fabricate reinforcement conforming to CSA-A23.1, Clause 12.
- .3 Ship bundles of reinforcing steel, clearly identified in accordance with reviewed bar lists.

3 Execution

3.1 **EXAMINATION**

- .1 Inspect formwork to ensure it has been completed and adequately braced in place before commencing to place reinforcement.

3.2 **PLACING OF REINFORCING STEEL**

- .1 Place reinforcing in accordance with CSA-A23.1, Clause 12, and reviewed placing Drawings. Support with chairs or spacers in as close a spacing as possible to prevent displacement of reinforcement from intended bar position, before and during placing of concrete. Pieces of block, wood, etc. are not acceptable as chairs and spacers.
- .2 Before placing, remove all loose scale, dirt, concrete residue from previous pours, oil or other coatings, which would reduce bond.
- .3 Turn the ends of tie wire towards the interior of the concrete.
- .4 Do not eliminate or displace reinforcement to accommodate hardware to be embedded in concrete.
- .5 Replace kinked and bent bars not called for on Drawings.
- .6 Bars shall be in lengths as long as possible. Where bars are joined, lap at least the length required by CSA-A23.1 unless shown otherwise.
- .7 Lap wire mesh sections at least 150 mm and wire together securely.
- .8 Unless shown otherwise on Drawings, provide reinforcing to housekeeping pads as follows:
 - .1 100 mm thick pad: 10M at 300 mm o.c. each way middle layer.
 - .2 150 mm thick pad: 15M at 300 mm o.c. each way middle layer.

3.3 **STRUCTURAL SYNTHETIC MACRO FIBER REINFORCEMENT**

- .1 Structural Synthetic Macro Fibers: Add to concrete and mix for 3 – 5 minutes to provide uniform distribution.
- .2 For broomed surfaces, broom once in one direction only.

3.4 **ANCHORING OF DOWELS OR REINFORCING BARS**

- .1 Drill holes in accordance with grout manufacturer's printed directions.
- .2 Blow out dust and debris from holes with compressed air.
- .3 Dispense grout cartridges with a dispensing gun, filling anchoring holes.
- .4 Insert dowel or reinforcing bar, turning slowly during insertion. After insertion, holes should be full of epoxy.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- .1 Read this Section in conjunction with the following Sections:
 - .1 Section 03 11 00 - Concrete Forming
 - .2 Section 03 20 00 - Concrete Reinforcing.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners
- .2 ASTM A563M - Carbon and Alloy Steel Nuts [Metric]
- .3 ASTM C260 - Specification for Air-Entraining Admixtures for Concrete
- .4 ASTM C881 - Specification for Epoxy-Resin-Base Bonding System for Concrete
- .5 ASTM C494 - Specification for Chemical Admixtures for Concrete
- .6 ASTM C920 - Standard Specification for Elastomeric Joint Sealants
- .7 ASTM C 1116 - Standard Specification for Fiber-Reinforced Concrete
- .8 ASTM C 1550 - Standard Test Method for Flexural Toughness of Fiber Reinforced Concrete (Using Centrally Loaded Round Panel)
- .9 ASTM C 1579 - Standard Test Method for Evaluating Plastic Shrinkage Cracking of Restrained Fiber Reinforced Concrete (Using a Steel Form Insert)
- .10 ASTM C 1609 - Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete
- .11 CAN/CSA-A3001 - Cementitious Materials for Use in Concrete
- .12 CSA-A23.1-14 - Concrete Materials and Methods of Concrete Construction
- .13 CSA-A23.2 - Methods of Test for Concrete
- .14 CSA-G40.20/G40.21-M - General Requirements for Rolled or Welded Structural Quality Steel

- .15 CISC/CPMA 2.75 - Canadian Institute of Steel Construction Standard 2.75 - A Quick Drying Primer for Use on Structural Steel
- .16 CAN/CSA G164-M - Hot-Dip Galvanizing of Irregularly Shaped Articles
- .17 SDI/ANSI C - 2011 - Standard for Composite Steel Floor Deck – Slabs
- .18 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 The flooring Contractor shall supply the concrete as per CSA A23.1-14.
- .2 Store materials on Site in a manner to prevent damage thereto. Protect from weather. Comply with CSA-A23.1-14, Clause 5.1.
- .3 Protect Work of this section from damage. Protect other Work from damage resulting from this Work. Repair damaged Work to the satisfaction of Consultant at no cost to Owner.

1.4 **ENVIRONMENTAL CONDITIONS**

- .1 Conform to CSA-A23.1-14, Clause 7.4.
- .2 During cold weather, Provide temporary heating and enclosures required. Mix, place and protect concrete in accordance with CSA-A23.1-14, Clause 7.4.
- .3 Designate areas for environmentally responsible disposal of excess concrete and truck washout.

1.5 **TOLERANCES**

- .1 Concrete in place shall be plumb, level and true to linear building lines. Maximum variations (not accumulative) shall conform to CSA-A23.1-14, Clause 6.4.
- .2 A permitted variation in one part of the construction or in one section of the Specification shall not be construed as permitting violation of the more stringent requirements for any other part of the construction, or in any other Specification section.

1.6 **INSPECTION AND TESTS**

- .1 Refer to “Quality Control” in Section 01 10 00 – General Requirements.
- .2 Materials and concrete Work will be inspected and tested for conformance to CSA-A23.1-14 and to Specifications by an independent inspection/testing company selected and paid for by the Contractor, approved by the Owner.
- .3 Tests include the following:
 - .1 Obtaining certification of cement.
 - .2 Tests of aggregates.
 - .3 Test for setting mixes of concrete and design of mixes.
 - .4 Concrete cylinder test. Three cylinders from each day's placement for each 110 m³ of concrete or for each 30 m³ of concrete placed in small amounts on successive days.

- .5 Air content test and slump test which will be made on same batch of concrete from which test cylinders are made.
- .4 Tests will be made in accordance with CSA-A23.2.
- .5 Inspection/testing company's reports of tests will be forwarded to Consultant and Contractor with an opinion or reason for any abnormalities noted thereon.
- .6 Inspection/testing company will inspect and review placement of reinforcing steel bars and verify size of reinforcing in accordance with reviewed shop and placing Drawings prior to concrete placement. Any and all irregularities may deem installation to be unacceptable and must be rectified prior to concrete placement. Reports of inspection will be forwarded by the inspection/testing company to Consultant and Contractor.

1.7

SUBMITTALS

- .1 Product catalogues: Submit as Shop Drawings, up-to-date catalogue of Products proposed for use under this section in accordance with Section 01 33 00. Include the following in submittal:
 - .1 Specified admixtures
 - .2 Column anchor bolts
 - .3 Premoulded joint filler
 - .4 Joint sealant and primer
 - .5 Sealant
 - .6 Anchor bolt protection
 - .7 Bonding agent
- .2 Concrete mix design: Submit concrete Supplier's latest statistical analysis of all concrete mixes to be used on this Project.
- .3 Concrete producer's certification: Certification that plant, equipment and materials to be used in concrete comply with requirements of CSA-A23.1-14.
- .4 Contractor's quality control: Proposed quality control procedures for hot or cold weather conditions, for ensuring correlation of concrete mix with strength or exposure classification for area of placement, and for finishing and curing methods.
- .5 Anchor bolt setting diagrams: Submit detailed Drawings for anchor bolt setting.

1.8

RECORDS

- .1 Keep a written record of the following:
 - .1 Concrete placements, showing location of placement, date of placement and cubic yards or metres of concrete placed.
 - .2 Signed trip ticket for each truck.
 - .3 Ambient air temperature and unusual occurrences during each placement.
- .2 Permit inspection of records by Consultant at any time. At completion of Work, submit a summary of such data in six copies to Consultant.

2.1 **MATERIALS**

- .1 Select one Product from that specified under each material listing. Source liquid admixtures for concrete from one manufacturer.
- .2 Portland cement: CAN/CSA-A3001 Normal, Type GU Portland Cement, Moderate Type MSb - Mild Exposure, or High Early Strength Type HE or Sulphate Resistant Type HS.
- .3 Portland cement: Conforming to CAN/CSA-A3001.
 - .1 Sulphate soil conditions: Sulphate resistant, type HS portland cement, or type GU portland cement blended to specified proportion with cementitious hydraulic slag to CAN/CSA-A3001-03, as specified for severe case, Table 3 of CSA-A23.1-14.
 - .2 Normal conditions: Normal, type GU portland cement.
- .4 Cementitious hydraulic slag: Conforming to CAN/CSA-A3001.
- .5 Coarse aggregate: Conforming to CSA-A23.1-14, Clause 4.2.3.4 and Table 11, Group I, 40-5 mm for slabs on grade, 20-5 mm for other slabs, and 9 mm maximum aggregate size for concrete fill on concrete filled steel stair treads and landings. Coarse aggregate to be 100% crushed, in cubular size.
- .6 Fine aggregate: Conforming to CSA-A23.1-14, Clause 4.2.3.3 and Table 10.
- .7 Water: Conforming to CSA-A23.1-14, Clause 4.2.2.
- .8 Formwork: Furnish formwork in accordance with Section 03 11 00.
- .9 Waterproofing admixture: Euclid, "Eucon Vandex AM 10", Everdure "Caltite", Sika "Sika 1 +/ViscoCrete 2100", Xypex "C-500 2%" or Kryton International Inc. "Krystol Internal Membrane (KIM) system", Master Builders Solutions (Formerly BASF Corporation) "MasterLife 300D".
- .10 Air entraining admixture: Conforming to ASTM C260:
 - .1 Master Builders Solutions (Formerly BASF Corporation) "MasterAir" Series
 - .2 Euclid "Airextra"
 - .3 Grace "Darex AEA EH" or "Darex AEA ED"
 - .4 Axim "Catexol AE260"/"Catexol AE360" (for low slump concrete)
- .11 Wet curing: Water conforming to CSA-A23.1, clause 4.2.2, clear and entirely free from any elements which might cause staining of concrete, and geosynthetic cloth minimum 0.1 mm thick polyethylene film) complying with maximum allowable moisture loss requirements of ASTM C156.
- .12 Water reducing admixture: Conforming to ASTM C494 Type A:
 - .1 Master Builders Solutions (Formerly BASF Corporation) "MasterPozzolith" Series or "MasterPolyheed" Series
 - .2 Euclid "WR 75"
 - .3 Grace "WRDA" series or "Zyla" series
 - .4 Axim "Catexol 1000N"

- .13 Retarding admixture: Conforming to ASTM C494, Type B or Type D:
 - .1 Master Builders Solutions (Formerly BASF Corporation) "MasterSet R" Series or "MasterSet DELVO" Series
 - .2 Approved equal
- .14 Accelerating admixture: Conforming to ASTM C494, Type C or Type E:
 - .1 Master Builders Solutions (Formerly BASF Corporation) "MasterSet AC 534" or "MasterSet FP 20"
 - .2 Approved equal
- .15 High-range water-reducing admixture: Conforming to ASTM C494, Type F:
 - .1 Master Builders Solutions (Formerly BASF Corporation) "MasterGlenium" Series or "MasterRheobuild 1000"
 - .2 Approved equal
- .16 Workability-retaining admixture: Conforming to ASTM C494, Type S:
 - .1 Master Builders Solutions (Formerly BASF Corporation) "MasterSure Z 60"
 - .2 Approved equal
- .17 Corrosion inhibiting admixture: Conforming to ASTM C494, Type C, 30% plus or minus 2% calcium nitrite:
 - .1 Euclid "Eucon CIA" at the rate of 10 litres/m³ (15 litres/m³) of concrete
 - .2 Grace "DCI" or "DCI-S" at the rate of 10 litres/m³ (15 litres/m³) of concrete
 - .3 Axim "Catexol 1000 CNCI" at the rate of 10 litres/m³ (15 litres/m³) of concrete
 - .4 Master Builders Solutions (Formerly BASF Corporation) "MasterLife CI 30" at the rate of 10 litres/m³ (15 litres/m³) of concrete.
- .18 Shrinkage-reducing admixtures: Conforming to ASTM C 494, Type S:
 - .1 Master Builders Solutions (Formerly BASF Corporation) "MasterLife SRA" Series or "MasterLife CRA 007"
 - .2 Approved equal.
- .19 Alkali-silica reaction-inhibiting admixtures: Conforming to ASTM C 494, Type S. Shall contain a nominal lithium nitrate content of 30 percent.
 - .1 Master Builders Solutions (Formerly BASF Corporation) "MasterLife ASR 30".
 - .2 Approved equal.
- .20 Viscosity-modifying admixture: Conforming to ASTM C 494:
 - .1 Master Builders Solutions (Formerly BASF Corporation) "MasterMatrix" Series
 - .2 Approved equal

- .21 Synthetic fibers: Shall conform to ASTM C 1116/C 1116M, Type III.
 - .1 Macrosynthetic fibers: Shall have an equivalent flexural strength ratio ($R_{e,3}$) of [] percent when tested in accordance with ASTM C 1609/C 1609M.
 - .1 Dosage shall be as recommended by the manufacturer or as shown on a plan.
 - .1 Master Builders Solutions (Formerly BASF Corporation) "MasterFiber MAC" Series.
 - .2 Euclid Chemical Company "TUF-STRAND SF"
 - .3 Approved equal
- .22 Anchor bolts: To meet specified requirements of ASTM A307, Section 1.3. Provide suitable nuts and washers to meet specified requirements of ASTM A563M, Table 11 (hot-dip galvanized to CAN/CSA G164-M).
- .23 Anchor bolt protection: Clean, non-soluble, rust inhibitive grease and 0.254 mm thickness polyethylene wrapping.
- .24 Flowable construction grade grout: Pre-mixed, without aggregate fillers, non shrink, flowable type; complete with forms for flowing in place:
 - .1 Euclid "Euco NS"
 - .2 W.R. Meadows "CG-86"
 - .3 Sika "M-Bed Standard" or "Sika Grout 212"
 - .4 Master Builders Solutions (Formerly BASF Corporation) "MasterFlow 100" (formerly) "Construction Grout"
 - .5 CPD "Non-Shrink Construction Grout"
 - .6 Dayton Superior "1107 Advantage Grout"
 - .7 Five Star Products "FSP Construction Grout"
- .25 Epoxy grout: Premixed, non-shrink, consisting of thermosetting resin base, with inert fillers, with minimum seven-day compressive strength of 10,000 psi, suitable for use on dry or damp surfaces:
 - .1 Dayton Superior "J-54 Sure-Grip Epoxy Grout"
 - .2 Euclid Chemical Company "E3-G"
 - .3 Sika Chemical Company "Sikadur 42 Grout Pak"
 - .4 W.R. Meadows, Inc. "EG-96 Plus"
 - .5 Five Star Products "DP Epoxy Grout"
- .26 Bonding agent: Conforming to ASTM C881:
 - .1 Sika Chemical "Sika-Dur Hi-Mod"
 - .2 Euclid "452LV or MV"
 - .3 W.R. Meadows "Resi-Weld 1000"

- .4 Master Builders Solutions (Formerly BASF Corporation) "MasterEmaco ADH 326" (formerly "Concresive Liquid LPL")
- .5 CPD "Epoocrete (Hi-Mod)"
- .6 Dayton Superior "Resi-Bond (J-58)"
- .7 Five Star Products "Bonding Adhesive"
- .27 Sealant for exposed V-joints: Grey in colour:
 - .1 Sika "RC-1"
 - .2 Euclid "Eucolastic I"
 - .3 Tremco "Vulkem 116"
 - .4 Master Builders Solutions (Formerly BASF Corporation) "MasterSeal NP1" (formerly Sonolastic "NP-1")
- .28 Sealant - exterior immersion conditions:
 - .1 Vulkem 171 primer and two-part chemical curing, pour grade Vulkem 245 polyurethane sealant.
 - .2 Master Builders Solutions (Formerly BASF Corporation) MasterSeal P 173 primer and MasterSeal SL2 sealant.
- .29 Asphalt coating (for portion of steel columns embedded in, or located below, concrete): Henry "110-14" or approved equivalent, including primers recommended by coating manufacturer.
- .30 Bond breaker coating: Dayton Superior "Sure-Lift WB (J5)" or Cresset "Crete-Lease 20-VOC" by Form and Build, two-coat application, brush applied.
- .31 High density insulation: Dow Styrofoam "HI-40" or Owens-Corning "Foamular 400" unless shown or noted otherwise.
- .32 Steel angles: New material conforming to CSA-G40.20-M/G40.21-M, Grade 300W cleaned and primed with primer conforming to CISC/CPMA 2.75 (hot-dip galvanized in accordance with CAN/CSA G164-M requirements).
- .33 Epoxy capsule type anchors: Hilti "HVA Adhesive Anchor", two-part, threaded steel stud and epoxy adhesive filled capsule anchoring system. Install per manufacturer's recommendations.
- .34 Premoulded joint filler: Rigid grade, closed cell polyethylene or PVC foam, 6 mm thick, unless shown or noted otherwise, conforming to ASTM D1752, Type 1:
 - .1 W.R. Meadows "Deck-O-Foam" pre-scored, conforming to ASTM 1622 and ASTM 3575.
 - .2 CPD "Closed Cell Foam Joint Filler", conforming to ASTM D1056 and ASTM D1667.
- .35 Premoulded joint filler adhesive: For securing joint filler to abutting adjacent structures, as recommended or supplied by manufacturer of joint filler used.
- .36 Backer rod type "A": "Spal-Pro Rod" by Metzger-McGuire Co. or "CRL Retainer Spline" by C.R. Laurence, Mississauga, Ontario. Use with epoxy sawcut joint sealant for floor

slab on grade only. Backer rod size to be slightly greater than joint width to ensure a snug, secure fit.

- .37 Backer rod type "B": Extruded closed cell, circular polyethylene foam, sized 25% larger than sawcut joint. Use with standard joint sealant for sawcuts in concrete on metal deck.
- .38 Standard joint sealant: Two-component chemically reactive polyurethane-modified conforming to ASTM C920, Type M, Grade NS, Class 25, grey. Use one of the following:
 - .1 Euclid "Eucolastic II"
 - .2 Sika "Sikaflex 2C NS/SL"
 - .3 Tremco "Vulkem 245"
 - .4 Sonneborn "Sonolastic SL2"
- .39 Stair nosings for concrete stairs: American Safety Tread Co./Safety Stair Products "FA-311D", IKG Industries "Mebac C-3E" or Wooster Products equivalent.
- .40 Stair nosings for concrete filled steel pan stairs: American Safety Tread Co./Safety Stair Products, "FAL311", IKG Industries Mebac "A-3E" or Wooster Products equivalent.
- .41 Concrete topping to create slopes: Stabilized concrete aggregate, lightweight insulating concrete conforming to ASTM C332, Group I, as manufactured by Specialty Vermiculite Canada Corp. or approved equivalent. Slip sheet: 6 mil polyethylene sheet.

2.2 FLOOR FINISHES SCHEDULE

- .1 Type 1
 - .1 Hand screed
 - .2 Power steel trowel finish
 - .3 Water cure

2.3 CONCRETE MIX PROPORTIONS

- .1 Ready-mixed concrete and concrete proportions to be in accordance with CSA-A23.1-14, Clause 4.3.1, as per Table 5, Alternative (1) Performance and as follows:
 - .1 Minimum allowable compressive strengths at twenty-eight days are as follows unless otherwise noted or shown.
 - .1 15 MPa: for lean concrete fill
 - .2 15 MPa: for mud slab
 - .3 35 MPa: for footings
 - .4 35 MPa: for piers, grade beams, curb and walls
 - .5 32 MPa: for slab on grade (interior)
 - .6 35 MPa: for slab on grade (exterior)
 - .7 35 MPa: for exterior aprons

- .2 Minimum cement content as per code requirement: If blended normal Portland cement/cementitious hydraulic slag is used, slag content to be not more than 25% of total volume of cement.
- .3 Slump at point of deposit: 80 mm with a maximum tolerance of plus or minus 20 mm. Not exceeding 225 mm when high-range water-reducing admixtures are used.
- .4 Keep water-cement ratio to a minimum to increase strength and durability of concrete.
- .2 Note:
 - .1 If supplementary cementing materials are used as part of the percentage of recycled content, Supplier must fill the Consultant's material information sheet template.
 - .2 Exposure classification: as defined in Table 2 of CSA-A23.1-14 and as follows, unless otherwise noted on structural drawings:
 - .1 C-1 for exterior reinforced concrete
 - .2 N-CF for interior slabs on grades
 - .3 C-1 for interior footing
 - .4 F-1 for exterior non-reinforced concrete.
 - .3 Air content for exterior concrete: conforming to CSA-A23.1-14, Clause 4.3.3, Table 4.
 - .4 Add corrosion inhibitor (to concrete mix) (to concrete mix for foundation walls only) at specified rate.
- .3 Concrete proportions for concrete to be in accordance with CSA-A23.1-14, Clause 4.3.1, and as follows:
 - .1 Minimum allowable compressive strength at 28 days: see 2.3.1.1 unless otherwise noted or shown on the drawings.
 - .2 Minimum cement content: If blended normal Portland cement/cementitious hydraulic slag is used, slag content to be not more than 25% of total volume of cement. If blended type 10 Portland cement/cementitious hydraulic slag is used, slag content to be not more than 35% of total volume of cement.

2.4 **ADMIXTURES**

- .1 Admixtures
 - .1 Add admixtures to concrete mix in accordance with manufacturer's recommendations. Have admixture manufacturer make available, at no cost, upon seventy-two hours notice, the services of a qualified, full-time field representative to assure proper use of admixtures.
 - .2 Except where specified otherwise herein, comply with CSA-A23.1-14.
 - .3 The use of calcium chloride or additional admixtures, other than that specified, is not acceptable.
- .2 MVRA Admixture

- .1 Add MVRA in accordance with manufacturer's instructions. Mix designs below 0.42 and above 0.52 to meet CSA standards may require adjustment. Consult with MVRA manufacturer.
- .2 Freshening on site with held back mix water is acceptable so long as it complies with ACI guidelines and does not exceed the original water-to-cementitious material ratio or the instructions of the Consultant.
- .3 Other admixtures are acceptable, but each must be added separately.
- .4 The following admixtures are not acceptable:
 - .1 Shrink Reducing Admixture (SRA)
 - .2 Crystalline Growth admixture

3 Execution

3.1 EXAMINATION

- .1 Confirm surfaces on which concrete is to be placed are free of frost, water, and debris before placing concrete.
- .2 Confirm that reinforcement, inserts and other built-in Work are in place and secured before placing concrete.
- .3 Prior to placement of concrete, confirm that reinforcement is secured in correct location.
- .4 Replace incorrectly fabricated reinforcement, relocate misplaced reinforcement and install omitted reinforcement before concrete is placed, as directed by Consultant. Incorrectly fabricated, misplaced or omitted reinforcement will be considered defective Work performed by this section. Establish elevations of compacted underfloor base prior to commencing Work.
- .5 Establish elevations of compacted underfloor base prior to commencing Work.

3.2 SETTING AND BUILDING-IN

- .1 Set and build into formwork anchorage devices and other embedded items required for other Work that is attached to or supported by cast-in-place concrete. Use setting Drawings, diagrams, instructions, and directions provided by Suppliers of items to be attached. Refer to CSA-A23.1-14 "Fabrication and Placement of Hardware and Other Embedded Items" for acceptable tolerances.
- .2 Advise trades well in advance of scheduled concrete placements to allow adequate time for supply of items to be built in. Have respective trades verify location of items supplied by them.
- .3 Set column anchor bolts to comply with the following tolerances:
 - .1 Tolerance of anchor bolt location: Conform to CSA-A23.1-14, Clause 6.7.
 - .2 Allowable anchor bolt height tolerance: To within plus or minus 12 mm maximum.
 - .3 Tolerance for placing embedded items: Conform to CSA-A23.1-14, Clause 6.7.
- .4 Set bumper posts in concrete footings and fill with ram packed 20 MPa concrete. Form top of fill to a crown, smooth finish.

3.3 PLACING OF CONCRETE

- .1 Place concrete in accordance with CSA-A23.1-14, Clause 6.8.5.4.
- .2 Install sluices to limit height of free fall of concrete to 1200 mm maximum. Place concrete to prevent layering and segregation and vibrate sufficiently to ensure thorough compaction, maximum density and according to CSA-A23.1-14, Clause 6.8.5.4. Hand spade concrete adjacent to forms.
- .3 Before placing fresh concrete against set or partially set concrete, clean surfaces to remove dirt, scum, shavings, debris, laitance, etc. On set surfaces, brush generously with a bonding compound.
- .4 Check work frequently with accurate instruments during placing of concrete.
- .5 If rubber waterstops are used, systematically and thoroughly vibrate concrete around waterstops to avoid honeycombing and voids, to ensure complete contact between waterstop and concrete.
- .6 Work concrete into complete contact with forms and embedded items. Consolidate concrete adjacent to side forms along the entire length of forms and ensure smooth surface finish after stripping of formwork.
- .7 Install sluices to limit height of free fall of concrete to 1.2 m maximum. Place concrete to prevent layering and segregation and vibrate sufficiently to ensure thorough compaction, maximum density and in accordance with CSA-A23.1, Clause 6.8.5.4. Hand spade concrete adjacent to forms with metal spatulas.
- .8 Before placing fresh concrete against set concrete at construction joints, clean surfaces to remove dirt, scum, shavings, debris, laitance, etc.; grease dowels generously at construction joints. Provide bond break between pours.
- .9 Where floor drains occur, level floor around walls and provide minimum uniform slope of 1.6 mm per 300 mm to drains if not specify otherwise on the design drawings.
- .10 Install premoulded joint filler for full depth of slabs.
 - .1 Except in areas to receive subsequent architectural floor finish, knife score joint filler through 75% of its thickness 6 mm from top of material to be set at finish floor elevation.
 - .2 Set premoulded joint filler in adhesive.
 - .3 Set scored face of filler against existing structure and ensure no adhesive is applied to top 6 mm portion which will be stripped just prior to installation of sealant.

3.4 **PLACING OF REINFORCING STEEL**

- .1 Place reinforcing steel in accordance with reviewed Shop Drawings and Section 03 20 00.

3.5 **TREATMENT OF FORMED CONCRETE**

- .1 Treat and finish exposed formed surfaces in accordance with CSA-A23.1-14, Clause 7.7.
- .2 Where top of grade beams or foundation walls will be exposed to view in the finished Work, steel trowel same to a level, smooth finish.
- .3 Treat and prepare surfaces to be waterproofed or dampproofed to a smooth and even finish free from projecting mortar, concrete fins, honeycombing and other irregularities

and with juncture of wall and footing covered with masonry mortar. Patch as required in accordance with CSA-A23.1-14, Clause 7.7.2.

3.6 **ARCHITECTURAL CONCRETE**

- .1 All concrete surfaces exposed to public view shall be "Architectural Concrete" quality in accordance with CSA-A23.1-14/A23.2, Clause 8.3 - Architectural Concrete. Finish such exposed concrete to a "light sandblast" finish in accordance with ACI 303R.

3.7 **ANCHOR BOLT PROTECTION**

- .1 Adequately protect unburied portion of anchor bolts set in concrete, including nuts and washers from rusting, corrosion and damage by a heavy coating of specified coating material; wrap in a manner to exclude moisture.
- .2 Clean surfaces to be protected to bare steel followed by the specified protection system.

3.8 **GROUTING**

- .1 Grout column base plates prior to installation of siding, precast panels or decking. Shims or double nuts alone are not structurally stable to carry the foregoing loads.
- .2 Place grout in accordance with the grout manufacturer's printed directions. Form around bases, place grout in a manner which will ensure positive bearing of the full area of the steel plate on top of the supporting surface. Thoroughly compact, leaving no voids.

3.9 **SEALANT APPLICATION**

- .1 Sealant at V -joints: Prime, prepare substrate and apply sealant full joint depth in accordance with manufacturer's printed directions. Tool to a smooth semi-concave finish. Exclude joints in surfaces to receive waterproofing treatment.

3.10 **CONSTRUCTION JOINTS**

- .1 Form construction joints. Dowels occur on construction joints unless detailed otherwise. Grease dowels generously just prior to new pour. Place bond break to adjacent slabs. Place galvanized circular steel forms as column isolation joints as shown..

3.11 **SAWCUTTING CONTROL AND CONSTRUCTION JOINTS – SOFT CUT JOINTS**

- .1 Sawcut control joints and construction joints in slab in straight lines, 3 mm wide x 35 mm deep for slab on grade, and 3 mm wide x 30 mm deep for slab on metal deck.
- .2 Perform "dry method" using "Soff-Cut saw" as soon as the slab will support the weight of the saw and operator without disturbing the final finish. Perform sawcutting from zero to two hours after final floor finishing or within a concrete cutability window of 1.1 MPa/10.5 kg/cm² to a maximum of 5.6 MPa/56.3 kg/cm². Replace manufacturer's patented anti-ravel skid plate with each new blade to avoid spalling and ravelling.
- .3 Take sawcut joints to face of columns.
- .4 After sawcutting, vacuum clean joints to remove dust and debris.
- .5 When cleaned joints are dry and prior to traffic being allowed over area, install temporary polyethylene backer rod in joints to prevent contamination of same.

3.12 **SAWCUTTING CONTROL AND CONSTRUCTION JOINTS – REGULAR SAWCUT JOINTS**

- .1 Sawcut control joints and construction joints in slab straight lines, 3 mm wide x 35 mm deep for slab on grade, and 3 mm wide x 30 mm deep for slab on metal deck.
- .2 Perform sawcutting twelve to twenty-four hours after concrete (or deferred monolithic traprock topping) has been placed, depending on when saw can be run over concrete surface without leaving tread marks, when concrete can be sawn without dislodging aggregate and before uncontrolled shrinkage has occurred. Do not postpone sawing operations beyond these time limitations. Concrete not utilizing retarding admixtures placed with temperature exceeding 26°C (79°F) shall be sawn not later than twelve hours after placing.
- .3 In strip poured slabs, sawcut joints at locations shown in accordance with the following sequence:
 - .1 Initially, sawcut mid-transverse section of completed strip pour with a fine saw blade.
 - .2 Vacuum out debris and re-run saw over finely cut joint using a blade of size to produce 5 mm wide x 35mm deep sawcuts.
 - .3 Repeat .1 and .2 at one-quarter points (one each side of the mid-sawcut on poured strip).
 - .4 Cut other sawcuts in the strip to 3 mm wide x 35mm deep (i.e. no fine sawcutting required).
- .4 Continuously spray water on saw blade during sawing. Grind edges of sawcuts to eliminate burrs; do not grind to bevel or chamfer joint edges. In sawcutting floor slabs on metal deck, run a wet vacuum cleaner immediately behind sawcutting equipment.
- .5 Take sawcut joints to face of columns.

3.13 **CURING/SEALING OF SLABS**

- .1 At premoulded joints to be subsequently caulked, and after curing/sealing operations are complete, remove scored strip from top of isolation joints in floor slab. Clean joints above premoulded joint filler and place temporary polyethylene rope to prevent contamination of joint until sealant is applied.

3.14 **JOINT FILLER**

- .1 Do not apply filler in areas of concrete slab which are to receive quarry tile, ceramic tile, carpet, resilient flooring or epoxy topping system.
- .2 Do not fill isolation joints, construction joints, and control joints sooner than 120 days after concrete pours. Execute joint sealing during cool, dry ambient conditions when slab is in contracted state to minimize future joint separation at sealant-filled joints. Provide filler maintenance if filler must be applied sooner than specified as approved by Consultant.
- .3 Clean sawcut joints with a high power industrial vacuum cleaner to remove dust and debris. Do a second pass of vacuum cleaner as required to render joints clean.
- .4 Fill sawcuts in concrete floor slab on grade using heavy duty sawcut joint filler (epoxy or polyurea), as follows:
 - .1 Using epoxy: Provide type "A" backer rod in sawcut joints, push to the bottom of sawcut. Fill joint with filler, finish top flush with the surface of the slab.
 - .2 Using polyurea: Fill joint full depth with filler, finish top flush with the surface of the slab.

- .5 Prime walls of joint as recommended by filler manufacturer. Mix filler as directed by manufacturer. Coat surfaces of metal in contact with filler primer as recommended by filler manufacturer.
- .6 At sawcuts in concrete slabs on metal deck, provide type "B" backer rod, set to allow a sealant depth of 13 mm. Fill remainder of joint with standard joint sealant. Top of sealant to be slightly concaved from the surface of the slab.
- .7 Comply with sealant manufacturer's primer, application and temperature requirements. Mask floor to edge of joints and fill joint with joint filler. After initial set prime sealant surface and refill joints with sealant as required to produce slightly convex joint surface.
- .8 Remove 6 mm scored strip from top of premoulded joint filler. Caulk over premoulded joint filler with standard joint sealant.
- .9 Fill exterior sawn construction and control joints and over premoulded isolation joint filler with specified standard joint sealant (hydrocarbon resistant joint sealant).

3.15 **SITE CLEAN UP**

- .1 Remove excess materials including waste hardened concrete and other debris resulting from Work of this section from Site and leave premises in a condition acceptable to Consultant.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- .2 Read this Section in conjunction with the following Sections:
 - .1 Section 03 11 00: Concrete Forming
 - .2 Section 03 20 00: Concrete Reinforcing
 - .3 Section 03 30 00: Cast-In-Place Concrete

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- .2 ASTM A820 - Standard Specification for Steel Fibres for Fibre Reinforced Concrete
- .3 ASTM C156 - Test Method for Water Retention by Concrete Curing Materials
- .4 ASTM C157/157M-08 - Standard Test Method for Length of Change of Hardened Hydraulic-Cement Mortar and Concrete
- .5 ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- .6 ASTM C494 - Standard Specification for Chemical Admixtures for Concrete
- .7 ASTM C881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete
- .8 ASTM C920 - Standard Specification for Elastomeric Joint Sealants
- .9 ASTM C1260 - Standard Test Method for Potential Alkali Reactivity of Aggregates
- .10 ASTM C1609 - Flexural Performance of Fiber Reinforced Concrete (Using beam with third-point loading)
- .11 ASTM D1752 - Standard Specification For Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- .12 ASTM G109 - Standard Test Method for Determining Effects of Chemical Admixtures on Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments

- .13 AASHTO T259 - Standard Test Method to Chloride Ion Penetration (Salt Ponding Method)
- .14 CAN/CSA-A3001 - Cementitious Materials for Use in Concrete
- .15 CSA-A23.1 - Concrete Materials and Methods of Concrete Construction
- .16 CSA-A23.2 - Methods of Test for Concrete
- .17 CAN/CSA G30.18-M - Billet-Steel Bars for Concrete Reinforcement
- .18 CE - *Conformite Europeene* (European Conformity)

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Submit manufacturer's Product data, performance criteria and other documentation for each material specified in this section that is proposed for use, including:
 - .1 Admixtures
 - .2 Liquid curing/sealing, curing/hardener and curing/antispalling compound
 - .3 Premoulded joint filler
 - .4 Joint sealant and primer
 - .5 Bonding agent
- .3 Also submit the following:
 - .1 Proposed method for bulkheads and formwork
 - .2 Proposed placement equipment
 - .3 Schedule of events and casting plan regarding placement operations, and records of concrete casts
 - .4 Letter from steel fibre manufacturer certifying that steel fibres have obtained the CE marking of System 1 and a copy of the CE product label.
 - .5 Certification of current membership in good standing, with the Concrete Floor Contractors Association (CFCA).
- .4 Concrete mix design: Submit concrete Supplier's latest statistical analysis of all concrete mixes to be used on this Project.
- .5 In addition to that specified above, submit other documents as defined in the referenced CSA standards which are applicable to Work of this section.

1.4 RECORDS

- .1 Keep a written record of concrete placements, showing location, date, cubic metres of concrete including signed trip ticket for each truck, ambient air temperature, and unusual occurrences during each placement. Permit inspection of records by Consultant at any time. At completion of Work, submit a summary of such data in triplicate to Consultant.

1.5 QUALITY ASSURANCE

.1 Single Source Subcontractor

- .1 It is the intent of this section to establish a single competent source being the concrete floor finishing trade Subcontractor to be responsible for providing complete, durable concrete floors and other concrete structures as specified herein, including provision of formwork, reinforcing, concrete and finishing complete as specified herein.
- .2 Slab placing and finishing shall be done by an established Subcontractor with at least five years of proven, accredited and satisfactory experience in this trade, employing skilled personnel. Submit proof of this requirement to Consultant.

.2 Steel Fibre Supplier

- .1 The steel fibre Supplier shall have a minimum five years experience in Canada and provide a list of job histories that demonstrates their Product has been used successfully in a minimum of five projects of similar type, size and complexity.
- .2 If the Supplier of the steel fibres is not the manufacturer, the distributor shall document that they have a minimum five years experience in distributing steel fibres from the same source.
- .3 If steel fibres are supplied from different manufacturing facilities the Supplier shall provide documentation that material being produced meets the same quality at all locations. The Supplier shall provide traceability of the fibre back to the manufacturing facility.

1.6 **INSPECTION AND TESTS**

- .1 Refer to "Quality Control" in Section 01 10 00 – General Requirements.
- .2 Materials and concrete Work will be inspected and tested for conformance to CSA-A23.1 and to Specifications by an independent inspection/testing company selected and paid for by the Contractor, approved by the Owner.
- .3 Tests include the following:
 - .1 Obtaining certification of cement
 - .2 Tests of aggregates
 - .3 Verification of steel fibre content
 - .4 Test for setting mixes of concrete and design of mixes
 - .5 Concrete cylinder test. Three cylinders from each day's placement for each 110 m³. of concrete, or for each 30 m³. of concrete placed in small amounts on successive days.
 - .6 Slump tests made on the same batch of concrete from which test cylinders are made.
- .4 Tests will be made for conformance of Work to CSA-A23.1 in accordance with CSA-A23.2.
- .5 Inspection/testing company's reports of tests will be forwarded to Consultant and to Contractor with an opinion or reason for any abnormalities noted thereon.

1.7 **PRE-CONSTRUCTION MEETING**

- .1 Prior to start of Work, arrange for a Project site meeting of all parties associated with Work of this section. Presided by Consultant, meeting to include Contractor, floor finishing Subcontractor, admixture manufacturer representative, floor Products manufacturer representative, Owner's Representative, and testing company's representative.
- .2 In the meeting, review Specifications for Work included under this section and determine a complete understanding of requirements and responsibilities relative to Work included, storage and handling of materials, materials to be used, placing of underslab vapour retarder or waterproofing, installation of materials, sequence and quality control, Project staffing, restrictions on areas of concrete placements, and other matters affecting the construction, so as to permit compliance with the intent of this section.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Store materials on Site in a manner to prevent damage thereto. Protect materials from inclement weather. Comply with CSA-A23.1, Clause 5.1.
- .2 Protect materials and Work of this section from damage. Protect other Work from damage resulting from this Work. Replace damaged Work which cannot be satisfactorily repaired.

1.9 ENVIRONMENTAL CONDITIONS

- .1 During hot weather, conform to CSA-A23.1 Clause 7.4.
- .2 During cold weather, provide temporary heating and enclosures required. Mix, place and protect concrete in accordance with CSA-A23.1, Clause 7.4.
- .3 Use insulated polyethylene blankets over top of interior concrete slabs in addition to geosynthetic cloth when curing concrete in periods of cold weather.
- .4 Do not use propane heaters. All temporary heaters to be vented to outside. Do not use propane or gas powered vehicles during concrete placements.

1.10 VERIFICATION

- .1 Verify actual sizes of equipment pads with the mechanical, process and/or electrical Contractors, in advance of placing concrete. If there is deviation from dimensions shown on Consultant's Drawings, inform the Consultant and request authorization to proceed.

1.11 TOLERANCES

- .1 Concrete in place shall be plumb, level and true to linear building lines. Maximum variations (not accumulative) shall conform to CSA-A23.1, Clause 6.4.
- .2 Slabs-on-grade: slab flatness tolerances in accordance with CSA-A23.1, Table 22, Class C: $F_F=35$ and $F_L=25$ specified overall, and $F_F=20$ and $F_L=17$ minimum local. Levelness tolerances (F_L) do not apply to inclined surfaces. Refer to CSA-A23.1 Clause 7.5.1.3.
- .3 Suspended floor slabs: Slab flatness tolerances in accordance with ACI Standard 302: $F_F=25$ specified overall and $F_F=17$ minimum local. (In the case of suspended floor slab receiving thin set tile or resilient flooring: $F_F=30$ specified overall, and $F_F=25$ minimum local.
- .4 A permitted variation in any part of the construction or in any section of Specification shall not be construed as permitting violation of more stringent requirements for any other part of construction or in any other Specification section.

1.12 WARRANTY

- .1 Warrant Work of this section against defects and deficiencies for a period of five years from date Work is certified as substantially performed in accordance with the general conditions of the Contract.
- .2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective Work satisfactory to the Consultant and at no expense to the Owner.
- .3 Defects shall include but are not limited to de-bonding of deferred topping from structural slab, spalling and/or cracking.

2 Products

2.1 **MATERIALS**

- .1 Use one Product from that specified under each material. Source liquid admixtures for concrete from one manufacturer. Source liquid curing/sealing compound by same manufacturer which is supplying shake hardener.
- .2 Non-metallic hardener: Factory pre-mixed dry shake:
 - .1 Master Builders Solutions Canada Inc. "MasterTop 110 ABR"
 - .2 Sika "Diamag 7"
 - .3 Euclid "Surflex"
 - .4 CPD "Floor Hardener Pre-Mix (Standard)"
 - .5 Dayton Superior "Quartz Tuff"
- .3 Metallic hardener: Factory pre-mixed dry shake:
 - .1 Master Builders Solutions Canada Inc. "MasterTop 200"
 - .2 Sika "Ferroplete"
 - .3 Euclid "Eucoplate HD"
 - .4 CPD "Duramet Floor Hardener Pre-Mix"
 - .5 Dayton Superior "Ferro-Tuff"
- .4 Non-oxidizing metallic hardener: Factory pre-mixed dry shake:
 - .1 Euclid "Diamond-Plate"
 - .2 Master Builders Solutions Canada Inc. "MasterTop 210 COR – Natural" (formerly "Lumiplate – Natural")
- .5 Emery hardener: Natural emery aggregate pre-mixed with Type 10 normal Portland cement, superplasticizers and wetting agents:
 - .1 Sika "Emeri-Crete SH Premixed"
 - .2 Euclid "Surflex-E"
 - .3 Dayton Superior "Emery Tuff"
- .6 Conductive/static disseminating/spark resistant hardener: Factory pre-mixed dry shake:

- .1 Dayton Superior "Ferro Tuff S.D."
- .7 Liquid curing/sealing compound - solvent based acrylic: Conforming to ASTM C309 Type 1, Class B and CSA-A23.1, having minimum solids content of 27%:
 - .1 Euclid "Diamond Clear "
 - .2 Dayton Superior "Day-Chem Cure + Seal 30%"
- .8 Liquid curing/sealing compound - water based acrylic: Conforming to ASTM C309, Type 1, Class B and CSA-A23.1:
 - .1 "Vocomp 25 or Vocomp 20" – used in conjunction with Sure Step (slip-resistant additive).
 - .2 Master Builders Solutions Canada Inc. "MasterKure CC 160 WB"
 - .3 Euclid "Aqua-Cure"
 - .4 Sika "Florseal W.B."
 - .5 CPD "Cure & Seal 20 (Water Based)"
 - .6 Dayton Superior "Safe Cure + Seal (J-18)"
- .9 Liquid curing/sealing compound - water based acrylic: Conforming to ASTM C309, Type 1, Class B, and CSA-A23.1, but with a minimum solids content of 26%:
 - .1 Master Builders Solutions Canada Inc. "MasterKure CC 1315 WB" (formerly "Kure 1315")
 - .2 Euclid "Super Aqua-Cure"
- .10 UV-resistant liquid curing/sealing compound - solvent based acrylic: Conforming to ASTM C309, Type 1, Class B, 26% - 30% solids content:
 - .1 Sonneborn "Kure-N-Seal 30"
 - .2 Euclid "Super Diamond Clear"
 - .3 Dayton Superior "Day-Chem Cure + Seal (J-22)"
 - .4 W.R. Meadows "CS309/30"
- .11 Water for curing: Conforming to CSA-A23.1, Clause 4.2.2, clear and entirely free from any elements which might cause staining of concrete.
- .12 Conductive liquid curing compound: For use with conductive/static dissipating, spark resistant finishes:
 - .1 Dayton Superior "Day-Chem S.D. Cure"
 - .2 Approved equivalent
- .13 Dustproof compound: Concrete floor hardener and dustproofing treatment.
 - .1 Sika "Sealhard 400"
 - .2 Dayton Superior "Day-Chem Hardener (J-15)"
 - .3 Euclid "Surfhard"

- .4 W.R. Meadows "Med-Cure"
- .5 Master Builders Solutions Canada Inc. "MasterKure HD 300 WB"
- .14 Liquid densifying/hardening compound: Proprietary blend of silicate polymers:
 - .1 W.R. Meadows "Liqui-Hard"
 - .2 "Ashford Formula" by Duracon Consulting
 - .3 Euclid "Euco Diamond Hard"
 - .4 Dayton Superior "Day-Chem Sure Hard (J-17)"
 - .5 Sika "Sikafloor 3S"
 - .6 Master Builders Solutions Canada Inc. "MasterKure HD 200 WB"
- .15 Concrete Enhancer / protection: "Bellatrix" by WR Meadows, used in conjunction with Liqui-Hard or approved equivalent. Used on previously sealed surfaces, as well as surfaces that have been previously stained or dyed and sealed. Check compatibility with existing sealer prior to full application.
- .16 Geosynthetic cloth for wet curing: Terrafix 240R or approved equivalent.
- .17 Polyethylene film for wet curing: Minimum 0.1 mm thick, complying with maximum allowable moisture loss requirements of ASTM C156.

2.2 **FLOOR FINISHES SCHEDULE**

- .1 Refer to Section 03 30 00 Cast-in Place Concrete

3 **Execution**

3.1 **EXAMINATION**

- .1 Examine previously constructed Work including placement and compaction of underfloor materials. Check thicknesses and review compaction test results of sub-floor fill to receive this Work. Report to Consultant in writing any defects or discrepancies. Commencement of Work implies acceptance of existing conditions.
- .2 Establish elevations of compacted underfloor base prior to commencing Work.
- .3 Ensure that placing of limestone is sequenced with placing of concrete to avoid displacement of limestone by construction traffic.

3.2 **FLOOR FINISHING**

- .1 Laser Screeding
 - .1 Laser screed floor slabs as scheduled herein, using a laser screed vehicle. The laser vibratory screed is to be operated only by trained and qualified personnel who are fully familiar with the equipment.
 - .2 Machine float and machine trowel floor surfaces to smooth, level and dense surfaces free from trowel marks, ridges and depressions. Equip screeds for superflat floor with laser.
 - .3 Use hand-held vibratory screed, float and trowel surfaces in areas inaccessible to laser screed vehicle, to same density and surface quality specified for floors finished with laser screed.

.2 Power Screeding

.1 Interior Slabs

- .1 Power screed floor slabs with mechanical vibratory screeding equipment. Machine float and machine trowel floor surfaces to smooth, level and dense surfaces free from trowel marks, ridges and depressions. Use hand vibrators in non-strip poured concrete slab.
- .2 Immediately following floating, remove water accumulation from slab edges.

.2 Exterior Slabs

- .1 Power screed exterior floor slabs with mechanical vibratory screeding equipment. Float surface to provide a sidewalk "swirl" texture.

- .3 Use hand-held vibrators and hand screed, float and trowel surfaces in areas inaccessible to power equipment, to same density and surface quality specified for floors finished with power operated equipment.
- .4 For concrete mixes containing steel fibre reinforcement, ensure that finishing process leaves surface free of protruding fibres. If fibres protrude from surface after concrete has set, remove protruding fibres. Fill any resulting groove in the floor with an epoxy cement paste, finish smooth and level with the floor.
- .5 Do not contaminate or adulterate various floor finishing mixes.

3.3 **TRAPROCK SHAKE HARDENER**

- .1 Over freshly floated concrete, apply premixed traprock shake in two equal applications at right angles to a total minimum application rate specified. Distribute evenly. Float between application of shake and after second shake applications with power floats. Machine trowel to smooth, level and dense surface, in uniform colour, free from trowel marks, ridges, pinholes and other defects.
- .2 Vacuum dewater finished traprock topped/hardened floor to remove excess water from the surface of slab.

3.4 **NON-METALLIC HARDENER**

- .1 Power screed floor slab and float area indicated to receive non-metallic hardener.
- .2 Over freshly floated concrete, apply premixed non-metallic shake in two equal applications at right angles, to total application rate specified. Distribute evenly. Do not throw shake. Float between applications of shake and after second shake application with power floats. Machine trowel to smooth, level and dense surface, in uniform colour, free from trowel marks, ridges, pinholes and other defects.

3.5 **METALLIC HARDENER**

- .1 Power screed floor slab and float area indicated to receive metallic hardener.
- .2 Over freshly floated concrete, apply premixed metallic shake in two equal applications at right angles, to total application rate specified. Distribute evenly. Do not throw shake. Float between applications of shake and after second shake application with power floats. Machine trowel to smooth, level and dense surface, in uniform colour, free from trowel marks, ridges, pinholes and other defects.

3.6 **EMERY HARDENER**

- .1 Power screed floor slab and float area indicated to receive emery hardener.
- .2 Over freshly floated concrete, apply emery shake in two equal applications at right angles, to total application rate specified. Distribute evenly. Do not throw shake. Float between applications of shake and after second shake application with power floats. Machine trowel to smooth, level and dense surface of uniform colour, free from trowel marks, ridges, pinholes and other defects.

3.7 **STATIC DISSEMINATING/SPARK RESISTANT (SDSR) HARDENER**

- .1 Apply shake in two applications to total rate of 9 kg/m².
- .2 Fill and cover ground rods and mesh with mortar mixture of SDSR shake. Float flush to adjacent abutting floor slab.
- .3 Apply first shake application to freshly floated concrete commencing at areas adjacent to forms, columns and walls where moisture will be lost first. Apply first shake application at two-thirds of the specified total rate. Distribute evenly. Do not throw shake.
- .4 Perform hand floating as required using wood floats. Do not use magnesium floats, bull floats or darbies.
- .5 Machine float floor surface as soon as shake has absorbed moisture (indicated by darkening of surface). Do not allow float blades to dig into surface. Float just sufficiently to bring moisture from base slab through shake.
- .6 Immediately following floating of first shake application, apply remaining one-third of total specified rate in same manner as first shake application and machine float as specified. Compact surface further by a third mechanical floating. Take special care to prevent tracking or spilling of concrete, sand, stone or any other material into finished surface.
- .7 As surface further stiffens, as indicated by loss of sheen, mechanically trowel with blades relatively flat. Remove marks, pinholes, in final raised trowel operation. Do not burnish; do not use a rough swirl finish.
- .8 Tests: 60 days following completion of SDSR floor application, perform in the presence of the Consultant, material manufacturer's standard electrical tests for static disseminating quality and spark resistance. Utilize non-destructive methods only.
- .9 Submit copies of test reports and a test certificate to Consultant substantiating that completed floor is spark resistant and static disseminating (i.e. less than 250,000 ohms).

3.8 **MISCELLANEOUS FINISHES**

- .1 In areas specified to receive subsequent epoxy or urethane floor overlay or coating, finish concrete floor surface with one pass steel trowel.
- .2 Install abrasive nosings to stair treads prior to placement of concrete and hand trowel treads to a swirl, non-slip surface.
- .3 On stair treads to receive resilient floor, steel trowel concrete to a smooth finish.

3.9 **CURING/SEALING OF STRIP POURED SLABS - GENERAL**

- .1 Immediately after finishing of alternate strip pours, and prior to sawcutting, apply liquid curing/sealing compound to strip edges for width of 900 mm from edges.
- .2 At premoulded joints to be subsequently caulked, and after curing/sealing operations are complete, remove scored strip from top of isolation joints in floor slab. Clean joints above

premoulded joint filler and place temporary polyethylene rope to prevent contamination of joint until sealant is applied.

- .3 Refer to "Floor Finishes Schedule" as specified previously herein for type of curing/sealing for various floor areas.

3.10 **CURING/SEALING OF SLABS – NON-SUPERFLAT FLOORS**

- .1 At premoulded joints to be subsequently caulked, and after curing/sealing operations are complete, remove scored strip from top of isolation joints in floor slab. Clean joints above premoulded joint filler and place temporary polyethylene rope to prevent contamination of joint until sealant is applied.
- .2 Refer to "Floor Finishes Schedule" as specified previously herein for type of curing/sealing for various floor areas.

3.11 **WATER CURING AND LIQUID COMPOUND SEALING**

- .1 Winter Concreting
 - .1 After sawcutting operations have been completed, water down entire area and cover with geosynthetic cloth and overlay with insulated polyethylene blankets. Remove geosynthetic cloth and blanket after seven consecutive days minimum and allow substrate to dry. When dry, approximately forty-eight hours, apply first coat of liquid curing/sealing compound at rate and by method recommended by manufacturer.
 - .2 Apply second coat at same rate as first coat immediately after first coat has dried, and prior to traffic being allowed over area.
- .2 Non-Winter Concreting
 - .1 After sawcutting operations have been completed, water down entire area and cover with filter cloth. Remove cloth after seven consecutive days minimum and allow substrate to dry. When dry, approximately forty-eight hours, apply first coat of liquid curing/sealing compound at rate and by method recommended by manufacturer.
 - .2 Apply second coat at same rate as first coat immediately after first coat has dried, and prior to traffic being allowed over area.

3.12 **WATER CURING AND LIQUID DENSIFYING/HARDENING COMPOUND**

- .1 Winter Concreting
 - .1 After sawcutting operations have been completed, water down entire area and cover with geosynthetic cloth and overlay with insulated polyethylene blankets. Remove geosynthetic cloth and blanket after three consecutive days minimum and allow substrate to dry. On the fifth day, apply one coat of liquid densifying/hardening compound by method recommended by manufacturer.
 - .2 (Immediately after first coat of liquid densifying/hardening compound has dried, and prior to traffic being allowed over area, apply a second coat at the rate of 25% of the volume of the first coat).
 - .3 Dry buff applied compound after it has cured for minimum twenty-four hours, to provide immediate gloss.
- .2 Non-Winter Concreting

- .1 After sawcutting operations have been completed, water down entire area and cover with filter cloth. Remove cloth after three consecutive days minimum and allow substrate to dry. On the fifth day, apply one coat of liquid densifying/hardening compound by method recommended by manufacturer.
- .2 (Immediately after first coat of liquid densifying/hardening compound has dried, and prior to traffic being allowed over area, apply a second coat at the rate of 25% of the volume of the first coat).
- .3 Dry buff applied compound after it has cured for minimum twenty-four hours, to provide immediate gloss.

3.13 CURING OF IN-FILL OR CLOSURE SLABS

- .1 After sawcutting operations have been completed, apply one coat of curing/sealing compound in accordance with manufacturer's recommendations. Apply second coat at same rate as first coat immediately after first coat has dried, and prior to traffic being allowed over area.

3.14 LIQUID COMPOUND CURING/SEALING – AGGREGATE SHAKES (AND TOPPINGS)

- .1 After sawcutting operations have been completed, cure and seal floor finished with shake hardener or topping with one coat of liquid curing/sealing compound at rate and by method recommended by manufacturer.
- .2 Apply second coat at same rate as first coat immediately after first coat has dried, and prior to traffic being allowed over area.
- .3 In static disseminating/spark resistant hardened floor, apply one coat of conductive curing/sealing compound only. After compound has hardened, sweep floor and Provide a temporary building paper covering over the entire area.

3.15 WATER CURING

- .1 Water cure floors designated to be surfaced with ceramic or quarry tile, and epoxy or urethane. Do not use curing/sealing compound.
- .2 Using geosynthetic cloth: Immediately after floors have been power trowelled and water sheen has dissipated, cover slabs with geosynthetic cloth for a minimum of seven days. Remove geosynthetic cloth in sections to execute required sawcutting of slabs, then replace as specified herein. Upon completion of curing period, remove and dispose of geosynthetic cloth cover, boards and ballast from the Site.
- .3 Using polysheet: Immediately after floors have been power trowelled and water sheen has dissipated, cover slabs with polyethylene sheet for a minimum of seven days. Lap end and side laps between polyethylene sheets a minimum of 300 mm and apply wood boards over laps to prevent sheet from displacing. Apply additional wood boards or other form of ballast in field of sheet as required to prevent wind and other forms of displacement. Remove polyethylene sheet in sections to execute required sawcutting of slabs, then replace as specified herein. Upon completion of curing period, remove and dispose of polyethylene sheet cover, boards and ballast from the Site.

3.16 JOINT FILLER

- .1 Refer to Section 03 30 00 Cast-in-place Concrete

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- | | | | |
|-----|-----------------|---|--|
| .1 | CAN/ULC-S102 | - | Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies |
| .2 | CSA A82.1-M | - | Burned Clay Brick |
| .3 | CSA A165 Series | - | CSA Standards on Concrete Masonry Units |
| .4 | CSA A179 | - | Mortar and Grout for Unit Masonry |
| .5 | CSA A370 | - | Connectors for Masonry |
| .6 | CSA S304.1 | - | Design of Masonry Structures |
| .7 | CSA A371 | - | Masonry Construction for Buildings |
| .8 | CSA W47.1 | - | Certification of Companies for Fusion Welding of Steel Structures |
| .9 | CSA W48.1-M | - | Carbon Steel Covered Electrodes for Shielded Metal Arc Welding |
| .10 | CSA W59-M | - | Welded Steel Construction (Metal Arc Welding) |
| .11 | CSA W117.2 | - | Safety in Welding, Cutting, and Allied Processes |
| .12 | AODA | - | Accessibility for Ontarians with Disabilities Act |

1.3 **SUBMITTALS**

.1 Submit the following in accordance with Section 01 33 00:

.2 Product data: Submit as Shop Drawings, manufacturer's specifications and other data for masonry.

.3 Scaled masonry wall elevations with the following information:

- | | |
|----|---|
| .1 | Block arrangement, wall thickness |
| .2 | Core fills |
| .3 | Rebar, rebar designation, laps, dowels, and anchors |
| .4 | Openings and lintels |
| .5 | Bond beam and horizontal reinforcement |
| .6 | Control joint location and extent |

.4 Submit EPD (Environmental Product Declaration) for concrete masonry units.

- .1 EPD to be prepared in accordance with ISO 14025 and ISO 21930.
- .2 EPD to report GEP (Global Warming Potential) in units of kg CO2 equivalent per cubic meter of concrete masonry product

1.4 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Check materials for damage and carefully unload. Remove unsatisfactory materials from the Site and replace with new materials to satisfaction of Consultant at no increase in Contract Price.
- .2 Store materials on Site in a manner to prevent damage thereto. Stockpile for easy heating if required. Protect from the weather. Do not concentrate storage on any part of the structure so as not to set up any strain beyond the designed load of any portion thereof.
- .3 Take particular care so as not to overload unsupported portions of the structure which have not attained their full strength.
- .4 Comply with CSA A371.
- .5 Protect the following:
 - .1 Masonry materials during storage and construction from wetting by rain, snow or ground water, or inter-mixture with earth or other materials.
 - .2 Metal reinforcing or ties against corrosion or contamination, including ice, which will reduce or destroy bond.
 - .3 Other Work from damage resulting from this Work.
 - .4 Sills, ledges and projections from droppings of mortar.
- .6 Cover tops of masonry walls not enclosed or sheltered during rain, at the end of each day's construction and at times when Work is not in progress, with waterproof covers temporarily secured against displacement, until flashings are completed. Drape cover over wall and extend 600 mm down both sides. Anchor securely in position. Protect exposed corners against droppings or damage from other trades, by boarding or other means.
- .7 Prevent grout or mortar from staining the face of masonry to be left exposed or painted. Immediately remove grout or mortar in contact with such masonry.
- .8 Cold weather protection: Do not lay masonry at air temperatures below 5°C (41°F) without prior review by Consultant of proposed protective measures. Comply with CSA A371.
- .9 Repair or replace damaged Work to satisfaction of Consultant at no increase in Contract Price.

1.5 **JOB MOCK UP**

- .1 Prior to commencing masonry Work, erect a sample wall panel mock-up consisting of specified materials, and illustrating bond, joint tooling, control joint, insulation, air/vapour barrier, ties, brick tint, etc. required for final Work. Coordinate with Section 07 21 00 for the provision of insulation and air/vapour barrier for mock-up purposes.
- .2 Build mock-up at Site, where directed, in full thickness and approximately 1200 mm x 1200 mm including also, the proposed range of colour, texture and workmanship to be expected in the completed Work.

- .3 Obtain Consultant's acceptance of visual qualities of the mock-up before start of Work. Retain mock-up during construction as a standard for judging completed Work; do not alter, move or destroy until Work is completed. Use sample panels to test proposed cleaning procedures.

- .4 Provide separate mock-up panel for brick veneer, glaze block, cavity wall conforming to the same foregoing requirements.

1.6 **SCAFFOLDING**

- .1 Erect, maintain and remove on completion, scaffolding adequate for the proper execution of the Work.
- .2 Conform to "Occupational Health and Safety Act". Lay masonry from scaffolds erected on same side as face Work. Do not support scaffolding from finished building surfaces.

1.7 **WELDING**

- .1 Retain a firm certified in accordance with CSA W47.1 Division 1 or 2.1 to perform welding of anchor clips.
- .2 Employ welding operators licensed per CSA W47.1 for types of welding required by the Work.

1.8 **TEMPORARY BRACING**

- .1 Temporarily brace masonry Work during erection to prevent damage due to winds or other lateral loads until permanent structure provides adequate bracing.

2 **Products**

2.1 **MATERIALS**

- .1 Source (each type of) masonry unit from one manufacturer. Units to be of uniform texture and colour for each kind required.
- .2 Brick Veneer: Metric modular, hard burned clay brick masonry units, conforming to CSA A82.
 - .1 Finish exposed ends of brick at external corners, headers, control joints, expansion joints and openings same as the face.
 - .2 To match existing brick in all respects, modular size, with special shapes and sizes as detailed.
 - .3 Where brick veneer masonry type is not specified, provide Type X, exterior grade.
 - .4 Manufacturer:
 - .1 Brampton Brick
 - .2 Skycon
 - .3 Shaw Brick
 - .4 Forterra Brick
 - .5 Sills: in accordance with Contract Drawings. Colours to match existing or as selected by Consultant.

- .3 Concrete blocks: Normal weight, metric modular, moisture-controlled units conforming to CSA A165.1, Type H/15/A/M (and Type S/15/A/M).
 - .1 Exposed surfaces: Free of cracks, chips or other blemishes, and broken corners. Use sash blocks at control joints, solid block around openings for rolling steel doors or shutters and where noted, and concrete block lintels over openings in concrete block walls unless steel lintels are shown.
 - .2 Units on external corners of exposed interior block and block at door jambs: Bullnosed type.
 - .3 Special shapes: Manufacture to shape shown; do not field cut stretcher units to make special shapes.
- .4 Concrete blocks: Lightweight, metric modular moisture-controlled units conforming to CSA A165.1, Type H/15/C/M and Type S/15/C/M. Do not use for walls in contact with earth or where exposed to the weather. For the purpose of fire-resistance rating, conform to the requirements of L₂20S as specified in the National Building Code.
 - .1 Exposed surfaces: Free of cracks, chips or other blemishes and broken corners. Include required sash blocks for control joints, solid block around openings for rolling steel doors or shutters where noted, and concrete block lintels over openings in concrete block walls unless steel lintels are shown.
 - .2 Units on external corners of exposed interior block and block at door jambs: Bullnosed type.
 - .3 Special shapes: Manufacture to shape shown; do not field cut stretcher units to make special shapes.
 - .4 Cure concrete blocks using carbon capturing technology with a minimum sequestration rate of 225 grams per 190 x 190 x 390 mm concrete block. Adjust this rate on a volumetric basis for other block sizes.
- .5 Mortar: Conforming to CSA A179-M, Type "S".
- .6 Mortar (exterior wythe blocks in cavity wall): Conforming to CSA A179-M, Type "N", 1:1:6 ready mixed, as supplied by Maxi Mix or Daubois Inc. Use pre-mixed/pre-bagged/pre-gauged cement-lime requiring water to be added in the mixer per mortar manufacturer's directions. No loose sand allowed on site. Mix colour pigment manufactured by Harcros Pigment Canada or Solomon Colours, Inc. to produce coloured mortar colour; colour as selected by the Consultant.
- .7 Mortar (rendering, patching or leveling): Quick-setting, polymer-modified, fiber-reinforced cementitious rendering mortar for interior and exterior concrete wall and floors. Minimum 3 mm thickness and requiring water to be added in the mixer per mortar manufacturer's directions. "Planitop 330 Fast" by Mapei or approved equal.
- .8 Grout: Conforming to CSA A179-M, coarse.
- .9 Horizontal masonry reinforcement (for single wythe masonry block walls): Welded wire, galvanized units in heavy duty truss or ladder two-side rod design by Dur-O-Wal, Blok-Lok, or Hohmann and Barnard, prefabricated in straight lengths of not less than 3 m with matching corner "L" and intersection "T" units. Overall width shall be such that side rods are positioned at the centreline of both face shells of the concrete block. Reinforcing gauge and finish to meet requirements of the Ontario Building Code and referenced CSA Standards.

- .10 Ties from outer wythe to inner wythe: Hot-dip galvanized of types as specified below complete with insulation support and V-tie by Fero Corporation as distributed by Stuart & Associates:
- .1 For tying brick, concrete block and masonry unit veneers to concrete block: use Fero Block Shear Tie in combination with two-wire ladder horizontal reinforcing 3.66 mm diameter wire side and cross rods.
 - .1 Block shear length: to suit concrete block (inner wythe) width and thickness of insulation.
 - .2 V-tie length: as required to provide placement of V-tie legs at centreline of veneer (outer wythe). Provide block shear ties at 800 mm horizontal x 600 mm vertical spacing and 300 mm maximum spacing around wall openings, top, base and corners or as noted on Drawings.
 - .2 For tying brick, concrete block and masonry unit veneers to cast in place concrete and structural steel: Use Fero RAP ties fastened to backup with U-CAN fasteners.
 - .1 RAP plate length: To suit thickness of insulation.
 - .2 V-ties: Of length to provide placement of V-tie legs at the centreline of veneer (outer wythe). Provide ties at 600 mm x 600 mm spacing and 300 mm maximum spacing around wall openings, top, base and corners or as noted on Drawings.
 - .3 For tying brick, concrete block and masonry units to structural columns and beams: Use Fero CAT tie attached with UCAN fasteners.
 - .1 V-ties: Of length to provide placement at the centreline of veneer (outer wythe). Provide CAT ties.
 - .4 For tying brick, concrete block and masonry unit veneers to metal studs: Use Fero side mounting RAP ties attached to side of stud with U-CAN fasteners.
 - .1 Side mounting RAP plate length: To suit width of metal stud and thickness of sheathing/insulation.
 - .2 V-ties: Of length to provide placement of V-tie legs at the centreline of veneer. Provide side mounting RAP ties at 400 mm x 600 mm vertical spacing and 300 mm maximum spacing around wall openings, top, base and corners or as noted on Drawings.
 - .5 For tying brick, concrete block and masonry unit veneers to wood studs: Use Fero Adjustable BVTs attached to stud with UCAN fasteners as supplied by Stuart & Associates. The Fero Adjustable BVTs length to suit width of insulation/sheathing.
 - .6 The Fero V-ties shall be of length to provide placement of V-tie legs at the centreline of veneer (outer wythe). Provide adjustable BVTs at 400 mm horizontal x 600 mm vertical spacing and 300 mm maximum spacing around wall openings, top, base and corners or as noted on Drawing.
- .11 Masonry anchors: 6 mm thick steel plate anchors and clips to laterally support masonry walls from other walls or structural elements. For interior or dry locations, clean to SSPC-SP3 and prime with CISC/CPMA solvent reducible primer. For exterior or humid conditions, hot-dip galvanize to CSA G164. For non-structural anchorage, Blok-Lok "Flex-O-Lok" may be used.

- .12 Masonry-to-precast concrete (concrete) anchors: 1.5 mm (16 gauge) galvanized steel dovetail anchors. Supply filled 0.9 mm (20 gauge) galvanized steel dovetail slots for building-in in concrete (precast concrete).
- .13 Vertical reinforcement: Conforming to CAN/CSA G30.18-M, Grade 400.
- .14 Insulation adhesive: Synthetic rubber based compatible with insulation as recommended by insulation manufacturer.
- .15 Concrete block cell insulation: "Zonolite" granular vermiculite by W.R. Grace.
- .16 Compressible filler atop non-fire rated masonry walls: Where ceiling is used as a return air plenum use:
 - .1 "Zero Draft Z2-600" by Can-Am Building Envelope Systems, a foamed-in-place material with a flame spread rating of 25 or less in accordance with CAN/ULC-S102, or
 - .2 Fibreglass or mineral wool sealed with a firestop spray meeting the maximum flame spread and smoke ratings as above, as manufactured by 3M, Tremco or Johns Manville.
- .17 Compressible filler atop non-fire-rated masonry walls: Where ceiling space is not used as a return air plenum, use soft grade closed cell foam joint filler strips by CPD.
- .18 Premoulded control joint gasket: Dur-O-Wal "Rapid Control Joint" in "Wide-Flange" design of type to suit wall thickness. (Use "Regular" design for control joints at pilasters or columns.) For fire-rated control joint gaskets, use fire-rated closed cell neoprene conforming to ASTM D1056 or ASTM D2056.
- .19 Brick Control Joints Material:
 - .1 Neoprene Sponge by Blok-Lok Limited.
 - .2 NS - Closed Cell Neoprene Sponge by Hohmann & Barnard Company
- .20 Expansion joint flashings: Insulated Lexsuco "Lexpand" wall expansion joint with rigid polyvinyl nailing strips, of type to suit joint width shown. Adhesive to be as supplied by flashing manufacturer, and 0.6 mm thick x 25 mm (24 gauge x 1") wide metal batten strips with oval head galvanized "Confas" masonry anchors for securement of expansion joint flashing nailing strips to masonry substrate.
- .21 Dampproof course and through-wall flashings: "Blueskin SA" by Monsey Bakor, or "Sopraseal Stick" by Soprema, self-adhesive grade.
- .22 Cavity wall ventilation inserts: Dur-O-Wal "Cell Vent Weep-Hole Ventilator". Colour as selected by the Consultant.
- .23 Cavity wall drainage net: High density polyethylene or nylon woven mesh type mortar dropping control devices with trapezoidal zigzag-shaped top edge, design to allow moisture/water to flow/drain downward in cavity to weep holes, 25 mm thick x 250 mm high x manufacturer's standard lengths "Mortar Net" with insect barrier or "Mortar Trap" by Hohmann and Barnard Inc.
- .24 Precast concrete sills and wall caps: Of sizes and profiles shown complete with slopes and drips, 35 MPa concrete poured in rigid forms, high frequency vibrated, colour pigments added to match finish of the wall face in which they occur. Pigments as manufactured by Harcros Pigment Canada. Use same mortar specified for brick veneer, for setting sills and caps.

- .25 Brick and block vents: Titus "Model OXL-77" complete with duct extension and birdscreen; exposed surfaces clear anodize finished.
- .26 Anchor bolts: Minimum 9 mm diameter steel, in length shown on Drawings, hot-dip galvanized to CAN/CSA G164-M.
- .27 Foamed-in-place air seals: Class 1, single component polyurethane foam conforming to CAN/ULC-S710.1, with flame spread rating of 20 or less and smoke developed of 25 or less. Density of 20.8 to 28.8 kg/m³, "Zerodraft Foam Sealant" by Canam Building Envelope Specialists Inc., or "Great Stuff Pro" by Dow Chemical Company, or "LEF" by Tremco.
- .28 Parging: "Gem Foundation Coating" by Gemite Products Inc.

3 Execution

3.1 **MORTAR MIXING**

- .1 Mix mortar with the maximum amount of water consistent with workability to provide maximum tensile bond strength within the capacity of the mortar. Use a mechanical mixer. No hand mixing permitted.
- .2 Do not use mortar which has begun to set or if more than 2½ hours has elapsed since initial mixing. Retemper mortar during the 2½ hour period only as required to restore workability.

3.2 **GENERAL MASONRY CONSTRUCTION**

- .1 Carefully and neatly lay masonry, truly vertical and horizontal, with joints of uniform size as required to suit requirements for design coursing and bonding.
- .2 Tenth intersections of walls with alternating units, except as otherwise shown or where control joints and expansion joints occur.
- .3 Lay blocks in running bond except where shown otherwise. Lay in full mortar beds with face shell vertical joints filled. Align block webs vertically and with thicker ends of face shells up.
- .4 When thumbprint hard, tool exposed joints shallow concave with non-staining round jointer. Tool joints flush where shown and where gypsum wallboard, ceramic tile and resilient base are to be applied as finish.
- .5 Lay prefaced block in running bond, in full mortar beds and with vertical joints filled with mortar. Neatly tool joints shallow concave with non-staining tools.
- .6 Lay ledge blocks in running bond in full mortar beds and with vertical joints filled with mortar. Tool joints flush.
- .7 Keep masonry walls 25 mm clear of underside of steel building frame, roof or floor and deck over. For non-fire rated masonry walls used as air plenum, pack the clear space with the specified material of either fibrous filler and spray seal combination, or foam-in-place. For non-fire rated masonry walls that are not used as air plenum, fill the clear space with specified foam strips. Compress to 50% of original thickness.
- .8 Lay brick in such a way that vertical joints in alternate brick courses are plumb from the top course to the bottom course.

- .9 Cut masonry units using a motor-driven table saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full-size units without cutting wherever possible.
- .10 Match coursing, bonding (colour and texture) of new masonry work with existing Work where indicated.
- .11 Build control joints in masonry walls at 9000 mm unless shown otherwise. Provide joints using sash block units. Fill chase and joint with premoulded gasket full height of control joints. Leave a depth of 12 mm for caulking. Locate control joints in modular dimensions.
- .12 Coordinate building-in of anchors as required for the proper installation of the Work of other trades.
- .13 Provide solid block or Provide metal lath under block and fill block cells solid for lintel bearing and as required to secure built-in anchor bolts and/or anchors.
- .14 Build-in door frames, borrowed light and glazed screen frames, anchors, inserts, loose lintels, shelf angles, conduits and other items required to be built into masonry. Set anchors between frames and masonry and fill voids between metal frames and masonry walls with mortar.
- .15 Build recesses to receive items recessed in masonry.
- .16 Build-in anchor bolts for wood copings on tops of masonry walls and other locations. Install anchor bolts in a staggered arrangement to prevent wood blocking from "cupping".

3.3 **REINFORCING, TIES AND ANCHORS**

- .1 Build-in continuous masonry reinforcement in horizontal courses terminating at vertical terminations such as control and expansion joints, full height of walls and partitions, at every second block course. Install reinforcing in first and second courses over door and window openings.
 - AND/OR -
- .2 Build-in continuous masonry reinforcement in horizontal inner wythe courses of cavity wall, terminating at vertical terminations such as control and expansion joints, full height of walls, at specified spacing. Install reinforcing in first and second courses over door and window openings.
- .3 Maintain continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut, bend and lap reinforcing units as per printed directions of manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- .4 Where a new masonry wall is superimposed on an existing masonry wall, tie same to the existing masonry wall in accordance with the code.
- .5 Build-in dovetail anchors.
- .6 Weld masonry anchor clips to structural steel in accordance with the following standards:
 - .1 CSA W48.1-M: For electrodes. If rods are used, only coated rods are allowed.
 - .2 CSA W59-M: For design of connections and workmanship.
 - .3 CSA-W117.2: For safety.
- .7 Thoroughly clean welded joints and expose steel for a sufficient space to perform welding operations. Touch-up disturbed primer paint with matching primer.

- .8 Where shown, install vertical steel reinforcing and fill block cells with grout. At lintels, install reinforcing per schedule and fill with grout. Allow 200 mm minimum bearing on each lintel end up to 1200 mm span; 400 mm minimum bearing on each end for spans exceeding 1200 mm. Temporarily support lintels until concrete has cured.

3.4 **MODIFICATIONS TO EXISTING MASONRY**

- .1 Match existing bond and coursing height of adjacent masonry to remain.
- .2 Tooth new masonry into existing masonry in run of wall and at intersections with existing partitions.
- .3 At new openings in masonry walls, remove units, clean and re-install rotated to conceal cut and expose finish surface.
- .4 Clean bond areas of adjacent masonry to remain, remove loose material and prepare masonry to receive new masonry toothed in.
- .5 Install reinforcement as necessary to provide continuity of reinforcing and stability between existing and new masonry work.
- .6 Provide repair anchors as necessary to stabilize existing masonry adjacent to and affected by the Work.

3.5 **CAVITY WALL CONSTRUCTION**

- .1 Lay block as specified under "General Masonry Construction".
- .2 Tie exterior wythe to interior wythe using shear connectors spaced 600 mm vertically and 800 mm horizontally.
- .3 Lay damp course and through-wall flashings. Lap joints 50 mm minimum. Roll with steel hand roller to ensure proper contact at laps. Carry through-wall-flashings continuous past exterior steel columns.
- .4 Extend flashing membrane one block course up the back wall and return into mortar joint a minimum 25 mm.
- .5 Install cavity wall ventilator inserts in vertical brick or block joints immediately over dampproof courses and through-wall flashings, at 600 mm o.c. Set 3 mm from the face of masonry unit. Ensure inserts are not plugged with mortar or debris. Slope flashings towards the exterior in order that any water that penetrates the exterior wythe and drains to the bottom, is directed back to the exterior through the inserts.
- .6 Install through-wall flashings at any interruption of the air space behind the face veneer such as:
 - .1 Bottom of cavity walls
 - .2 Over shelf angles and lintels in exterior walls
 - .3 At other locations shown
- .7 Flashing above windows and doors that is discontinuous shall be turned up at ends to form a dam.
- .8 Place continuous run of drainage net on top of through-wall flashing.
- .9 Keep exterior wall cavities free from mortar droppings. Strike mortar joints facing cavity flush.

- .10 Coordinate masonry Work with the application of sheet membrane air/vapour barrier on cavity side of inner masonry wythe.

3.6 **CAVITY WALL INSULATION**

- .1 Place insulation in horizontal parallel courses in full bed of adhesive, tightly fitted between masonry reinforcement and in firm contact with adhesive. Apply adhesive in accordance with manufacturer's directions.
- .2 Cut and fit insulation to provide complete unbroken installation with minimum joints. Fit insulation tightly around ties. Butter insulation joints with adhesive.
- .3 Progressively install insulation, retaining wedges at maximum spacing of 400 mm horizontally at each masonry reinforcing course. Ensure that wedge presses insulation in tight and firm contact with adhesive. Wherever possible have wedge occur at junction of vertical and horizontal joint.

3.7 **COMPOSITE WALL CONSTRUCTION**

- .1 Lay face brick on exposed face in running bond (with full headers every sixth course as shown) (with split headers every sixth course).
- .2 Wet bricks before using in dry weather; keep dry and cover in freezing weather. Wet tops of walls where Work is left off before Work is resumed.
- .3 Parge back of face brick wythe and face of masonry block back-up with setting mortar to ensure void is filled. Lay face brick with shove joint in full mortar bed and with vertical joints filled solid.
- .4 Provide brick joints 10 mm wide horizontally and vertically, finished to a shallow concave finish.
- .5 Lay block and brick as specified under "General Masonry Construction".
- .6 Block cell insulation: As block masonry is being built, pour vermiculite insulation in block cells. Do not lay more than six block courses between pours. Rod insulation into cells to ensure that no voids or air pockets are left unfilled.
- .7 Wall expansion joint flashings: Secure flashing flaps to substrate with a full coat of adhesive and mechanically fasten every 300 mm through metal strips. Extend flashing as required to provide proper connection with roof expansion joint.

3.8 **PARGING**

- .1 Parge predampened masonry walls with type S mortar applied in two uniform coats to a total thickness of 19 mm. Scarify first parging coat to ensure full bond to subsequent coat.
- .2 Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 3 mm per m.
- .3 Damp cure parging for at least twenty-four hours and protect until cured.

3.9 **FIELD QUALITY CONTROL**

- .1 The Contractor may engage an inspection and testing company to observe workmanship and to conduct block, mortar and grout strength tests in accordance with CSA A165.1, CSA A179, and CSA S304, and will pay all costs thereto.

3.10 **REPAIR, POINTING AND CLEANING**

- .1 Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout; point to eliminate evidence of replacement.
- .2 Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar.
- .3 Point-up joints including corners, openings and adjacent Work to provide a neat, uniform appearance, properly prepared for application of sealant compounds.
- .4 Rake out to 12 mm depth, joints between sills and between ends of sills and masonry. Point to full 12 mm depth with pointing material specified. Tool pointing to a slightly concave smooth condition.

3.11 **FINAL CLEANING**

- .1 After mortar is thoroughly set and cured, clean one-half of sample wall panel. Obtain Consultant's acceptance of sample wall panel cleaning before proceeding to clean building masonry Work.
 - .1 Dry clean to remove large particles of mortar using wood paddles and scrapers. Use chisel or wire brush if required.
 - .2 Scrub down wall with stiff fibre brush.
 - .2 Acid cleaning of masonry is not permitted.
- End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- | | | | |
|-----|---------------------|---|---|
| .1 | ASTM A325M | - | Standard Specification for High-Strength Bolts for Structural Steel Joints [Metric] |
| .2 | ASTM A563M | - | Standard Specification for Carbon and Alloy Steel Nuts [Metric] |
| .3 | ASTM A570 | - | Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality |
| .4 | ASTM B695 | - | Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel |
| .5 | ASTM F959 | - | Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use With Structural Fasteners |
| .6 | ASTM F1554 | - | Standard Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength |
| .7 | CSA-G40.20/G40.21-M | - | General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel |
| .8 | CAN/CSA S16.1 | - | Limit States Design of Steel Structures |
| .9 | CSA S136 | - | Cold-Formed Structural Steel Members |
| .10 | CAN/CGSB 1.181 | - | Ready-Mixed Organic Zinc-Rich Coating |
| .11 | CGSB 85-GP-16M | - | Painting Galvanized Steel |
| .12 | CISC | - | Canadian Institute of Steel Construction, "Code of Standard Practice" |
| .13 | CISC/CPMA 2.75 | - | Canadian Institute of Steel Construction/Canadian Paint Manufacturers Association "A Quick-Drying Primer for Use on Structural Steel" |
| .14 | CMAA No. 70 | - | Crane Manufacturers Association of America, Specification #70 |
| .15 | CSA W47.1 | - | Certification of Companies for Fusion Welding of Steel Structures |
| .16 | CSA W48 Series | - | Electrodes |
| .17 | CSA W48.1-01 | - | Welding |
| .18 | CSA W59-M | - | Welded Steel Construction (Metal Arc Welding) |

- | | | | |
|-----|----------------|---|---|
| .19 | CSA-W117.2 | - | Safety in Welding, Cutting, and Allied Processes |
| .20 | CSA W178.1 | - | Certification of Welding Inspection Organizations |
| .21 | CSA W178.2 | - | Certification of Welding Inspectors |
| .22 | SSPC Volume 02 | - | The Society for Protective Coatings, "Steel Structures Painting Manual, Vol. 2" |
| .23 | AODA | - | Accessibility for Ontarians with Disabilities Act |

1.3

DESIGN CRITERIA

.1 Framing Design

- .1 Building has been designed on the basis of steel sections shown and it is the intent of Contract that designated shapes, thicknesses, arrangements and grades of material be used.
- .2 If for any reason sections shown are not available, substitute sections may be proposed for use and must be accepted in writing by Consultant prior to use. Consultant may consider such substitutions only if proposed members provide equal or greater strength with deflection compatible with adjacent construction, and do not interfere in any way with the architectural construction or the installation of mechanical, process and electrical utilities. No increase in payment will be made because of substitutions. Proposed substitutions to Class IV sections must be accompanied by calculations which are to be sealed and signed by a Professional Engineer licensed to practice in the province of Ontario.

.2 Design Requirements

- .1 Obtain written acceptance from Consultant before fabricating members with randomly located butt welded splices.
- .2 Obtain location of maximum stresses in members where randomly located butt welded splices will occur.
- .3 If members with randomly located butt welded splices are used, have visual and non-destructive inspection/testing executed by an independent inspection/testing company, qualified in accordance with the Specifications, and pay all costs thereto. Refer to "Source Quality Control" herein for testing required. Identify unit costs for such testing as an attachment to the Tender. Submit test results to Consultant.

1.4

SUBMITTALS

.1 Shop Drawings

- .1 In advance of preparation of detail Shop Drawings, submit for review, typical details of connections, special connections, and connections which do not meet requirements of "Beam Connections" article specified herein.
- .2 Submit Shop Drawings for fabrication and erection of structural steel in accordance with Section 01 33 00.
- .3 Clearly show and describe in detail, steel members, dimensions and connections, etc.

- .4 In the case of trusses, show complete elevations of members and welded connection details on the same Drawing. Multiple letter-size detail sheets for connection welds will not be accepted.
- .5 Steel data: In addition, submit mill test reports, equivalent test data or manufacturer's certification, that steel provided conforms to Specifications.
- .6 Test results and certifications: Submit test reports, procedure Specifications and certifications as required to substantiate welded connection design, and welder qualifications
- .7 Submit EPD (Environmental Product Declaration) for structural steel framing (if available).
 - .1 EPD to be prepared in accordance with ISO 14025 and ISO 21930.
 - .2 EPD to report GWP (Global Warming Potential) in units of kg CO2 equivalent per tonne of steel.
- .2 Diagrams/templates: Submit to installing trade, anchor bolt diagrams and/or templates for anchor bolt locations, in accordance with installing trade's schedule requirements.
- .3 Maintenance: Submit six 4 litre cans of primer-finish paint in the same colour and type as shop-applied primer, in accordance with Section 01 10 00 – General Requirements. Provide labels on each can identifying contents, manufacturer and trade name, colour, date, generic paint type and intended use (touch-up of structural steel).

1.5 **QUALITY ASSURANCE**

- .1 Welding Qualifications
 - .1 Welding: Executed by an organization certified in accordance with CSA W47.1 Division 1 or 2.1.
 - .2 Operators employed on the Work: Qualified "Class O" per CSA W47.1 for work as required by Contract.
 - .3 Inspection/testing company, and welding inspector and supervisors: Meeting qualifications per CSA W178.1 and CSA W178.2 and are certified by the Canadian Welding Bureau in Category (a), Buildings.
 - .4 Have welding undertaken by companies and welders fully approved to CSA W47.1 and CSA W59-M.
- .2 Testing and Inspection
 - .1 Refer to "Quality Control" in Section 01 10 00 – General Requirements.
 - .2 Except for inspection/testing of splices introduced by fabricator in steel sections at random locations as specified herein, Contractor will employ an inspection/testing company to perform other shop and field inspection/testing as specified herein, and will pay costs for same.
 - .3 Inspection/testing company's representative will visit fabrication plant and submit reports of each visit, with copies to Contractor and Consultant. Reports will show tonnage fabricated and inspected, with comments on conformity to Specifications, workmanship and listing of defects or inaccuracies encountered. Reports will also be submitted for inspection of field erection per CAN/CSA S16.1.

- .4 Mill inspection: Inspection will determine that materials conform to Specifications. Mill test reports, properly correlated to materials, will be accepted in lieu of physical tests.
- .5 Shop inspection: Inspection will establish that structural steel is fabricated within specified tolerances and in accordance with reviewed Shop Drawings and in conformance with specified fabrication and welding procedures; surface preparation and prime painting as specified herein. Steel will also be inspected in the shop prior to shipment to Site.
- .6 Extent of inspection/testing during fabrication and erection will be as specifically detailed to inspection/testing company by Consultant. Cooperate with inspection/testing company personnel and allow access and facilities for inspection and testing.
- .7 Inspection and testing does not relieve Contractor of its responsibility for quality control but is a precaution against errors. Defective materials and/or workmanship may be rejected, regardless of previous inspection, whenever found.
- .3 Welded joints: Inspection/testing company will perform non-destructive testing of 25% of welded connections chosen at random as follows:
 - .1 Moment connections involving use of fillet welds: 100% magnetic particle inspection for fillet welds.
 - .2 Moment connections involving use of full penetration groove welds: 100% ultrasonic testing for groove welds.
 - .3 Where moments are transferred by either fillet welds or groove welds into end plates in "T" joint configurations, base metal is to be examined by Ultrasonics for lamellar tearing or cracking.
- .4 Prime Painting
 - .1 Inspection/testing company will inspect cleaning and prime painting in fabricator's shop.
 - .2 Inspection/testing of surfaces will generally take place after preparation and cleaning of surfaces but prior to application of primer paint. Notify inspection/testing company in advance of surface preparation and primer paint application. Preparation of substrate will be inspected and evaluated for conformance with the referenced SSPC specifications, in particular, peak profile.
 - .3 Primer paint system will be tested for dry film thickness using non-destructive method; it will be inspected for cure and film imperfections such as runs, sags and embedded foreign matter; inspection/testing company will also inspect field touch-up and preparation of surfaces to receive same.
 - .4 Correct deficiencies and have such corrected Work approved by inspection/testing company before resumption of Work.

1.6 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Handle and store materials in shop and at site in a manner to prevent damage to primer finish. Repair or replace damaged materials due to improper storage or handling at no cost to Owner.

- .2 Deliver anchor bolts, base, bearing and leveling plates, cast-in hardware and other material that is supplied only under Work of this section to section responsible for installation, to location directed at time required by construction schedule.
- .3 Handle and store structural steel and cold-formed elements to prevent damage or corrosion to stored or erected Work, or to other property.
- .4 Verify paint delivery dates with paint supplier to ensure primer paint is supplied to coincide with schedule of Work.
- .5 Exercise care in handling shop-primed materials. Do not handle steel until primer paint has cured sufficiently to handle without damage to same.
- .6 Use nylon slings for handling and a combination of wood and/or polystyrene blocking between units, in stockpile and in transit. Schedule and sequence the Work so a minimum of handling occurs prior to erection.
- .7 Prevent the formation of wet storage stain on galvanized articles by complying with the following measures:
 - .1 Stack articles or bundle to allow air between the galvanized surfaces during transport from supplier. Load materials in such a manner that continuous drainage can occur.
 - .2 Raise articles from the ground and separate with strip spacers to provide free access of air to most parts of the surface. Incline in a manner which will allow continuous drainage. Do not lay galvanized steel on cinders, clinkers, wet soil or decaying vegetation.
 - .3 Handle galvanized articles in such a manner as to avoid any mechanical damage and to prevent distortion.

1.7 **PROJECT CONDITIONS**

- .1 Environmental requirements: Maintain ambient temperature and humidity conditions compatible to proper workability of primer paint material as specified by manufacturer and to a successfully completed installation. Keep a daily log of ambient temperature and humidity conditions during primer application. Have log made available for examination by the inspection/testing company.
- .2 Existing conditions: Field verify existing Site conditions and measurements which could have affect on the Work.

1.8 **WARRANTY**

- .1 Submit a written warranty in a form approved by Owner, warranting primer-finish paint system against chipping, cracking, flaking, blistering, peeling on delamination from substrate for a period of two years, commencing from date of Substantial Performance.

2 **Products**

2.1 **MATERIALS**

- .1 Structural shapes, plates, etc.: New material conforming to CSA-G40.20/G40.21-M, Grade 350W for W and H shapes, and Grade 300W for other shapes, and plates.
- .2 Hollow structural sections: New material conforming to CSA-G40.20/G40.21-M Grade 350W, Class C.

- .3 Checker plate: To CSA G40.21, Grade 300W, with rolled in embossments to provide non-slip surface.
- .4 High strength bolts, nuts and washers: Conforming to ASTM A325M, with each type and size of bolt and nut of same manufacture and of same lot.
 - .1 Bolts: Heavy, hexagon head high strength structural bolts, of standard size, of lengths required for thickness of members joined and for type of connection.
 - .2 Nuts: Heavy hexagon semi-finished nuts per ASTM A563M.
 - .3 Washers: Flat and smooth hardened washers, quenched and tempered.
- .5 Machine bolts and anchor rods: As specified below, complete with hexagon heads and nuts:
 - .1 Common bolts: Conforming to ASTM A307, Grade A, of lengths required to suit thickness of material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.
 - .2 Anchor rods: Conforming to ASTM F1554, grade 55, of lengths noted, but projecting not less than 13 mm beyond nut unless otherwise noted.
 - .3 Nuts: Per ASTM A563M.
- .6 Expansion bolts: Stud/wedge type; Carbon Steel Hilti Kwik Bolts, medium duty or Rawl-stud (threaded version) by Rawlplug Canada Ltd. Galvanize bolts per ASTM B695. Refer to Drawing for bolt diameter and length.
- .7 Anchor bolt sleeves: High impact, high density polyethylene plastic sleeves; "Wilson" by Acrow Richmond, or "Contec D-I-S" by Dayton Superior.
- .8 Welding electrodes: To meet CSA W48 series on welding electrodes. Any process which produces deposited weld metal meeting requirements of applicable CSA W48 series standard for any grade of arc welding electrodes shall be accepted as equivalent to use of such electrodes.
- .9 Primer paint: Solvent-reducible alkyd, light grey, in fast drying, lead and zinc-chromate free formulation conforming to CISC/CPMA 2.75. Use one brand of primer paint throughout the Work, in any of the following, tinted to the specified colour:
 - .1 "97-680" by PPG Canada Inc.
 - .2 Selectone "MR-05-3" by Selectone Paints Ltd.
 - .3 ICI Devoe "Rustguard 4140-6120"
 - .4 "Kem Bond HS-B50WZ4" by Sherwin-Williams
- .10 Primer paint: Solvent reducible alkyd, white, in fast drying, lead and zinc-chromate free formulation conforming to CISC/CPMA 2.75. Use one brand of primer paint throughout the Work, in any of the following:
 - .1 "97-680" by PPG Canada Inc.
 - .2 Selectone "MR-05-5" by Selectone Paints Ltd.
 - .3 ICI Devoe "Rustguard 4140"
 - .4 "Kem Bond HS-B50WZ4" by Sherwin-Williams

- .11 Galvanizing: Hot-dip galvanizing with minimum zinc coating of 600 g/m² to CAN/CSA G164-M.
- .12 Galvanized primer: Zinc rich conforming to CGSB 1-GP-181M for new galvanized metal in compliance with CGSB 85-GP-16M. For galvanized fabrications touchup to remain unpainted in finished Work, use W.R. Meadows of Canada Ltd. "Galvafrid" or Kerry Industries "Z.R.C." or Niagara Paint Inc. "PL052898" zinc rich coating.

2.2 **WORKMANSHIP AND FABRICATION**

- .1 Design details and execute Work in accordance with CAN/CSA S16.1.
- .2 Shop weld per welding requirements specified herein.
- .3 Carefully make and fit details and take special care so finished Work presents a neat and workmanlike appearance.
- .4 Assemble members true and without twists or open joints.
- .5 Properly cut and size holes for connecting Work of other trades where such can be determined prior to fabrication. Where possible, show such holes on Shop Drawings.
- .6 **Beam Connections**
 - .1 Of type to adequately resist reactions produced by framing or load conditions.
 - .2 Beam and girder to column connections to be of type which applies vertical reaction with negligible eccentricity at connecting face of column, such as double angle web connections or unstiffened seats, unless otherwise shown.
 - .3 Comply with requirements of CISC Handbook of Steel Construction, except that length of beam or girder web angles shall not be less than half the depth of beam or girder, and single angles shall not be used for beams or girders except as otherwise shown on the Drawings.
 - .4 Use direct connections to flanges of spandrel beams to restrain twisting.
 - .5 Do not use fish plate or shear plate connections.
- .7 **Holes**
 - .1 Cut holes and reinforce openings only where shown. Cutting of holes in structural members in the field will not be permitted except with written approval of Consultant.
 - .2 Prevent accumulation of water in tubular members by providing drainage holes.
- .8 **Columns and base plates:** Sawcut bottom of columns and weld to flattened base plates. Size holes in base plates to allow for slight field adjustment to bring columns into line.
 - .1 Follow suggested anchor rod hole sizes by CISC Handbook of Steel Construction, latest edition.
 - .2 Provide washers with standard size holes, added beneath the nuts and sized to cover entire hole when anchor rod is located at the edge of the hole. Washer thickness must be adequate to prevent pulling through the hole and not less than 1/3 the anchor rod diameter.
 - .3 Weld washers appropriately to base plates of columns which belong to the braced bays and/or the moment frame.

.9 Beams, Girders, Purlins, Girts and Sag Rods

- .1 Beams, purlins, girts and sag rods are as shown and as required to complete the Work. Machine bolts may be used for girts, and door frames not connecting to columns if they are not in a braced bay, and therefore not part of bracing system.

.10 Trusses and sway frames: Welded construction, with lines of truss members intersecting at panel points, and with connections to withstand stresses shown. Place welded spacers in double members in accordance with the Ontario Building Code. Camber trusses as shown on Drawings.

.11 Door Frames

- .1 Select frames for trueness of web and flange. Straighten sections as required so finished frames are uniform, square and true.
- .2 Provide door frames with plates, extensions, stops, lintels, including required expansion bolts and anchors for field installation.
- .3 Fabricate and assemble frames by welding. Join built-up members by plug welding. Continuously weld exposed joints, with welds ground smooth.
- .4 Tack weld temporary steel spreaders to prevent frames from springing out of shape. Grind welds smooth following removal of spreaders.

2.3 **SURFACE PREPARATION AND PRIME PAINTING**

- .1 Clean structural steel to SSPC SP3 - Power Tool Cleaning.
- .2 Prepare paint material in accordance with paint manufacturer's written directions. Material may be thinned if required, using materials recommended by paint manufacturer, using minimum amounts, but not exceeding paint manufacturer's maximum allowable mixing ratio. Provide for paint manufacturer representation in shop for application instructions. Comply with paint manufacturer's recommendations relative to equipment and application techniques.
- .3 Prime Painting
- .1 Shop prime steel with one coat of primer paint to a dry film thickness of 0.051 mm to 0.064 mm.
- .2 Clean but do not paint surfaces to be field welded or buried in concrete or masonry (or surfaces to receive sprayed fireproofing).
- .3 Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7°C (45°F).
- .4 Paint surfaces which will be inaccessible after assembly with two coats of primer paint before assembly. Paint surfaces inaccessible during general painting of the building with two shop coats before erection.
- .5 Paint materials under cover and leave under cover until paint is thoroughly dry. Thoroughly work paint into joints and open surfaces. Follow paint manufacturer's recommendations regarding application methods, equipment, temperature and humidity conditions.
- .6 Use one brand of paint throughout the Work.

2.4 **HOT-DIP GALVANIZING**

- .1 Galvanize specified steel members.
- .2 Perform hot-dip galvanizing after fabrication. Provide relief and drain holes. After galvanizing, ream holes to proper size and re-tap threads. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with galvanize primer in accordance with manufacturer's printed directions.
- .3 Wet storage stain: Remove wet storage stain that may have developed in the coating before installation so that premature failure of the coating does not occur. Remove wet storage stain in accordance with galvanizer's recommendations.
- .4 Repair of galvanized items: Repair coatings damaged by welding, cutting, or during handling, transport or erection using cold galvanizing compound specified, and as follows:
 - .1 Ensure surface is clean, dry, and free of oil, grease and corrosion.
 - .2 Power clean surface to near white metal condition, extending into undamaged galvanized coating.
 - .3 Apply touch up material to a dry film thickness of 0.203 mm minimum. If touched up Work is to remain exposed in the finished Work, apply a finish coat of aluminum paint to provide a colour blend with the surrounding galvanizing.
 - .4 Coating shall be continuous, adherent, smooth and evenly distributed.

2.5 **SOURCE QUALITY CONTROL**

- .1 Non-destructive testing of randomly located butt welded splices: Using ultrasonic, radiographic or other non-destructive test method acceptable to Consultant, test butt welded splices which are composed of random lengths of structural sections as follows:
 - .1 100% of splices in beams, beam columns, girts or any other member in the zone where tensile bending stresses are greater than 0.90 times the design maximum bending stress. For simply spanning members this may be taken to be any splice within the central third of span.
 - .2 10% of splices located elsewhere, chosen at random.

3 **Execution**

3.1 **REMOVALS**

- .1 Take precautions to protect the existing structure from damage.
- .2 Dismantle and cut existing structural steel as required. Provide temporary shoring and bracing required for these operations. Retain a Professional Engineer to design the temporary shoring and to review this Work on site.
- .3 Remove and dispose of off site, existing steel which is dismantled but not designated for reuse. It shall become the property of the Contractor.

3.2 **EXAMINATION**

- .1 Verify that location of concrete piers, foundations and anchor bolts are correct and at proper elevations to allow for subsequent grouting of structural steel base plates.
- .2 Check location of anchor bolts in sufficient time to allow any required corrective Work to be performed by Contractor responsible before commencement of structural steel erection, to assure that schedule of steel erection is maintained.

3.3 **ERECTION**

- .1 Erect structural steel Work conforming to CAN/CSA S16.1.
- .2 Set steel accurately to lines and elevations shown. Set column bases and shim to proper elevations, ready for grouting.
- .3 Obtain Consultant's written permission prior to any field cutting or altering of structural members.
- .4 Only light drifting to draw parts together will be permitted; any enlargement of holes to execute bolted connections shall be done by reaming with a twist drill. Burning is not permitted for forming of holes, enlarging of holes, or matching of unfair holes.
- .5 Guying and bracing: Structure has been designed to resist loads shown only in its completed, fully-clad state. Review the structure for loads, including wind and temperature effects, acting on frames under various stages of erection until completion of structure. Make provision for horizontal and vertical erection loads and for temporary guying and bracing to keep structural frame safe, plumb and in true alignment per CAN/CSA S16.1.
- .6 Tolerance: Plumb and level individual pieces of structural steel frame in accordance with CAN/CSA S16.1.
- .7 General Connections
 - .1 Weld or otherwise bolt main member connections with high tensile-strength bolts using CISC double angle header connections, except where specifically noted or shown otherwise. Provide high tensile-strength bolted connections per "Bolted Connection" paragraph specified herein using minimum 19 mm diameter bolts conforming to ASTM A325M.
 - .2 Do not permit connections to encroach on clearance lines required for the installation of Work of other contracts and subcontracts.
 - .3 Support the dead load of the steel structure plus the weight of the metal deck and siding on steel (shims) or (double-nuts) until grouting is completed.
- .8 Bolted Connections
 - .1 Perform high tensile-strength bolted connections in accordance with CAN/CSA S16.1. Accurately space holes of size 2.0 mm larger than nominal diameter of bolt.
 - .2 Furnish compressors or electrical equipment capable of supplying and maintaining required pressure at wrench. Make connections without the use of erection bolts, some high tensile-strength bolts will serve that purpose. Nuts on bolts, except high tensile-strength bolts, shall be prevented from becoming loose by burring bolt thread or by lock washers or lock nuts. In the case of sag rods, connect each end with double nuts; in other words, one nut above and one nut below the web of the girt.
- .9 Welded Connections
 - .1 Perform welding without causing damage or distortion to the Work. Should there be, in opinion of Consultant, inspection/testing company will test such welds for efficiency. Remove any Work not meeting CSA standards and replace with new Work satisfactory to Consultant. Execute welding in accordance with the following standards:

- .1 CSA W48.1-M - for electrodes (If rods are used, only coated rods are allowed)
- .2 CSA W59-M - for design of connections and workmanship
- .3 CAN/CSA-W117.2-M - for safety
- .2 Take necessary safety precautions in accordance with CSA standards when welding is carried out in cold weather.

3.4 **FIELD QUALITY CONTROL**

- .1 Field inspection by an inspection/testing company will be performed to meet requirements as specified under "Inspection/Testing" specified herein, and include:
 - .1 Inspection of erection and fit-up, including placing, plumbing, leveling and temporary and permanent bracing.
 - .2 Inspection of bolted connections.
 - .3 Inspection of welded joints.
 - .4 General inspection of field cutting and alterations.
 - .5 General inspection of preparation, prime painting and field touch up of prime painting.

3.5 **CLEANING AND TOUCH-UP**

- .1 As steel is erected, clean bolt heads, washers and nuts, previously unprimed connections, surfaces damaged during erection, welds and burned or scratched surfaces, with power wire brush to SSPC-SP3, then touch-up with same primer used in the shop, and to shop paint dry film thickness. Coverage of touch-up paint to a given area shall be concentrated to disturbed, damaged or unpainted portion, and extend to limits as required to maintain continuity and integrity of paint film and appearance.
- .2 As steel is erected, thoroughly wash down with clean water, or other means as approved by paint manufacturer, to remove mud, erection marks and other foreign matter from steel.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- | | | | |
|-----|---------------------|---|--|
| .1 | ASTM A123/A123M | - | Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| .2 | ASTM A153/A153M | - | Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| .3 | ASTM A653/A653M | - | Specification for Steel Sheet, Zinc Coated, (Galvanized) or Zinc-Iron Coated Alloy Coated (Galvannealed) by the Hot-Dip Process |
| .4 | CSA-G40.20/G40.21-M | - | General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels |
| .5 | CSA S136 | - | Cold-Formed Steel Structural Members |
| .6 | CSA W47.1 | - | Certification of Companies for Fusion Welding of Steel Structures |
| .7 | CSA W48 Series | - | Electrodes |
| .8 | CSA W59-M | - | Welded Steel Construction (Metal Arc Welding) |
| .9 | CSA W178.1 | - | Certification of Welding Inspection Organizations |
| .10 | CSA W178.2 | - | Certification of Welding Inspectors |
| .11 | CISC/CPMA 2.75 | - | Canadian Institute of Steel Construction/Canadian Paint Manufacturers Association, A Quick-Drying Primer for Use on Structural Steel |
| .12 | AODA | - | Accessibility for Ontarians with Disabilities Act |

1.3 **DESIGN CRITERIA**

- .1 Base design on CSA S136.
- .2 Unit stress under full live and dead loads not to exceed 138 MPa (20,000 psi) and live load deflection (of metal roof deck) not to exceed L/240th of the span. Refer to structural Drawings for loadings, and related data. Minimum base steel thickness of all deck is as shown on Drawings.
- .3 Roof deck to conform with Factory Mutual "Loss Prevention Data Sheets 1-28, Wind Design; 1-28R, Roofing Systems and 1-29, Roof Deck Securement and Above-Deck Roofing Components" for Zone 1 uplift pressures.
- .4 Comply with roof deck requirements of the Ontario Building Code.

- .5 Design metal deck to generally span over four or more supports (three or more spans). For one-span or two-span conditions, heavier gauge deck may be required.

1.4 **SUBMITTALS**

- .1 Shop Drawings: Submit in accordance with Section 01 33 00. Show the following:
 - .1 Design loads
 - .2 Materials, gauges and dimensions
 - .3 Layout and installation details
 - .4 General notes indicating material and installation compliance with the Specifications
- .2 The design and Shop Drawings shall bear the seal of a qualified Professional Engineer licensed to practice in the Province of Ontario. .

1.5 **QUALITY ASSURANCE**

- .1 Metal deck installer: Manufacturer's construction forces, or by an installer accredited by deck manufacturer.
- .2 Welding Qualifications
 - .1 Welding: Executed by organizations certified in accordance with CSA W47.1 Division 1 or 2.1.
 - .2 Operators employed on the Work: Qualified "Class 0" per CSA W47.1 for Work as required by Contract.
 - .3 Inspection/testing company, welding inspector, and supervisors: Meeting qualifications per CSA W178.1 and CSA W178.2 and are certified by the Canadian Welding Bureau in Category (a), Buildings.
 - .4 Welding undertaken by companies and welders approved to CSA W47.1 and CSA W59-M.
- .3 Testing/Inspection
 - .1 Refer to "Quality Control" in Section 01 10 00 – General Requirements.
 - .2 The Contractor will select and pay for an independent inspection/testing company approved by the Owner to perform field inspection and testing.
 - .3 The inspector will inspect welded joints and will perform visual inspection of 25% of welded connections chosen at random. The inspector will also inspect button clinching, cutting, screws used, and to observe workmanship in general.

1.6 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Comply with CSSBI guidelines, and the requirements specified herein.
- .2 Protect the Work of this section from damage. Protect other Work from damage resulting from this Work. Replace damaged Work that cannot be satisfactorily repaired.
- .3 Store materials on Site in a manner to prevent damage thereto, or deterioration of finish. Materials which show evidence of "white rust" will not be accepted.

- .4 Stockpile panels tilted to provide water run-off, free from ground contact on firm, level, non-staining supports extending full width of sheet and spaced not more than 900 mm apart. Where possible, pile individual sheets or panel length and types separately. Cover components with non-plastic sheet coverings to protect from direct sunlight and moisture penetration. Tie coverings to prevent blow-off. Vent to allow air movement.
- .5 Store panels away from chemically corrosive substances (e.g. salt, cement), away from materials that could contaminate the surface (e.g. diesel oil, paint, grease), and away from construction traffic.
- .6 Transport materials to Site in a manner to prevent in-transit damage. These measures include, but are not limited to crating, polyethylene wrapping system, etc.

2 Products

2.1 METAL DECK

- .1 General: Source deck from one manufacturer.
- .2 Sheet metal for metal deck and accessories: Conforming to ASTM A653/A653M, having zinc coating in the following designations:
 - .1 ZF75 zinc coating: Where deck is designated to be painted in the field
 - .2 Z275 zinc coating: Where deck is to be left exposed.
- .3 Roof deck profile: 38 mm depth, in any one of the following:
 - .1 VicWest "RD-938"
 - .2 Agway "RD 36"
 - .3 The Roll Form Group "S-15"
 - .4 Canam Steel Works "P3615"
- .4 Floor deck profile: 38 mm depth, composite, (inverted type,) in any of the following:
 - .1 VicWest "HB 938"
 - .2 Agway "CD 36"
 - .3 The Roll Form Group "S-15-K"
 - .4 Canam Steel Works "P3615 Composite"
- .5 Floor deck profile: 38 mm depth, non-composite type, in any of the following:
 - .1 VicWest "FD-938"
 - .2 Agway "RD-36"
 - .3 The Roll Form Group "S-15"
 - .4 Canam Steel Works "P-3615"
- .6 Roof deck profile: 76 mm depth, in any one of the following:
 - .1 VicWest "RD-308"
 - .2 Agway "RD-75-200"

- .3 The Roll Form Group "S-30-8"
- .7 Floor deck profile: 76 mm depth, non-composite type, in any one of the following:
 - .1 VicWest "FD-306"
 - .2 Agway "CD-75-150"
- .8 Smoke curtains: Same as metal deck complete with (specify gauge) angle (tee) trim, reinforcing, stiffeners, etc.

2.2 **SHEET STEEL ACCESSORIES**

- .1 Closure plates, flute closures: Sheet steel in base thickness of 0.914 mm (20 ga). Notch flute closures to fit flute profile.
- .2 Roof sump pans at roof drains: Sheet steel in base thickness of 1.9 mm (14 ga) in overall size as shown, of slope design to fit roof slope, formed with depressed level and flat bottom 38 mm below adjacent roof deck surface at low side. Form 75 mm flanged edges to fit flat on top of adjacent roof deck.
- .3 Ridge and valley plates: Fabricate from single width sheet steel in base thickness of 1.2 mm (18 ga), in sections as long as possible. Fabricate to form transition slopes required, not less than 115 mm effective width per side, with 75 mm flange for securing to roof deck.
- .4 Metal cants: Sheet steel in base thickness of 1.9 mm (14 ga).
- .5 Curbs around roof openings: Sheet steel in base thickness of 1.6 mm (16 ga). For curb openings in excess of 1200 mm, use 1.9 mm thick (14 ga).
- .6 Mechanical equipment curbs: By mechanical division.
- .7 Deck edge supports: Steel sheet in base thickness and zinc coating same as deck, complete with welded anchor straps.
- .8 Inverted floor deck lock plates: Sheet steel in base thickness of 1.6 mm (16 ga).

2.3 **COATING SYSTEM**

- .1 Coating system for underside of prepainted deck: Silicone modified polyester (SMP) system, coil coated, using US Steel Supply "WeatherX" or ArcelorMittal "Perspectra Series". Coil coated surface pretreated and primed prior to application of coating. Unexposed surface primed and wash coat finished. Colour: to later selection by Consultant from manufacturer's full colour range.

2.4 **DECK SECUREMENT**

- .1 Welding electrodes: To meet CSA W48 series on welding electrodes. Any process which produces deposited weld metal meeting requirements of applicable CSA W48 series standard for any grade or arc welding electrodes shall be accepted as equivalent to use of such electrodes.
- .2 Mechanical fasteners: Hilti or Construction Fasteners Limited, FM-approved fasteners for Class 1-60 (1-90) Windstorm Resistance.

2.5 **MISCELLANEOUS ACCESSORIES**

- .1 Mechanical fasteners (for sheet metal to sheet metal connections): Self drilling, self-drilling sheet metal screws not less than No. 14.

- .2 Stud shear connectors: Size and pattern as indicated on Drawings.
- .3 Zinc rich primer: For touch-up of galvanized metal, use W.R. Meadows "Galvafrid" or Kerry Industries "Z.R.C."
- .4 Compressible flute closures: Closed cell neoprene, moulded to fit flute profile.
- .5 Waterproof tape, caulking: Self adhesive waterproof tape, and Tremco "Butyl Sealant".
- .6 Acoustic deck insulation: Custom cut in a square cross section to fill entire width, thickness and length of deck flute, Owens Corning Canada "AF 100", Fibrex Insulation "Sound Attenuation Batt", or Roxul "RXL20". Supply to roofer for installation.
- .7 Structural shapes and plates, etc.: Structural quality conforming to CSA-G40.20-M/ G40.21-M, primer to match that of structural steel and conforming to CISC/CPMA 2.75 (others).
- .8 Structural shapes and plates: Structural quality steel conforming to CSA-G40.20-M/ G40.21-M, hot-dip galvanized to ASTM A123. For nuts, bolts and other hardware, hot-dip galvanize in accordance with ASTM A153.

3 Execution

3.1 **INSTALLATION**

- .1 Install deck in accordance with reviewed Shop Drawings.
- .2 Roof deck and floor deck to generally span over four or more supports. For one or two span conditions, a heavier gauge metal deck may be required.
- .3 Roof deck and connections to steel framing shall be capable of resisting direct uplift due to wind immediately upon erection. (Wind uplift forces as shown on Drawings). Roof deck and connections to steel framing shall also be capable of resisting diaphragm action, if required.
- .4 Roof deck acts as a diaphragm structurally. Mechanically fasten or weld decking to steel and button clinch interlocking rib joints in accordance with the structural steel Drawings. End joints between deck sections shall be on supports.
- .5 Patching or replacement of less than full sheets of metal decking will not be permitted.
- .6 Damaged, bent or dished sheets shall be rejected and removed from the Site.
- .7 Place metal decking on supporting steel members so a continuous bearing is obtained. Minimum end bearing of any decking unit shall be 50 mm. Make end joints over supports. Where 50 mm bearing is not achievable, place metal deck supports as required. These deck supports shall be designed by a Professional Engineer licensed to practice in the province of Ontario, and shall be shown on Shop Drawings.
- .8 Provide deck edge supports as required to support high deck flutes where deck runs parallel to structural steel at building perimeter, roof and floor openings, and at interface with walls.
- .9 Align metal deck units end to end to provide accurate fit with corresponding units, with sections parallel, level and straight.
- .10 Place closures and closure plates on ends of decks, around openings and along deck edges where walls and flute direction are parallel.
- .11 Screw vertical closure plates to steel deck.

- .12 Properly secure all deck sheets on the roof prior to leaving the jobsite at the end of each Working Day. Remove from the roof and lower to the ground, all steel deck cuttings, strapping, packaging material and other debris resulting from decking Work at the completion of each Working Day.

3.2 **DECK SECUREMENT**

- .1 Secure deck to structural steel by mechanical fastening or by welding.
- .2 Welding
 - .1 Thoroughly and securely weld decking to supporting steel by means of 19 mm effective diameter fusion welds at 300 mm on centre maximum or as noted or shown otherwise. End joints between deck sections shall be on supports.
 - .2 Conform to CSA Welding Standards W59-M, W48 Series and W117.2.
 - .3 Button clinch interlocking rib joints at 900 mm on centres or as noted or shown otherwise. Screw interlapping side joints at 900 mm o.c. or as noted or shown otherwise. To ensure that joints are fully engaged, stand on high flute of deck while clinching.
 - .4 Hold deck in contact with adjoining member while welding.
- .3 Mechanical Fastening
 - .1 (Install prepainted deck using mechanical fasteners only.) Secure decking to structural steel framing with mechanical fasteners.
 - .2 Type and frequency of fasteners shall be as specified by the deck manufacturer's Design Engineer.
 - .3 All end joints between deck sections shall be over structural steel support framing.
 - .4 Button clinch interlocking rib joints at maximum 900 mm on centres or as noted or shown otherwise. To ensure joints are fully engaged, stand on high flutes of deck while clinching.

3.3 **CUTTING AND FITTING**

- .1 Field cut metal decking to fit around columns, supports, passage of mechanical or process equipment and other projections where indicated and/or required. Ensure that information on size and location of openings is obtained before fabrication commences. Have respective trades mark the location of cuts prior to cutting.
- .2 Perform cutting using power operated devices without the use of torches. Accuracy of the opening shall be to within 3 mm of the opening size shown. Remove sharp burrs caused by cutting process and touch up with zinc rich primer.
- .3 Cut circular openings for roof drains as coordinated with (mechanical trade) (roofing trade).
- .4 Coordinate location and size of openings with mechanical trades (Contract) to permit the hoisting of roofing materials. Cut openings and reinforce opening perimeter to suit. Provide safeguards and weather protection for each opening as required by the Work. Close openings with roof deck material to match existing installed as progress of roofing Work dictates.
- .5 Provide protection around deck openings to meet Ministry of Labour requirements.

3.4 REINFORCING DECK OPENINGS

- .1 Reinforce roof openings up to maximum 450 mm in either dimension (square or diameter)
 - .1 For roof deck openings up to 150 mm across the flutes, no reinforcement is necessary provided that not more than two vertical deck webs are removed.
 - .2 For roof deck openings over 150 mm to 300 mm across the flutes, reinforce with not less than a 51 x 51 x 6 mm steel angle across each side of the opening in a direction perpendicular to the flutes. Weld angles to at least two flutes on each side of the opening. Alternatively, provide reinforcing of design based on a structural analysis of the loads involved. Show this reinforcing on Shop Drawings.
 - .3 For roof deck openings over 300 mm to 450 mm across the flutes, Provide suitable reinforcement of design based on a structural analysis of the loads involved. Show this reinforcing on Shop Drawings.
- .2 Reinforce floor openings up to 300 mm in either dimension
 - .1 Provide reinforcing in accordance with structural Drawings.

3.5 PLACEMENT AND FASTENING OF ACCESSORIES

- .1 Install equipment and roof penetration curbs. Fasten to metal deck at maximum 300 mm on centres with mechanical fasteners.
- .2 Set roof sump pans in locations for roof drains, with bottom level. Screw fasten to roof deck at 150 mm centres around perimeter of pan.

3.6 TAPING AND CAULKING

- .1 Tape and caulk around columns, openings and at edges of deck for concrete slab as required to prevent leakage of concrete and/or water. Tape all end joints; caulk all side joints.

3.7 FIELD TOUCH-UP

- .1 Touch up marred galvanized surfaces and welds after installation, with zinc rich primer, to the satisfaction of Consultant. Touch up welds at top surface of metal deck.
- .2 Repair welding burn holes in metal deck that miss structural supports to the satisfaction of the Consultant.
- .3 Touch-up surfaces of prepainted material marred due to welding or otherwise, with matching prepaint material.
- .4 Remove and replace any deck panels with excessive welding burn holes at the discretion of the Consultant.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- | | | |
|-----|---------------------|---|
| .1 | ASTM A53 | - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless |
| .2 | ASTM F1554 | - Standard Specifications for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength |
| .3 | ASTM A325M | - High-Strength Bolts for Structural Steel Joints [Metric] |
| .4 | ASTM A500 | - Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| .5 | ASTM A653/A653M | - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process |
| .6 | ASTM B209M | - Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| .7 | ASTM B210M | - Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes |
| .8 | ASTM B221M | - Specification for Aluminum-Alloy Extruded Bars, Rods, Profiles and Tubes |
| .9 | ASTM B241/B241M | - Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube |
| .10 | ASTM B308/B308M | - Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles |
| .11 | ASTM D635 | - Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position |
| .12 | ASTM E84 | - Test Method for Surface Burning Characteristics of Building Materials |
| .13 | ASTM F436 | - Hardened Steel Washers (for Use with High Strength Bolts) |
| .14 | CAN3-S157-M | - Strength Design in Aluminum |
| .15 | CSA-G40.20/G40.21-M | - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel |
| .16 | CAN/CSA-S16.1 | - Limit States Design of Steel Structures |

- .17 CAN/CGSB-1.181 - Ready Mixed Organic Zinc Rich Coating
- .18 CGSB 85-GP-16M - Painting Galvanized Steel
- .19 CAN/CSA G164-M - Hot-Dip Galvanizing of Irregularly Shaped Articles
- .20 CSA W47.1 - Certification of Companies for Fusion Welding of Steel Structures
- .21 CSA W47.2 - Certification of Companies for Fusion Welding of Aluminum
- .22 CSA W48 Series - Electrodes
- .23 CSA W59-M - Welded Steel Construction (Metal Arc Welding)
- .24 CSA-W117.2 - Safety in Welding, Cutting and Allied Processes
- .25 CISC/CPMA 2.75 - Canadian Institute of Steel Construction/Canadian Paint Manufacturers Association "A Quick-Drying Primer for Use on Structural Steel"
- .26 CISC - Canadian Institute of Steel Construction, "Code of Standard Practice"
- .27 OPSS - Ontario Provincial Standard Specifications
- .28 SSPC - Steel Structures Painting Council, "Steel Structures Painting Manual, Vol. 2"

1.3 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit Shop Drawings for fabrication and erection of miscellaneous metals in accordance with Section 01 33 00.
 - .2 Clearly show and describe all items; sections, dimensions, erection details, anchors and fastenings, connection and jointing details.
 - .3 Shop Drawings for stairs and handrails and support members shall bear the seal and signature of a licenced Ontario Professional Structural Engineer responsible for their design.

1.4 QUALITY ASSURANCE

- .1 Retain a firm certified in accordance with CSA W47.1 Division 1 or 2.1 to perform welding. (For aluminum Work, retain a firm certified in accordance with CSA W47.2-M to perform welding.
- .2 Employ welding operators licensed per CSA W47.1 for types of welding required by the Work.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Coordinate deliveries to comply with construction schedule and arrange ahead for strategic off-the-ground, covered storage locations. Do not load areas beyond the designed limits.
- .2 Handle and store metal materials at job Site in a manner to prevent damage to other materials, (to existing buildings) or property.

- .3 Handle components with care, and Provide protection for surfaces against marring or other damage. Ship and store members with cardboard or other resilient spacers between surfaces. Use lifting chokers of material which will not damage surface of steel members.
- .4 Use strippable coatings or wrappings to protect exposed surfaces of prefinished metal Work which does not receive Site finishing. Use materials recommended by finishers or manufacturers of metals, to ensure that method is sufficiently protective, easily removed, and harmless to the finish.
- .5 Prevent the formation of wet storage stain on galvanized articles by complying with the following measures:
 - .1 Stack articles or bundle to allow air between the galvanized surfaces during transport from Supplier. Load materials in such a manner that continuous drainage could occur.
 - .2 Raise articles from the ground and separate with strip spacers to provide free access of air to most parts of the surface. Incline in a manner which will allow continuous drainage. Do not lay galvanized steel on cinders, clinkers, wet soil or decaying vegetation.
 - .3 Handle galvanized articles in such a manner as to avoid any mechanical damage and to prevent distortion.
- .6 Tag metal fabrications, including associated anchor bolts, sleeves, and bases, or otherwise mark for ease of identification at Project site.

1.6 **COORDINATION**

- .1 Supply to concrete, masonry and/or other sections, materials requiring setting and/or building-in in concrete, masonry or other trades. This includes inserts, anchors, frames, sleeves, etc. Verify locations of said materials.

1.7 **PROJECT CONDITIONS**

- .1 Field measurements: Take measurements at the building to assure proper fitting, fabrication, and erection of the Work. Check dimensions in the field, whether or not shown, upon which the accurate fitting together and building-in of the metal fabrication Work may depend or which affects the proper installation of the Work of others.

2 **Products**

2.1 **MATERIALS**

- .1 General: Metals shall be free from defects which impair strength or durability, or which are visible. Metals shall be new, of best quality and free from rust, waves or buckles, and clean, straight throughout entire length, sharply defined profiles and true in web and flange.
- .2 Structural shapes, plates, etc.: New material conforming to CSA-G40.20/G40.21-M, Grade 350W for W and H shapes, and Grade 300W for other shapes, and plates.
- .3 Hollow structural sections: New material conforming to CSA-G40.20/G40.21-M Grade 350W, Class H.
- .4 Welding materials: Conforming to CSA W48.1-M and CSA W59-M.

- .5 High strength bolts, nuts and washers: Conforming to ASTM A325M, with each type and size of bolt and nut of same manufacture and of same lot.
 - .1 Bolts: Heavy, hexagon head high strength structural bolts, of standard size, of lengths required for thickness of members joined and for type of connection.
 - .2 Nuts: Heavy hexagon semi-finished nuts per ASTM A563M.
 - .3 Washers: Flat and smooth hardened washers, quenched and tempered.
- .6 Machine bolts and anchor rods: As specified below, complete with hexagon heads and nuts:
 - .1 Common bolts: Conforming to ASTM A307, Grade A, of lengths required to suit thickness of material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.
 - .2 Anchor rods: Conforming to ASTM F1554, Grade 36, of lengths noted, but projecting not less than 13 mm beyond nut unless otherwise noted.
 - .3 Nuts: per ASTM A563M.
- .7 Primer paint: Solvent reducible alkyd, light grey, in fast drying, lead and zinc-chromate free formulation conforming to CISC/CPMA 2.75. Use one brand of primer paint throughout the Work, in any of the following, tinted to the specified colour:
 - .1 "97-680" by PPG Canada Inc.
 - .2 Selectone "MR-05-3" by Selectone Paints Ltd.
 - .3 "Kem Bond HS-B50WZ4" by Sherwin-Williams
- .8 Primer paint: Solvent reducible alkyd, white, in fast drying, lead and zinc-chromate free formulation conforming to CISC/CPMA 2.75. Use one brand of primer paint throughout the Work, in any of the following:
 - .1 "97-680" by PPG Canada Inc.
 - .2 Selectone "MR-05-5" by Selectone Paints Ltd.
 - .3 "Kem Bond HS-B50WZ4" by Sherwin-Williams
- .9 Primer paint: Solvent reducible alkyd, red oxide, in fast drying, lead and zinc-chromate free formulation conforming to CISC/CPMA 2.75. Use one brand of primer throughout the Work, in any of the following:
 - .1 PPG "97-900"
 - .2 Selectone "J-82"
 - .3 ICI Devoe "27454"
 - .4 Sherwin-Williams "Kem Bond HS B50NZ3"
- .10 Galvanizing: Hot-dip galvanizing with minimum zinc coating of 600 g/m² to CAN/CSA G164-M.
- .11 Galvanized primer: Zinc rich conforming to CAN/CGSB-1.181 for new galvanized metal in compliance with CGSB 85-GP-16M. For galvanized fabrications touchup to remain unpainted in finished Work, use W.R. Meadows of Canada Ltd. "Galvafrid" or Kerry Industries "Z.R.C." or Niagara Paint Inc. "PL052898" zinc rich coating.

- .12 Handrails
 - .1 Steel pipe handrails: Conforming to ASTM A53, Type "S", Grade B steel pipe, powder coat finish. Colour to be selected by Consultant from manufacturer's standard colour range. Secure handrail to bracket with 2#10 FHMS through two countersunk holes in bracket.
 - .1 Handrail brackets: Julius Blum cast steel model 378 (377 -flat handrail), powder coat finish, and with flanges tapped for bolting. Colour to match steel pipe handrails. Secure bracket to post with 2#10 FHMS through countersunk holes into threaded insets in the post.
- .13 Steel pipe bumpers: Conforming to ASTM A500, cold rolled, bare, seamless steel pipe of sizes shown.
- .14 Stainless steel pipe: To ASTM A312, Type 304, 180-grit finish.
- .15 Pass Through Trays / Metal Liner: minimum 18 gauge stainless steel sheet to ASTM A167, type 304 to AISI No. 4 finish. Sheet to be levelled, free of buckles, warps and imperfections. Size and thickness as indicated on Drawings.
- .16 Galvanized sheet steel: 0.0897 mm (13 ga) core thickness commercial quality to ASTM A653/A653M, Grade A, with Z275 zinc coating designation.
- .17 Checkered plate: To ASTM A36, 6 mm thick, with raised diamond floor surface pattern.
- .18 Aluminum and steel bar grating: As manufactured by Fisher & Ludlow, Armco Irving, Borden Metal Products or Ohio Gratings Inc.
- .19 Grating treads and landings: As manufactured by Borden Metal Products, Armco Irving, Fisher & Ludlow or Ohio Gratings Inc. Furnish treads with 32 mm x 5 mm bearing bars incorporating 32 mm crosshatch abrasive nosing.
- .20 Fiber reinforced plastic (FRP) grating: Manufactured from premium grade (isophthalic) (vinylester) resin, conforming to ASTM E-84, Class 1 and flame rating and self-extinguishing requirements of ASTM D635. Patterns shall be (rectangular) (square), covered with baked on safety non-skid epoxy grit. Colour; (grey) (yellow) (custom). Fabricate grating to carry uniform distributed load of ____ lbs. ft² as manufactured by Fisher & Ludlow, Seasafe Inc., or MAK Enterprises Inc.
- .21 Ladder rungs (on steel rails): "Algrip" by Safe Walk Inc., "Mebac" by IKG Industries, "Slipnot" by W.S. Molnar Co. or Safety-Tread by Amico.
- .22 Ladder rungs (cast in concrete): 20 mm rectangular solid aluminum, alloy 6051T4 with non-slip surface, No. 2916 by Stepcon Industries Inc. or approved alternative.
- .23 Highway type beam guardrails: Single rail (double rail) manufactured by Armtec Limited, Canadian Metal Rolling Mills, or Canada Culvert and Metal Products, OPSS Type DD-909-A complete with standard terminal sections, splicers, galvanized steel nuts and bolts and 125 mm diameter concrete filled standard pipe posts.
- .24 Plastic handrail: Extruded high quality virgin PVC in colour to Consultant's selection: Rehau "Art. 70039RAU - PVC9505", Micro Plastics Canada Ltd., or VPI Rail "103A", verify models to handrail and railing steel plate size. Furnish covers with protective strippable covering to protect PVC from scratches and marring during construction process.

- .25 Drilled inserts: Ramset "Mega" or Hilti "HSL" heavy-duty anchors installed in accordance with manufacturer's directions, to sizes shown. Load capacity when embedded in 25 MPa concrete shall not be less than:

<u>Diameter</u>	<u>Pullout kN</u>	<u>Shear kN</u>
8 mm	30.0	36.0
10 mm	43.6	57.2
12 mm	53.6	82.8
16 mm	83.6	149.6
20 mm	119.6	205.6

- .26 Epoxy capsule type anchors: Hilti "HVA Adhesive Anchor", two-part, threaded steel stud and epoxy adhesive filled capsule anchoring system. Install per manufacturer's recommendations.

- .27 Stainless steel curbing for gas pump islands: Waggs Petroleum Equipment Island Forms or Pomeco/OPW Island Forms & Protective Curbing.

- .28 Bollards

.1 Interior Steel Pipe Bollards

- .1 Surface mounted, bolted down bollards with base plate, conforming to ASTM A500, Schedule 40 standard weight steel pipe cleaned to SSPC SP3 and shop primed with primer conforming to CISC/CPMA 2.75 (hot dip galvanized to CAN/CSA G164 M).
- .2 Dimensions of bollard as indicated on Drawings.
- .3 Base plate: 200 mm x 200 mm x 12.5 mm thick and 4 corner holes.
- .4 For Plastic Bollard Covers:
- .1 Cover with reflective stripe, plastic cover, safety yellow, 6 mm thick.
- .2 Finish: Schedule 40, safety yellow powder coat finish.

.2 Exterior Pipe Bollards

- .1 Concrete fille:
- .1 Hot dipped galvanized steel bollards. Fabricated in HSS in accordance with CSA G40.20/G40.21, Grade 350W, Class H or Schedule 40 steel pipe, grade B, in accordance with ASTM A53/53M
- .2 Sizes of bollard as indicated on Drawings.
- .3 Pipe Finish: ICI Devoe 201 or approved equivalent two-part polyamide epoxy tie coat, and exterior alkyd enamel topcoat conforming to CAN/CGSB-1.59-M.
- .2 Surface mounted, bolted down bollards with square base plate, hot dipped galvanized steel bollards. Fabricated in in accordance with CSA G40.20/G40.21, Grade 350W, Class H or Schedule 40 steel pipe, grade B, in accordance with ASTM A53/53M.
- .3 Bollard Cover with reflective stripe, plastic cover, 6 mm thick.

- .1 Finish: safety yellow finish.

2.2 **BASIC MATERIALS - ALUMINUM**

- .1 Aluminum rolled or extruded shapes: Structural quality to ASTM B308/B308M, Alloy 6061-T6.
- .2 Aluminum bar, rod, wire: To ASTM B221M.
- .3 Aluminum sheet or plate: To ASTM B209M.
- .4 Aluminum checkered plate: To ASTM B209M, Alloy 5086.
- .5 Aluminum drawn tubes: To ASTM B210M.
- .6 Aluminum pipe: To ASTM B241/B241M, Schedule 40, 6061 alloy.
- .7 Stainless steel bolts: Expansion bolts using high strength stainless steel conforming to ASTM A193, Grade B8, Type 316.
- .8 Aluminum finish: (plain mill finish) (clear anodic finish, designation AA-M12C22A41)
- .9 Accessories
 - .1 Steel bolts: To (ASTM F1554 grade 36) (ASTM A325M), hot-dip galvanized to CAN/CSA-G164-M, minimum zinc coating of 600 g/m².
 - .2 Bituminous paint: Henry "410-02" Bituminous paint.

2.3 **BASIC MATERIALS - STAINLESS STEEL**

- .1 Stainless steel sheet: To ASTM A167, type 304 to AISI No. 4 (2B) finish.
- .2 Stainless steel plate: To ASTM A167, type 304 to AISI No. 4 (2B) finish.
- .3 Stainless steel shapes: To ASTM A276, type 304 to AISI No. 4 (2B) finish.
- .4 Stainless steel fasteners: Type 304, (316).
- .5 Stainless steel pipe: To ASTM 312, type 316, 180 grit finish.
- .6 Stainless steel bolts: Expansion bolts using high strength stainless steel conforming to ASTM A193, Grade B8, Type 316.

2.4 **SHOP FABRICATION**

- .1 Fabricate items that are to be built into masonry or concrete and deliver to Project site for setting; furnish items complete with bolts, anchors, clips, etc., ready to set. Furnish, completely install and connect other items. Erect items to proper lines and levels, plumb and true, and in correct relation to adjoining Work. Secure parts in a rigid and substantial manner using concealed connections where practicable.
- .2 Where necessary to secure Work to the structure by means of expansion bolts, cinch anchors, and similar connections, lay out the Work and install such connections, install the Work and bolt up, unless otherwise noted.
- .3 Provide bolts, shims, blocks, nuts, washers, wedging pieces, etc., required for complete installation, unless otherwise noted.
- .4 Drill field holes for bolts or rivets. Do not burn holes.

- .5 Furnish fitting-up bolts, drift pins, other tools and equipment and do necessary reaming of unfair holes found in field connections. New holes or enlargement of unfair holes by use of cutting torch is cause for rejection of the entire member. Replacement shall be made at Contractor's expense.
- .6 Mill joints to a tight, hairline fit; cope or miter corners. Form joints exposed to weather to exclude water.
- .7 Remove burrs from all exposed cut edges.
- .8 Execute shop welding conforming with welding requirements specified under "Quality Assurance" and "Welding" herein. (Fabricate structural aluminum in accordance with CAN3-S157 and in accordance with reviewed Shop Drawings).
- .9 Accurately cut, machine and fit joints so that finished Work presents a neat appearance.
- .10 Assemble members without twists or open joints.
- .11 Drill properly sized holes for connecting the Work of other trades where such can be determined prior to fabrication. Where possible, show such holes on Shop Drawings. Place holes so not to cause an appreciable reduction in strength of member.
- .12 Certain miscellaneous metal elements are listed with a corresponding description below. Such listing is intended to provide clarity or to specify requirements for the given elements, and not to represent the scope of metal fabrications work.
- .13 Stairs – General
 - .1 Fabricate stairs with necessary components and in sizes and manner to enable installation directly to structure. Provide cast-in anchor assemblies supporting pickets, balustrades and other stair railing members. Provide bracing and hangers including necessary adjustment capability. Where possible, fit and shop assemble various sections of Work and deliver to Site in largest practicable sections.
 - .2 Forming and bending of exposed materials for treads shall be crisp, smooth, and of smallest possible radii.
 - .3 Fabricate items that are to be built into masonry or concrete and deliver to Project site for setting; furnish items complete with bolts, anchors, clips, etc., ready to set. Furnish, completely install and connect other items. Erect items to proper lines and levels, plumb and true, and in correct relation to adjoining Work. Parts shall be secured in a rigid and substantial manner using concealed connections where practicable.
 - .4 Where necessary to secure Work to the structure by means of expansion bolts, cinch anchors, and similar connections, do the Work of laying out and installing such connections, installing the Work and bolting up, unless otherwise noted. Drill or core holes in concrete and masonry Work.
- .14 Metal Pan Stairs
 - .1 Steel channel stringer: Of size, construction and attachment to structure as shown. Close exposed ends of stringers with 3 mm thick steel closure plates welded to edges of exposed flange edges and ground smooth.
 - .2 Sub-treads, risers and landing permanent metal forms: Steel sheet formed as shown; treads to be concrete filled, with bare metal riser incorporating 19 mm dust cove.

- .3 Supports: As detailed on Drawings.
- .15 Bar Grating
 - .1 Of pressure resistance welded construction. No notching of bearing or cross bars permissible.
 - .2 Band openings cut in grating and grating edges, using welded connections.
- .16 FRP Grating
 - .1 Fabricate FRP gratings so that a regular pattern is presented in the finished Work with all members lined up or evenly spaced, and pattern is unbroken.
- .17 Steel Ladders and Cages
 - .1 Assembly: Welded construction, complete with steel stiffeners, rungs, safety cage, angle rails, bent plate straps or angle brackets.
 - .2 Cage bars: Of 50 mm x 3 mm thick steel bent to form rings, located at maximum 1200 mm centres, with first hoop located 2.1 m from floor level.
- .18 Steel Pipe Handrails
 - .1 Close open ends of steel pipe handrail with 1.9 mm (14 gauge) closure neatly welded and ground smooth.
 - .2 Pipe railing to consist of top rail and intermediate rail, and with matching vertical standards.
 - .3 Form changes in direction of railing members by mitering or inserting prefabricated flush elbow fittings.
 - .1 Form curves by bending in jigs to produce uniform curvature without buckling, flattening, twisting, cracking, or otherwise deforming exposed surfaces.
 - .4 Perform all welding and joining in shop prior to finishing.
 - .5 Assemble end-to-end connections and splice joints by using internal sleeves, bonded by epoxy adhesive or by field welding. Do not field weld.
- .19 Pipe Railings
 - .1 Fabricate the same as steel pipe handrails.
 - .2 Where railings are permanently inserted into concrete floors, Provide steel pipe sleeve of adequate size to be cast into concrete with a 3 mm thick steel plate welded to bottom and required anchor rods to ensure a securely set sleeve.
 - .3 Fabricate removable railings in sections to permit for easy removal. Provide steel sleeves into which railing uprights will be inserted. Fabricate sleeves to sliding fit over uprights and to provide adequate support.
- .20 Stainless Steel Pipe
 - .1 Thoroughly clean welds and surrounding substrate area of weld spatter, flux or scale by wire brushing, grinding and polishing.
 - .2 Remove excess weld by grinding to provide for continuous weld line. Grind, polish, and buff welds exposed to view to match finish of parent material.

- .21 Flat Bar Handrails, Pickets
 - .1 Handrails: Continuous top and bottom flat bars supporting both ends of pickets.
 - .2 Pickets: Welded to top and bottom flat bar handrails.
 - .3 Connection to stairs: Weld both sides of bottom rail continuously to top flange of stringer.
 - .4 Wall brackets: Provide for railings supported from walls.
 - .5 Handrail cap: Cover top flat bar full length with extruded plastic handrail cover. Weld all joints in vinyl.
- .22 Channel Door Frames
 - .1 Structural channel sections, selected for trueness of web and flange, with joints welded and ground smooth. Furnish (bar stop) and bent bar anchors for anchorage to masonry or concrete as required.
 - .2 Fit frames with temporary spreaders to prevent frame from springing out of shape.
- .23 Steel Frames for Miscellaneous Openings
 - .1 Connections: Connect built-up members of frames by means of plug welding. Miter or cope and join members with continuous welding beads.
 - .2 Top of frames embedded in concrete: Fabricate frames so top of frames are flush with finish floor elevation.
- .24 Pipe Bumpers and Sleeves, Pipe Guardrails
 - .1 (Removable), constructed of steel pipe sizes shown, complete with lifting hole where bumper is to be removable, and 6 mm thick plate closure welded to bottom of guard post sleeves.
 - .2 Provide properly sized steel pipe sleeves to allow easy removal of pipe bumper.
- .25 Lintels
 - .1 Weld pairs of members back to back together and in no case shall lintels be more than 25 mm less in width than wall they support.
 - .2 Extend lengths to allow 150 mm minimum end bearing on masonry. Unless otherwise shown, lintels in block walls shall be of steel furnished under this section.
- .26 Toilet Partition Support Framing
 - .1 Fabricate for ceiling-hung toilet partitions in washrooms with suspended ceilings. Align steel framing member with, and directly above the ceiling, over the pilasters of partitions to provide a fastening point for the pilaster. Hang the framing member from building framing above and brace the assembly against movement. Provide supplementary, concealed steel framing as required to secure the hangers and bracing in place.
- .27 Lateral Supports For Masonry Walls
 - .1 Minimum size 100 x 100 x 150 x 6 mm thick, steel angles along top of concrete block walls as shown. Fasten angles to structure above and space at not over

1800 mm o.c. on both sides of the walls, staggering the angles, that when combined, angles are not over 900 mm o.c.

.28 Millwork Supports and Brackets

- .1 Design, fabricate, and supply metal framing and connections in accordance with Contract Drawings for support of the following: Millwork, washroom vanities, counters, and similar items. Supply stainless steel mounting hardware, brackets, bolts, sleeves, and the like for metal supports as required. Size of members and hardware.

.29 Mechanical Equipment Fabricated Supports

- .1 Design, fabricate, and Provide supplementary steel framing to support mechanical equipment at locations and elevations in accordance with Contract Drawings.
- .2 Coordinate Work with appropriate mechanical technical Sections. Obtain dimensions and weights of equipment from reviewed Shop Drawings.

.30 Checkered plate covers: Diamond shaped raised pattern, of nominal thickness shown exclusive of raised pattern.

.31 Floor plate: Shearing, cutting, or punching shall leave clean, true lines and surfaces. Drill countersunk holes in plate where it will be bolted in place.

.32 Kickplates: Continuous, 150 mm high x 6 mm thick.

2.5 **WELDING**

- .1 Execute welding to avoid damage or distortion to the Work. Should there be, in the opinion of Consultant or inspection and testing company, doubt as to adequacy of welds, such welds shall be tested for efficiency and any Work not meeting specified standards shall be removed and replaced with new Work satisfactory to Consultant. Execute welding in accordance with the following standards:

- .1 CSA W48-M: For electrodes. If rods are used, only coated rods are allowed.
- .2 CSA W59-M: For design of connections and workmanship.
- .3 CAN/CSA-W117.2-M: For safety.

- .2 Thoroughly clean welded joints and expose steel for a sufficient space to perform welding operations. Neatly finish welds. Where exposed to view and finish painted, apply weld continuously and grind to a uniformly smooth finish.

2.6 **CLEANING, SHOP PRIMING**

- .1 Omit prime painting of miscellaneous metals that will be painted with epoxy as specified in Division 9.
- .2 Clean steel to SSPC SP3 (SP6) and remove loose mill scale, weld flux and splatter.
- .3 Shop prime with one coat of primer paint to dry film thickness of 0.025 mm. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7°C (45°F). Paint items under cover and leave under cover until primer is dry. Follow paint manufacturer's recommendations regarding application methods, equipment, temperature, and humidity conditions.
- .4 Clean but do not paint surfaces being welded in field.

- .5 Do not paint surfaces embedded in concrete.
- .6 Do not paint surfaces in friction connections.
- .7 Treat surface of aluminum in contact with or embedded in dissimilar materials in accordance with CAN3-S157-M. Treat as if material is installed in the presence of moisture.

2.7 **HOT-DIP GALVANIZING**

- .1 Galvanize members exposed to exterior elements when in final location; members embedded on the exterior side of exterior walls; members embedded in concrete; members specified in this section or noted on Drawings.
- .2 Perform hot-dip galvanizing after fabrication. Plug relief vents air tight. After galvanizing, remove plugs, ream holes to proper size and re-tap threads. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with galvanize primer in accordance with manufacturer's printed directions.
- .3 Wet storage stain: Remove wet storage stain that may have developed in the coating before installation so that premature failure of the coating does not occur. Remove wet storage stain in accordance with galvanizer's recommendations.
- .4 Repair of galvanized items: Repair coatings damaged by welding, cutting, or during handling, transport or erection using cold galvanizing compound specified, and as follows:
 - .1 Ensure surface is clean, dry, and free of oil, grease and corrosion.
 - .2 Power clean surface to near white metal condition, extending into undamaged galvanized coating.
 - .3 Apply touch up material to a dry film thickness of 0.203 mm (8 mils) minimum. If touched up Work is to remain exposed in the finished Work, apply a finish coat of aluminum paint to provide a colour blend with the surrounding galvanizing.
 - .4 Coating shall be continuous, adherent, smooth and evenly distributed.

3 Execution

3.1 **ERECTION**

- .1 Fit joints and intersecting members accurately. Make Work in true planes with adequate fastenings. Build and erect Work plumb, true, square, straight, level and accurate to sizes detailed, free from distortion or defects detrimental to appearance or performance.
- .2 Stairs, Rails and Handrails
 - .1 Erect rigid and free from whip.
 - .2 Continuously weld connections for railings attached directly to steel stringers. Where rails return to wall Provide end returns and wall brackets.
 - .3 Provide temporary supports and bracing required to position stairs and landings.
 - .4 Adjust railings prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length.
 - .5 Continuously weld connections between handrails and balusters and in lengths of handrails.

- .6 Secure wall brackets to walls with through bolts and plate where these can be concealed, otherwise use bolts and expansion shields to achieve maximum rigidity of rail. Wood plugs for fixing to walls will not be permitted. Use metal anchoring devices.
- .3 Fit door frames and jambs with temporary steel spreaders to prevent springing frames and jambs out of shape.
- .4 Weld as specified herein.
- .5 Take adequate care to prevent damage to any material such as weld burns, etc.
- .6 Include all cutting and patching of masonry walls where necessary. Obtain Contractor's approval of cutouts in advance.
- .7 Insulate where necessary to prevent electrolysis due to dissimilar metal to metal contact, or metal to masonry and concrete. Use bituminous paint, butyl tape, building paper or other approved means.
- .8 Install materials in a good and workmanlike manner, cleaning and grinding all welding laitance and touching up primer where necessary.
- .9 Erect fibre reinforced plastic (FRP) grating plumb, true, square, straight, level and accurate to size detailed, in accordance with manufacturer's printed instructions.

3.2 **CONNECTIONS**

- .1 Weld or high strength bolt main member connections. Use CISC double angle header connections wherever possible. High strength bolted connections shall be bearing type using 19 mm diameter bolts conforming to ASTM A325M. Secondary members may be bolted with machine bolts.
- .2 Perform high tensile bolted connections in accordance with CSA-S16.1. Accurately space holes of size 1.6 mm larger than the nominal diameter of the bolt. Install bearing type high tensile bolted connections unless shown otherwise on Drawings. Provide compressor or electrical equipment capable of supplying and maintaining required pressure at the wrench. Make connections without the use of erection bolts; some high tensile bolts will serve that purpose. Prevent nuts on bolts, except high tensile bolts, from becoming loose by burring bolt thread, by welding or by lock washers or lock nuts.
- .3 Execute welding as specified under shop welding in Part 2 and as follows:
 - .1 Provide continuous welds on exterior Work to provide proper weathering.
 - .2 Take necessary safety precautions in accordance with CSA standards when welding is carried out in cold weather.

3.3 **FIELD TOUCH-UP**

- .1 Paint bolt heads, washers, nuts, field welds and previously unprimed items. Touch up shop primer (and galvanizing) damaged during transit and installation with material to match shop primer or galvanize coating.
- .2 Clean off dirt on installed miscellaneous metal surfaces.
- .3 Touch up all damaged surfaces of aluminum Work with one coat of zinc chromate primer.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 CAN/CSA O80 Series - Wood Preservation
- .2 CAN/ULC-S102 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- .3 CSA O121-M - Douglas Fir Plywood
- .4 NLGA - National Lumber Grades Authority
- .5 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **QUALITY ASSURANCE**

- .1 Each piece of pressure treated lumber and fire retardant treated lumber supplied to the job Site shall be shop marked with the pressure treatment brand, and ULC monogram respectively, in accordance with CAN/CSA O80-M.

1.4 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Store lumber in a dry area. Stack 150 mm clear of floor and with 6 mm spacers 1200 mm apart across each layer.
- .2 Cover materials with tarpaulins or polyethylene sheets to prevent moisture absorption and impairment of structural and aesthetic properties. Vent to allow air movement. Tie covering to keep in place.

1.5 **ROOF LUMBER PROTECTION**

- .1 During transit, storage, and immediately following installation, protect roof lumber from rainwater and condensation to prevent decay. Likewise, Provide protection whenever work is interrupted for whatever reason. Use waterproof tarpaulins tied down to prevent wind blow-off. Moisture control must be properly practiced to prevent the occurrence of lumber decay. Pressure treated lumber is not used in this Project.

2 Products

2.1 **MATERIALS**

- .1 Dimension lumber: Grade stamped, dressed, kiln dried lumber having a maximum moisture content at time of installation, of 15% for 50 mm or less in thickness, and 19% for stock over 50 mm thick in accordance with NLGA.
- .1 Interior blocking, furring, nailers: NLGA, 122c - Standard Light Framing Grade Spruce, Pine or Fir (S-P-F), S4S.

- .2 Fire retardant treatment of lumber and plywood: "Dricon" fire retardant treatment by J.A. Biewer or accepted equal, conforming to CAN/CSA-O80.20 and CAN/CSA-O80.27 respectively, to provide a flame spread rating of 25 or less in accordance with ULC test method CAN/ULC-S102.
- .3 Plywood: 19 mm thick, waterproof, grade stamped exterior grade Douglas fir plywood, select unsanded for concealed uses, good one side-sanded for use with single ply roofing in accordance with CSA O121-M.
- .4 Insulation within curbs and parapets: E'NRG'Y 3 AGF as supplied by Johns Manville, "Ikotherm III" by IKO Industries Ltd. Or "ACFoam III" by Atlas, polyisocyanurate insulation, fully adhered with mastic adhesive. Cover with plywood mechanically fastened through insulation to steel curb.
- .5 Loose insulation: Loose type; fiberglass by Owens-Corning Canada, mineral wool by Roxul Inc., or basalt wool by Fibrex Insulations, Inc.
- .6 Rough hardware: Bolts, anchors, nails, screws, expansion shields and other fastenings required to frame and fix rough carpentry as follows:
 - .1 Hardware for lumber to lumber in exterior locations: Steel screws or spiral nails hot-dip galvanized to ASTM A-153. Wood screws shall be countersunk head, full thread type.
 - .2 Hardware for lumber to metal in exterior locations: Self-drilling with fluoropolymer type barrier coating.
 - .3 Hardware for lumber to masonry or concrete in exterior locations: Drilled-in expansion shields or drilled in self-drilling masonry concrete screws with fluoropolymer type barrier coating.
 - .4 Hardware in interior locations: As specified above, but with electrogalvanized coating.

2.2 **SELECTION OF LUMBER PIECES**

- .1 Carefully select all members; select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making proper connections.
- .2 Discard wood members with defects which will render a piece unable to serve its intended function; lumber may be rejected by Consultant whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mould, as well as for improper cutting and fitting.

3 **Execution**

3.1 **MISCELLANEOUS WOODWORK**

- .1 Install miscellaneous wood blocking, strapping and nailers required for attachment of Work of all trades, in addition to roof woodwork. Set accurately so that they will be completely concealed.
- .2 Except where steel supports are specifically shown, Provide wood blocking and supports in metal stud partitions for fastening of items such as casework and other wall mounted accessories. Have respective trades approve the location of such wood blocking.
- .3 Use fire retardant lumber for blocking/framing in ceiling spaces, partitions and bulkheads.

- .4 Install and secure 50 mm x 250 mm full length temporary spruce, pine or fir treads and landings on steel stairs shown to receive concrete fill.
- .5 Install temporary wood protection strips at door jambs in high traffic areas.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- .2 Work includes, but is not necessarily limited to, the following:
 - .1 Roof framing including beams, joists, rafters, blocking, deck, strapping and plywood sheathing.
 - .2 Wall framing including studs, beams, lintels and blocking.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 ASTM D2559 - Adhesives for Structural Laminated Wood Products for use Under Exterior (Wet use) Exposure Conditions
- .2 CAN/CSA-O141 - Softwood Lumber
- .3 CAN/CSA-O80 Series - Wood Preservation
- .4 CAN/ULC-S102-M - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- .5 CAN/CSA G164-M - Hot Dip Galvanizing of Irregularly Shaped Objects
- .6 CSA O86.1 - Engineering Design in Wood (Limit States Design)
- .7 CSA O121-M - Douglas Fir Plywood
- .8 CSA O112 Series - CSA Standards for Wood Adhesives
- .9 CSA O151-M - Canadian Softwood Plywood
- .10 CSA O153-M - Poplar Plywood
- .11 CAN/CGSB-51.32-M - Sheathing, Membrane, Breather Type
- .12 CAN/CSA O122-M - Structural Glued-Laminated Timber
- .13 NLGA - National Lumber Grades Authority

1.3 **DESIGN CRITERIA**

- .1 Structural lumber shall be designed by a Professional Engineer whose seal shall appear on the Shop Drawings.

1.4 **SUBMITTALS**

- .1 Submit Shop Drawings in accordance with Section 01 33 00.
- .2 Shop Drawings shall indicate the following:
 - .1 All dimensions.

- .2 Stress grade.
- .3 Service grade.
- .4 Appearance grade.
- .5 Shop-applied finishes for glued-laminated lumber.
- .6 Drilled holes for glued-laminated lumber.
- .7 Connections, materials, sizes and finishes.
- .8 Related Work and material provided by other sections.

1.5 **QUALITY ASSURANCE**

- .1 Lumber shall conform to the grading rules of NLGA (National Lumber Grades Authority), Standard Grading Rules for Canadian Lumber.
- .2 Grade stamp: Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board. Likewise, identify plywood with a grade stamp of certifying agency.
- .3 Qualification of manufacturer: Structural glued-laminated members shall be manufactured by a plant approved by the Canadian Standards Association for the specified Work. Provide a certificate attesting to manufacture in compliance with the requirements of CSA Standard 0177 latest edition "Qualification Code for Manufacturers of Structural Glued-Laminated Timber", and shall affix the authorized label to all structural members supplied.
- .4 Source quality control: Upon request, provide the Consultant with CSA certificate covering manufacturing and quality control methods used. Copies of all material, tests, and approvals shall be provided upon request.
- .5 Parallel Strand Lumber Beams
 - .1 Fabricating plant: Approved by ICBO or Standards Council of Canada certified testing agency.
 - .2 Parallel strand lumber shall be manufactured under the supervision of a certified third party inspection agency selected by Consultant and paid by the manufacturer.
- .6 I-Joists
 - .1 Fabricating plant: Approved by ICBO or Standards Council of Canada or certified testing agency.
 - .2 I-joists shall be manufactured under the supervision of a certified third party inspection agency selected by the Consultant and paid by the manufacturer.

1.6 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Store wood in dry areas to maintain dimensional stability and tolerances.
- .2 Stack lumber 150 mm clear of floor.
- .3 Protect fire-retardant materials against high humidity and moisture.
- .4 Cover materials stored on Site with tarpaulins or polyethylene sheets to prevent moisture, absorption and impairment of structural and aesthetic-properties.

1.7 **WARRANTY**

- .1 The Products delivered shall be free from any defects in workmanship or materials and the design of members shall be adequate to carry the loads specified for the life of specified Project.

2 Products

2.1 **MATERIALS - SOLID STOCK LUMBER**

- .1 Lumber: Dry, softwood specie with moisture content (MC) not greater than 19% at time of installation in accordance with CSA O141 and NLGA standard grading rules for Canadian lumber. Use only grade marked lumber. Species and NLGA classification as follows:
 - .1 Joists, studding and light framing: No. 1 construction grade, Spruce, Balsam, Fir, Lodgepole Pine or Ponderosa Pine.
 - .2 Blocking, concealed framing, grounds, nailing strips: No. 2 Ontario White Pine, No. 2 Red Pine, or Construction No. 1 Jack Pine, or Construction Grade Douglas Fir.
 - .3 Posts, beams, joists: Select structural Douglas fir.
- .2 Wood preservative: Pressure applied CCA preservative with 6.5 kg/m³ average retention for roof woodwork and wood in contact with floor slabs or walls in areas to be waterproofed, and 4 kg/m³ elsewhere. Apply preservative in accordance with CAN/CSA O80 Series.
- .3 Fire retardant treatment of lumber: Conforming to CAN/CSA O80.20 to provide a flame spread rating of 25 or less, in accordance with ULC test method CAN/ULC-S102.

2.2 **MATERIALS - GLUED LAMINATED LUMBER**

- .1 Glued-laminated lumber: Conforming to CAN/CSA O122 structural, glued-laminated softwood structural timbers.
 - .1 Species group: As classified in CSA-O86.1, Code for Engineering Design in Wood.
- .2 Stress grade: as applicable
 - .1 24f bending.
 - .2 18t tension.
 - .3 16c compression.
- .3 Service grade: (Interior) (Exterior).
- .4 Appearance grade: Conforming to CSA O122-M, (industrial) (paint) quality.
- .5 Shop-applied sealers: (Alkyd varnish) (Polyurethane one component) (Polyurethane two component) (Shellac) (Wax stain).
- .6 For Use With Field-Applied Stains
 - .1 5% pentachlorophenol in a water-resistant vehicle.
 - .2 1% zinc naphthenate sealer.
 - .3 Synthetic alkyd resin sealer containing 1/10% of 1% phenyl-mercury-oleate.

2.3 **MATERIALS - PARALLEL STRAND LUMBER BEAMS**

- .1 Composition: Western Species (WS) veneer strands 3.2 mm or 1/10" thick, laminated in a continuous press with all grain parallel with the length of the member. Glue used in lamination is a phenol formaldehyde exterior-type adhesive which complies with ASTM D2559 or CSA O112.6M. Moisture content shall be between 7% and 16%.
- .2 Code approvals: Products shall be designed and installed to the standards set forth in the NER-292 report, CCMC Report No. 11161-R or CSA LO 4000-4440, all issued to manufacturer.
- .3 Identification: Identify parallel strand lumber with stamps noting the name and plant number of the manufacturer, the grade, the National Evaluation Service committee report number, CCMC number and the certifying inspection agency.
- .4 Hardware: Galvanized type as recommended by beam manufacturer.
- .5 Acceptable Product: "Parallam" by Trus Joist MacMillan or approved equivalent.

2.4 **MATERIALS - I JOISTS**

- .1 Flanges: "Microllam" laminated veneer lumber, manufactured according to the standards as specified in Report No. NER 126 or 2100f-1.8E or 2400f-2.OE MSR lumber, all issued to manufacturer. Moisture content shall be between 7 and 16%.
- .2 Web material: Either plywood complying with PS 1-83 or CSA O121-M or Sturdiwood oriented strand board manufactured by Weyerhaeuser Canada Ltd., Edmonton, Alberta, Canada, or other recognized equal which complies with APA and manufacturer's standards as substantiated by performance verification testing data and verified by an independent recognized testing agency. The Sturdiwood panels shall be produced under a quality control program with inspections by the American Plywood Association (NER-108).
- .3 Identification: Identify each of the joists by a stamp indicating the joist type, NER report number, CCMC number, manufacturer's name, plant number, the PFS Corporation logo (NER-251) and/or Warnock Hersey Professional Services Ltd. logo.
- .4 Hangers: Galvanized sheet steel of design and gauge recommended by joist manufacturer.
- .5 Nails: Galvanized common nails.
- .6 Acceptable Product: "TJI Joists" by Trus Joist MacMillan.

2.5 **WOOD DECK AND PLYWOOD SHEATHING**

- .1 Plywood for sheathing: Exterior type plywood conforming to CSA O121 "Douglas Fir Plywood", CSA O151 "Canadian Softwood Plywood", or CSA O153 "Poplar Plywood".
- .2 Wall sheathing paper: Conforming to CAN/CGSB-51.32M "Sheathing Membrane, Breathing Type".
- .3 Wood decking: To NLGA standard Grading Rules for Canadian Lumber. Commercial grade **Douglas Fir** 32 mm x 140 mm, predrilled at 750 mm o.c. for lateral spiking, single tongue and groove and "Veed" one side as minimum or match to existing
- .4 Decking under 64 mm thickness is single tongued and grooved. Decking available in (3 mm nominal increments.)
 - .1 Kiln dry decking to 15% maximum moisture content.

- .2 Decking lengths: 1.8 to 6 m or longer with a minimum of 90% planks exceeding 3 m (Square end trimmed). For single spans shorter than 3 m use decking of same length as span.

2.6 MISCELLANEOUS

- .1 Structural steel for connections: Conforming to CAN/CSA-S16.1 and shall be new material conforming to CSA-G40.20/G40.21. Structural steel prime coated with primer conforming to CISC/CPMA 2.75, oil alkyd.
- .2 Nails, spikes, staples and other connectors: To CSA B111, galvanized for exterior Work, interior highly humid areas and for treated lumber; plain finish elsewhere. Use spiral thread nails except where specified otherwise.
- .3 Bolt, nut, washer, screw and pin type fasteners: Hot-dip galvanized to CAN/CSA G164 for exterior work and for pressure preservative treated lumber. Elsewhere, for sight-exposed surfaces, apply a prime paint.

2.7 FABRICATION

- .1 Solid stock lumber: Comply with CSA-086.1 for all fabrication and assembly of structural components off site, or on site.
 - .1 Design construction details for expansion and contraction of materials.
 - .2 Machine-sand surfaces exposed in the finished Work. Hand-sand to an even smooth surface free from scratches.
 - .3 Pressure fire retardant treat lumber prior to final milling. Each piece shall bear the mark of Underwriters Laboratories of Canada indicating conformance to CAN/ULC-S102.
- .2 Parallel strand lumber beam: Design of assembly shall be in accordance with the latest edition of NBC and CSA-O86.1, for the requirements set forth on the Drawings and this section.
 - .1 Fabricate all members in accordance with the Drawings, Specifications, and Shop Drawings.
 - .2 Suitably mark all members reviewed for identification. Clearly mark straight beams and top surface of all members.
 - .3 Splicing, jointing, cutting holes or notching in locations other than shown on the Shop Drawings is not permitted.
 - .4 Apply specified sealer to exposed areas of glued-laminated members after fabrication. Double treat exposed ends of laminates.
 - .5 Where indicated on the Shop Drawings, treat exposed ends of glued-laminated members with laminated members covering exposed ends, as follows:
 - .1 19 mm thick wood member.
 - .2 One laminate.
 - .3 One laminate and mitred.
 - .4 One laminate, mitred and forming drip.

3 Execution

3.1 **EXAMINATION**

- .1 Prior to fabrication, check all dimensions relating to this section of Work. Report any discrepancies to the Consultant.
- .2 Prior to Site erection, examine all Site conditions relating to this section of Work to ensure that they are acceptable for a satisfactory installation. Report any discrepancies to the Consultant.

3.2 **ERECTION**

- .1 General
 - .1 Frame, anchor, fasten, tie, and brace all members to provide the necessary strength and rigidity.
 - .2 Treat ends of wood joists or beams and other members framing into masonry or concrete to prevent decay where the bottom of the member is at or below ground level, or provide a 12 mm air space at the end and sides of the member.

3.3 **GLUED-LAMINATED LUMBER**

- .1 The erection Subcontractor's Engineer shall ensure that all structural timbers and connections will safely sustain any erection loadings that may occur.
- .2 Use pads or blocking between slings and glued-laminated members when handling.
- .3 Glued-laminated members shall fit together properly, without trimming, cutting, or any other unauthorized modifications. Report any discrepancies to the Consultant.

3.4 **NOTCHING AND DRILLING**

- .1 Holes drilled in roof, floor or ceiling framing members shall be not larger than one-fourth the depth of the member, and located not less than 50 mm from the edges, unless the depth of the member is increased by the size of the hole.
- .2 Floor, roof and ceiling framing members may be notched provided the notch is located on the top of the member within one-half the joist depth from the edge of bearing, and is not deeper than one-third the joist depth, unless the depth of the member is increased by the size of the notch.
- .3 Notching is not permitted unless approved in writing by the Consultant. Make holes by drilling only, and shall be at the mid-depth of stud. Maximum diameter of hole shall be 25 mm
- .4 Do not notch, drill, or otherwise damage wall studs so that the undamaged portion of the stud is less than two-thirds the depth of the stud.
- .5 Do not notch, drill, or otherwise weaken the top plates in load-bearing walls and partitions to reduce the undamaged width to less than 50 mm unless the weakened studs are suitably reinforced.
- .6 Do not notch, drill, or otherwise weaken roof truss members unless such notching or drilling is allowed for in the design of the truss.

3.5 ANCHORAGE

- .1 Anchor building frames to the supporting walls.
- .2 Provide anchorage by fastening the sill plate and chords to the wall in accordance with the Drawings.
- .3 Anchor exterior columns and posts to resist uplift and lateral movement.

3.6 SILL PLATES

- .1 Level sill plates by setting them on a full bed of mortar, except that where the top of the foundation is level, they may be laid directly on the foundation, provided the junction between foundation and sill plate is caulked.

3.7 BEAMS

- .1 Beams shall have even and level bearing, and with not less than 90 mm length of bearing at end support.
- .2 Where a beam is made up of individual pieces of lumber that are nailed together, the individual members shall be 38 mm or greater in thickness and installed on edge. Where the individual members of a beam are butted together to form a joint, each such joint shall occur over a support or at or within 150 mm of the end quarter points of the clear span of the beam.
- .3 Joints in individual members of beams that are located at or near the end quarter points shall not occur in adjacent members at the same quarter point and shall not reduce the effective beam width by more than 25%, and members joined at quarter points shall be continuous over the adjacent supports.

3.8 FLOOR JOISTS

- .1 Except when supported on ribbon boards, floor joists shall have not less than 38 mm length of end bearing.
- .2 Ribbon boards shall be not less than 25 mm x 100 mm lumber let into the studs.
- .3 Floor joists may be supported on the top of beams or may be framed into the sides of beams.
- .4 When framed into the side of a wood beam, support the joists on joist hangers or other acceptable mechanical connectors on not less than 50 mm x 75 mm ledger strips nailed to the side of the beam.
- .5 When framed into the side of steel beams, support the joists on the bottom flange of the beam on not less than 50 mm x 50mm member bolted to the web with not less than 6 mm diameter bolts spaced not more than 600 mm apart. Splice such joists above the beam with not less than 50 mm x 50 mm lumber at least 600 mm long to support the flooring and provide not less than a 12 mm space between the splice and the beam to allow for shrinkage of the wood joists.
- .6 Unless ceiling furring or plywood cladding is installed on the underside of floor joists, restrain floor joists from twisting at the end supports and at intervals between supports not exceeding 2100 mm. Such restraint may be provided at end supports by toe nailing to the support, or by end nailing the joists to the header joist.

- .7 Restraint at the intermediate locations or at the ends may be provided by not less than 25 mm x 75 mm or 38 mm x 50 mm cross-bridging, or 25 mm x 3 mm steel strapping or 25 mm x 100 mm continuous wood strapping nailed to each joist and fastened at each end to the header or sill to prevent overall movement.
- .8 Blocking tightly fitted between joists and securely nailed in place is also permitted for restraining joint twisting.
- .9 Double header joists around floor openings when they exceed 1200 mm in length.
- .10 Double trimmer joists around floor openings when the length of the header joist exceeds 800 mm
- .11 When tail joists and header joists are supported by the floor framing, support by joist hangers, nailing, or other acceptable connectors.
- .12 Support non-load-bearing partitions parallel to floor joists on beams, load-bearing walls or doubled joists where the partition is over 1800 mm in length and contains openings that are not full ceiling height. Where such partitions contain no openings or openings that are full ceiling height, the joists need not be doubled. Non-load-bearing partitions less than 1800 mm in length need not be supported on framing, but may be supported by the subfloor. Doubled joists may be separated not more than 200 mm by blocking if the blocking is not less than 50 mm x 100 mm lumber spaced not more than 1220 mm apart. Non-load-bearing partitions at right angles to the floor joists are not restricted as to location.
- .13 Support load-bearing interior walls parallel to floor joists by beams or walls of sufficient strength to transfer safely the design loads to the vertical supports.
- .14 Support load-bearing interior walls at right angles to floor joists not more than 914 mm from the joist support when the wall does not support a floor, and not more than 600 mm from the joist support when the wall supports one or more floors, unless the joist size is designed to support such loads.

3.9 **WALL STUDS**

- .1 Wall studs shall be continuous for full-storey height, except at openings and shall not be spliced, except by glued joints.
- .2 Place wall studs at right angles to the wall face.
- .3 Design corners and intersections to provide adequate support for the vertical edges of interior and exterior cladding materials, and in no instance shall exterior corners be framed with less than the equivalent of two studs.
- .4 Unless shown or noted otherwise, double studs on each side of openings so that the inner studs extend from the lintel to the bottom wall plate and the outer studs extend from the top wall plates to the bottom wall plate.
- .5 Unless shown or noted otherwise, single studs may be used on either side of openings in non-load-bearing partitions, provided the studs extend from the top wall plate to the bottom wall plate.
- .6 Stud bearing walls not sheathed on at least one side shall have blocking at maximum 1200 mm centre-to-centre. Blocking shall be of the same depth as studs.

3.10 **WALL PLATES**

- .1 Wall plates shall be not less than 38 mm thick, and the same depth as the wall studs.
- .2 Provide a bottom wall plate in all cases. Do not project the bottom plate in exterior walls more than one-third the plate depth over the support.
- .3 Provide double top plate for all walls.
- .4 Stagger joints in top plates of walls at least two stud spacings.
- .5 Lap the top plates in all walls, or otherwise suitably tie at corners and intersecting walls.

3.11 **FRAMING OVER OPENINGS**

- .1 Bridge openings in non-load-bearing walls with not less than 76 mm material the same width as the studs, securely nailed to adjacent studs.
- .2 Bridge openings in load-bearing walls with lintels designed to carry the superimposed loads to adjacent studs.
- .3 Where two or more members are used in lintels, fasten together with not less than 82 mm nails in a double row, with nails not more than 450 mm apart in each row. No filler pieces are permitted in lintels.

3.12 **ROOF AND CEILING FRAMING**

- .1 Continue to bearing roof rafter, joists and ceiling joists, or splice over vertical supports that extend to suitable bearing.
- .2 Double roof and ceiling framing members on each side of openings greater than two rafter or joist spacings in width.
- .3 The length of end bearing of joists and rafters shall be not less than 38 mm.
- .4 Locate rafters opposite each other, and tie together at the peak, or offset by their own thickness if nailed to a ridge board not less than 17.5 mm thick.
- .5 Shape rafter supports to provide even bearing surfaces and support directly above the exterior walls.
- .6 Hip and valley rafters shall be not less than 50 mm greater in depth than the common rafters, and not less than 38 mm thick, actual dimension.
- .7 Ceiling joists and collar ties of not less than 50 mm x 100 mm lumber may be assumed to provide intermediate support to reduce the span for rafters and joists where the roof slope is 4/12 or greater and such collar ties more than 2400 mm in length shall be laterally supported near their centres by not less than 25 mm x 100 mm continuous members at right angles to the collar ties.
- .8 Dwarf walls and struts may be used to provide intermediate support to reduce the span for rafters and joists and when struts are used, they shall be not less than 50 mm x 100 mm material extending from each rafter to a load-bearing wall at an angle of not less than forty-five degrees to the horizontal.
- .9 When dwarf walls are used for rafter support, frame in the same manner as load-bearing walls and securely fasten top and bottom to the roof and ceiling framing to prevent overall movement and install solid blocking between floor joists beneath dwarf walls that enclose finished rooms.

- .10 Support the ridge of the roof by a load-bearing wall extending from the ridge to suitable bearing or by a ridge beam of not less than 50 mm x 150 mm material and such ridge beam shall be supported at intervals not exceeding 1220 mm by not less than 50 mm x 100 mm members extending vertically from the ridge to suitable bearing. When the roof slope is 4/12 or more, ridge support may be omitted, provided the lower ends of the rafters are adequately tied to prevent outward movement.
- .11 Where rafters are tied, the ties may consist of tie rods or ceiling joists forming a continuous tie for opposing rafters and members may be fastened together either directly or through a gusset plate.
- .12 Restrain from twisting roof joists supporting a finished ceiling other than plywood along the bottom edges by means of furring, blocking, cross-bridging or strapping.
- .13 Ceiling joists supporting part of the roof load from the rafters shall be not less than 25 mm¹ greater in depth than required for ceiling joists not supporting part of the roof load, except that when the roof slope is 3/32 or less, the ceiling joist sizes shall be determined from the span tables for roof joists.

3.13 **SUBFLOORING**

- .1 Provide subflooring beneath finish flooring where the finish flooring does not have adequate strength to support the design loads.
- .2 Where the edges of panel type subflooring are required to be supported, such support shall consist of not less than 50 mm x 50 mm blocking or tongued and grooved edged plywood.
- .3 Install plywood subflooring with the surface grain at right angles to the joists and with joints parallel to floor joists staggered.
- .4 When resilient flooring is to be applied directly to the plywood subfloor, install the plywood with common spiral galvanized nails.
- .5 Lay lumber subflooring at an angle of not less than forty-five degrees to the joists and fully support at the ends on solid bearing.

3.14 **ROOF SHEATHING**

- .1 Install plywood roof sheathing with the surface grain at right angles to the roof framing.
- .2 Install with a 2 mm gap between sheets. Nail to trusses and blocking with common wire galvanized nails.
- .3 Where panel-type roof sheathing requires edge support, the support shall be not less than 38 mm x 114 mm blocking securely nailed between framing.

3.15 **WALL SHEATHING**

- .1 Sheath exterior walls and gable ends when the exterior cladding requires intermediate fastening between supports or if the exterior cladding requires solid backing.
- .2 Apply lumber wall sheathing so that all ends are supported with end joints staggered.
- .3 Apply panel-type sheathing board so that vertical joints are staggered if the sheathing is applied horizontally, and a gap of not less than 1.6 mm left between sheets of plywood.

3.16 WALL SHEATHING PAPER

- .1 Apply a layer of sheathing paper over the sheathing so that the paper is lapped not less than 100 mm at the joints and returned around openings, and when applied horizontally, the upper sheets overlap the lower sheets.
- .2 When no sheathing is used, apply two layers of sheathing paper over the wall framing beneath siding. Apply the sheathing paper vertically over studs and lap joints not less than 100 mm. Attach the sheathing paper to the framing with roofing nails or staples, spaced not more than 75 mm o.c. along the edges of the outer layer of sheathing paper.
- .3 Sheathing paper may be omitted beneath siding where the joints in the siding are formed to effectively prevent the passage of wind and rain.

3.17 POST AND BEAM

- .1 Load-bearing beams shall be solid, built-up, glue-laminated, or parallel strand.
- .2 Erect and install beams in accordance with the plans, and installation information in the current manufacturer's design manual. Temporary construction loads which cause stresses beyond design limits are not permitted. Provide erection bracing to keep beams straight and plumb during erection and to assure adequate lateral support for the entire system until the structural framing is complete. Notify Consultant prior to enclosing the system, to allow for Site reviews of the installation.
- .3 Where beams extend to the exterior, waterproof glue shall be used, except that water-resistant glue may be used where the exposed portion is adequately protected against wetting.
- .4 Securely connect load-bearing roof beams to the exterior wall framing and to interior load-bearing walls or beams to resist adequately the uplift forces due to wind.
- .5 Determine the length of end bearings for load-bearing beams on the basis of the allowable design stress of the wood, but shall not be less than 38 mm.
- .6 When load-bearing beams are supported by mechanical connectors, the connectors shall be capable of supporting the design loads.
- .7 Where joints in load-bearing beams do not occur over solid supports, design joints according to CSA O86.
- .8 Tie together opposing load-bearing beams at the joints, by means of splices or suitable mechanical connectors.
- .9 Where secondary framing members span between floor beams, design the members and connections to support the required design loads.
- .10 Support loads from load-bearing walls, columns, or other concentrated loads using members designed to carry such loads.
- .11 Posts shall be solid, built-up or laminated.
- .12 Extend solid posts and individual members in built-up posts the full height of the wall storey, and fasten built-up members together with nails spaced not more than 300 mm o.c., and at least twice as long as the individual member thickness, or with not less than 9.5 mm diameter bolts fitted with washers and spaced not more than 450 mm o.c.
- .13 Provide intermediate studs or blocking between posts in post and beam walls for the support of exterior and interior cladding.

3.18 **I-JOISTS**

- .1 Erect and install joists in accordance with the plans and installation information in the current manufacturer's design manual. Temporary construction loads which cause stresses beyond design limits are not permitted. Provide erection bracing to keep joists straight and plumb during erection and to assure adequate lateral support for the entire system until the permanent sheathing material has been installed. Notify Consultant prior to enclosing system to allow Site review of the installation.
- .2 Use common nails to install joists.
- .3 Bearing points must be level.
- .4 Connect joists to beam using hangers. Do not toe nail. Do not force a hanger to fit or modify it or the member.
- .5 Never drill or notch joist flange unless shown.
- .6 All hanger connections shall be designed by the truss –design engineer and supplied by the truss fabricator. Erection drawing shall correlate all connections and trusses

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 CAN/CSA-O80-Series - Wood Preservation
- .2 CSA O86.1-M - Engineering Design in Wood (Limit States Design)
- .3 CSA O86.1S1 - Supplement to O86.1
- .4 CAN/CSA-O141-M - Softwood Lumber
- .5 CSA S307-M - Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings
- .6 CSA S347-M - Method of Test for Evaluation of Truss Plates Used in Lumber Joints
- .7 CSA W47.1 - Certification of Companies for Fusion Welding of Steel Structures
- .8 NLGA - Standard Grading Rules for Canadian Lumber

1.3 **DESIGN CRITERIA**

- .1 Design trusses in accordance with CSA-O86.1, CSA O86.1S1, OBC and NBC.
- .2 Limit live load deflections to 1/240th of span unless otherwise specified or indicated.
- .3 Provide camber for trusses as indicated.

1.4 **SUBMITTALS**

- .1 Submit Shop Drawings in accordance with Section 01 33 00.
- .2 Each Shop Drawing submission (showing connection details) shall bear signature and stamp of Professional Engineer licensed to practice in the province of Ontario.
- .3 Show design loads.
- .4 Indicate species, sizes, and stress grades of lumber used as truss members. Show pitch, span, camber, configuration and spacing of trusses. Indicate connector types, thicknesses, sizes, locations and design value. Show bearing details. Indicate design load for each member.
- .5 Indicate arrangement of webs or other members to accommodate ducts and other specialties.
- .6 Show lifting points for storage, handling and erection.
- .7 Show location of lateral bracing for compression members.

- .8 Indicate finish and corrosion protection for all steel components.
- 1.5 **QUALITY ASSURANCE**
 - .1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Administration Board.
 - .2 Fabricator for welded steel connections to be certified in accordance with CSA W47.1.
- 1.6 **PRODUCT DELIVERY, STORAGE AND HANDLING**
 - .1 Store trusses on job Site in accordance with manufacturer's instructions. Provide bearing supports and bracings. Prevent bending, warping and overturning of trusses.
- 2 **Products**
- 2.1 **MATERIALS**
 - .1 Lumber: Softwood species, select structural No. 1/No. 2 grade, S4S, with maximum moisture content of 19% at time of fabrication and to following standards:
 - .1 CAN/CSA-O141.
 - .2 NLGA (National Lumber Grading Association), standard grading rules for canadian lumber. All lumber shall be grade stamped.
 - .2 Plates and fastenings including but not limited to hold-downs and anchor bolts: To CSA-O86.1, hot-dip galvanized to CSA G164.
- 2.2 **FABRICATION**
 - .1 Fabricate wood trusses in accordance with reviewed Shop Drawings.
 - .2 Provide for design camber and roof slopes when positioning truss members.
 - .3 Connect members using bolts and nuts, metal connector plates, split rings or shear plates.
 - .4 Apply fire retardant treatment in accordance with CAN/CSA-O80 series.
- 3 **Execution**
- 3.1 **ERECTION**
 - .1 Erect wood trusses in accordance with reviewed Shop Drawings.
 - .2 Indicated lifting points to be used to hoist trusses into position.
 - .3 Make adequate provisions for handling and erection stresses.
 - .4 Exercise care to prevent out-of-plane bending of trusses.
 - .5 Install temporary horizontal and cross bracing to hold trusses plumb and in safe condition until permanent bracing and sheathing are installed.
 - .6 Install permanent bracing in accordance with reviewed Shop Drawings, prior to application of loads to trusses.

- .7 Do not cut or remove any truss material without approval of Consultant.
- .8 Remove chemical and other surface deposits on treated wood, in preparation for applied finishes.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- | | | | |
|----|----------------|---|--|
| .1 | AWI/AWMAC | - | American Woodwork Institute/Architectural Woodwork Manufacturers Association of Canada |
| .2 | CAN3-O188.1-M | - | Interior Mat-Formed Wood Particleboard |
| .3 | CSA O80 Series | - | Wood Preservation |
| .4 | CSA O115-M | - | Hardwood and Decorative Plywood |
| .5 | CSA O121-M | - | Douglas Fir Plywood |
| .6 | CAN/ULC-S102 | - | Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies |
| .7 | NEMA LD3 | - | National Electrical Manufacturers Association, High Pressure Decorative Laminates |
| .8 | AODA | - | Accessibility for Ontarians with Disabilities Act |

1.3 **SUBMITTALS**

.1 Shop Drawings

- .1 Submit in accordance with Section 01 33 00. Show on Shop Drawings, vanities, counters, cupboards, and other casework.
- .2 Show fabrication details, including exact sizes and description of anchorage and hardware, nature of the materials which are to be used as component parts, and installation and interface conditions.
- .3 Millwork
- | | |
|----|--|
| .1 | Contractor shall submit stamped Shop Drawings for miscellaneous metal framing, supports and other components used in the assembly. |
| .2 | Shop Drawings shall bear the seal and signature of a Professional Structural Engineer licensed in Province of Ontario. |

- .2 Samples: Submit duplicate samples of plastic laminate for colour and sheen verification.

1.4 **QUALITY ASSURANCE**

.1 Special Experience Requirements

- .1 Manufacturer/fabricator: Architectural woodwork shall be manufactured by a current member firm of AWI/AWMAC, and having a minimum of five years experience on Work of similar size and quality to that indicated and specified.

- .2 Installer qualifications: Engage an installer who is a current member firm of AWI/AWMAC, and who has successfully completed two architectural woodwork projects similar in scope, materials and design to that indicated and specified within the last five years.

- .2 Execute plastic laminate Work to CAN3-A172-M, except as specified otherwise.

1.5 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Deliver units to meet installation schedule. Arrange for strategic, off-the-ground, covered storage locations with constant minimum temperature of 16°C (61°F) and maximum moisture content of 12% when measured with moisture meter.
- .2 Cover plastic laminate faced surfaces and varnished surfaces at the factory with 480 kg/m³ kraft paper. Protect all surfaces with corrugated cardboard.
- .3 Provide adequate protection until finally accepted.

1.6 **WARRANTY**

- .1 Warrant Work of this section against defects and deficiencies for a period of two years from date Work is certified as substantially performed in accordance with the general conditions of the Contract.
- .2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective plastic laminate Work satisfactory to the Consultant and at no expense to the Owner.
- .3 Defects shall include, but not be limited to, warping and delamination.

1.7 **COORDINATION**

- .1 Coordinate with the frame Suppliers as to the time at which such items will be required for installation. Receive and store such items.

2 **Products**

2.1 **MATERIALS**

- .1 Wood Materials
 - .1 Restriction of source of supply: 50% of wood Products used in Work of this section must be Forest Stewardship Council (FSC) Certified, with chain of custody verification.
 - .2 Provide materials that comply with requirements of the AWI/AWMAC Manual for each type of woodwork and quality grade indicated and, where Products are part of woodwork, with requirements of the referenced Product standards that apply to Product characteristics indicated.
 - .3 Lumber: To AWI/AWMAC manual with the following requirements:
 - .1 Hardwood for concealed blocking and framing: Economy grade, any species that, when painted, will not show any defects.
 - .2 Moisture content: Provide kiln-dried (KD) lumber with an average moisture content range of 6% to 11% for interior Work. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed 5% to 10%.

- .3 Solid hardwood for transparent finish grade: to Architectural Woodwork Standards, Edition 1-2009, Grade I. Wood species and cut: To later selection by Consultant.
- .4 Architectural lumber: Clear, straight, kiln dried, select yellow birch for urethane or varnish finished fitments and door jambs. Lumber shall be kiln dried to 5% moisture content and free from blemishes that would be apparent after finish is applied.
- .2 Plastic laminate face sheets: Arborite, Formica, Wilsonart, Micarta, Nevamar, or Pionite conforming to NEMA LD3, postforming grade (PF42) for postformed Work, and standard grade (GP50) for flatwork, in solid colour range (woodgrain) (printed pattern), suede (glossy) (furniture) finish, as selected by Consultant.
 - .1 Plastic laminate backing: Product of manufacturer of face sheet used, grade PF30.
 - .2 Laminating core: Particleboard core of minimum 720 kg/m³ density conforming to CAN3-O188.1-M, sanded face, or Douglas Fir plywood conforming to CSA O121-M, G2S.
- .3 Countertop:
 - .1 Plastic laminate (upper cabinets) by Wilsonart or accepted equivalent. Colour: North Sea D90 or Alabaster D431.
- .4 Melamine surfaced boards: 720 kg/m³ density particleboard core with thermally fused low pressure laminate finish by Domtar, Arborite or Uniboard. Colour as selected by the Consultant.
- .5 Particle Board: to ANSI A208.1, Grade M-2, minimum 635 kg/m³ density, 100% post-industrial wood fibres, no added urea formaldehyde, thickness as indicated on Drawings. Uniboard Canada, or accepted equal.
- .6 Plywood:
 - .1 Softwood to CSA O151
 - .2 Douglas fir conforming to CSA O121-M, G2S, sanded, and stain grade birch conforming to CSA O115-M, G1S and G2S, depending on exposure.
 - .3 Hardwood plywood: conforming to CSA O115. Exposed faces shall be good grade and unexposed faces shall be sound grade, good one side and sound one side, G2S, depending on exposure.
 - .4 Marine Grade Plywood: Marine Douglas Fir, G2S, sanded, to CSA 0121, 9 ply – 3/4 inch (19 mm) thick.
 - .5 Fire retardant treated plywood: Pressure-impregnated fire retardant treated plywood conforming to CSA O80.27, to provide a flame spread rating of 25 or less, in accordance with CAN/ULC-S102.
- .7 Wood Trim:
 - .1 Softwood trim: In accordance with Architectural Woodwork Standards, Premium Grade, dressed 4 sides. Suitable for paint finish in profiles as indicated on Contract Drawings.

- .2 Hardwood trim: In accordance with Architectural Woodwork Standards Premium Grade. Kiln dried. Species and finished lumber (S4S), selected for compatible grain and colour. Edge grain (vertical).
- .3 Suitable for clear or stain finish in profiles as indicated on Contract Drawings and for window and door casings and Chair rails
- .8 Casework hardware: As follows:
 - .1 Adjustable shelf hardware (janitors' shelves): Extra heavy duty; Knappe and Vogt No. 87 ANO standards, No. 187LL ANO shelf brackets and matching shelf rests or Richelieu equivalent, all in anochrome finish. Locate standards at 600 mm o.c. maximum.
 - .2 Adjustable shelf hardware (cupboard shelves): Knappe & Vogt No. 255 standards and No. 256 shelf brackets, or Richelieu equivalent, nickel plated (brass) (epoxy coated white) (epoxy coated almond), mortised into cabinet sides.
 - .3 Door and drawer pulls: Canadian Builders Hardware CBH 220, 88 mm long aluminum (bronze) (brass) (stainless steel) or Hafele 116.05.922.
 - .4 Hinges: Blum "Clip 170" or Hettich "Euromat Topsafe 4955", 170 degree opening angle, concealed, self-closing, nickel plated.
 - .5 Drawer slides: Full extension, rated 100 lb. load, Knappe & Vogt 1400 or Accuride 3832.
 - .6 Cabinet door and drawer lock: Knappe & Vogt 986, nickel plated.
 - .7 Vanity brackets: Hebcos table brackets.
- .9 Shower and locker room seats: Premium Grade Maple or similar hardwood standard, shop finished with one coat of polyurethane varnish reduced 25% and 2 coats of polyurethane varnish.
- .10 Rough hardware: Supply all rough hardware to frame and fix finish carpentry. This includes bolts, anchors, nails, expansion shields and other fastenings required. Ensure bolts and screws are galvanized or non-ferrous material. Wood screws shall be full thread screws.
- .11 Fire retardant treated plywood: Pressure-impregnated fire retardant treated plywood conforming to CSA O80.27, to provide a flame spread rating of 25 or less, in accordance with CAN/ULC-S102.
- .12 Insulation: Refer to Section 07 21 00 Thermal Insulation.

2.2 **FABRICATION**

- .1 Obtain and verify dimensions at the building before fabrication of casework takes place, and in ample time to prevent unnecessary delays in the Work.
- .2 Make Work plumb, level and true, in as long lengths as practicable with joints arranged to be as inconspicuous as possible, and with proper provision for shrinkage.
- .3 Tool marks on exposed surfaces is deemed sufficient cause for rejection.
- .4 Neatly and accurately scribe, mitre and joint Work. Carefully mitre all exposed corners. Neatly cope intersecting moulds at inside corners; do not mitre.

- .5 Rout or groove back of flat trim; kerf backs of wide flat members, except for members with backs exposed in finished Work.
- .6 Assemble Work at the shop, unless impractical, and deliver ready for installation, with ample allowance for cutting, fitting and scribing.
- .7 Ensure that mill assembled units are of sizes that can be transported through the building to their final location.
- .8 Construct Work as shown or noted on the Drawings and Shop Drawings. Adequately frame as required to provide a firm and rigid installation complete with all gables, divisions and other members. Conceal all fastenings.
- .9 Plastic Laminate Work
 - .1 Veneer plastic laminate to core material in accordance with manufacturer's printed directions. Apply laminate face sheet to exposed surfaces of casework. Apply backing grade to underside of shelves and counters. Use melamine finished core for interior surfaces of drawers and cabinets only.
 - .2 Neatly butt plastic laminate, with self edging applied before face veneers. Seal core at joints and edges and where sink cut-outs are provided, with water-resistant material to retard movement of moisture to, or from, the assembly. Mechanically shop fasten backsplash core material to the top core with 1.5 mm (16 gauge) concealed brackets at 300 mm centres. Carry counter laminate material up at back edges to form integral coved backsplash.
 - .3 Joints in plastic laminate Work are not permitted except in pieces exceeding 2400 mm in length.
 - .4 Cut units for sinks in coordination with mechanical trade.

3 Execution

3.1 **EXAMINATION**

- .1 Inspect existing conditions upon which Work of this section is dependent. Report to the Consultant in writing any defects or discrepancies. Commencement of Work implies acceptance of existing conditions.

3.2 **INSTALLATION**

- .1 Set and secure materials and components in place, rigid, plumb and square, and in accordance with reviewed Shop Drawings. Be responsible for a rigid and secure attachment.
- .2 Casework: Install level plumb and true and complete in all respects. Rigidly and securely fasten to retaining structures using heavy duty hardware. Fit and scribe as required to achieve neat junctures with retaining structure and to conceal voids at such points. Install finish hardware for casework in accordance with manufacturers' directions. Adjust as required for a perfect fit and for ease of operation.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

.2 Work of this section includes but is not necessarily limited to, the following:

.1 Firestopping and smoke seals at penetrations through fire rated assemblies to match fire rating of such structures, in accordance with the Contract Documents, including but not limited to the following locations:

.1 Penetrations through fire resistance rated masonry and gypsum board

.2 Top of fire resistance rated masonry walls and gypsum board walls

.3 Intersection of fire resistance rated masonry and gypsum board

.4 Control joints in fire resistance rated masonry and gypsum board

.5 Openings and sleeves installed for future use in fire resistance rated separations

.6 Perimeter of floors at exterior walls

.7 Process and building services penetrations through floors

.2 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 OBC.

.3 Firestop system rating: Comply with F, FH, FT, or FTH ratings as required by authorities having jurisdiction.

1.2 **RELATED SECTIONS**

.1 Divisions 21, 22, 23, 26 and 27: Mechanical, Electrical and Communications: Firestopping and smoke seals within mechanical assemblies (i.e. inside ducts, dampers) and electrical/communication assemblies (i.e. inside bus ducts).

1.3 **REFERENCES**

.1 Conform to the latest edition of the following:

.1 ULC-S115, Standard Method of Fire Tests of Firestop Systems

.2 CAN/ULC S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials

.3 ASTM E2174, Standard Practice for On-Site Inspection of Installed Fire Stops

.4 ASTM E2307, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi Story Test Apparatus

.5 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgements

.6 AODA, Accessibility for Ontarians with Disabilities Act

1.4 **QUALIFICATION**

.1 Subcontractor qualifications: Accredited firm with not less than five years satisfactory experience as recommended by firestopping/smoke seal manufacturer.

1.5 **SUBMITTALS**

.1 Shop Drawings: Submit in accordance with Section 01 33 00.

.2 Submit manufacturer's Product data for each material to be used, and fire test certifications for assemblies as applicable to the Work.

.3 Submit details of each type of penetration and materials to be incorporated as smoke stop and/or firestopping assembly.

1.6 **QUALITY ASSURANCE**

.1 Job mock-up: Provide sample application at each type of penetration at the Site, in the presence of Consultant. After approval, such mock-up to constitute standard of acceptance for remainder of Work.

.2 Firestopping assemblies through fire rated structures are to comply with ULC or Warnock Hersey approved assemblies.

.3 An approved manufacturer's representative to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

.4 Firestop systems do not re-establish the structural integrity of load bearing partitions/assemblies or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

.5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgement derived from similar ULC or cUL system designs or other tests will be submitted to local Authorities Having Jurisdiction for their review and approval prior to installation. Engineer judgement drawings must follow the requirements set forth by the International Firestop Council.

1.7 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver materials in original unopened containers or unopened packages, with manufacturer's labels attached, installation instructions, and lot numbers intact and legible.

.2 Store materials in original containers, out of weather, and at a temperature below 32°C (90°F).

1.8 **JOBSITE CONDITIONS**

.1 Unmixed liquid components of foam are to rest in their original, unopened containers at a temperature between 18°C and 27°C (65°F and 80°F) for twelve hours before use.

.2 Sealant may be applied at temperatures ranging from -38°C to +71°C (-35°F to +160°F).

- .3 Do not apply materials when temperature of substrate or ambient air exceeds manufacturer's stated limits.

2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Provide fire stopping composed of components that are compatible with each other, the substrates forming openings and the items, if any, penetrating the fire stopping under conditions of service and application, as demonstrated by the fire stopping manufacturer based on testing and field experience.
- .2 Provide components for each fire stopping system that are needed to install fill material. Use only components specialized by the fire stopping manufacturer and approved by the qualified testing agency for the designated fire resistance rated systems.
- .3 Fire stopping materials are either "cast-in-place" (integral with concrete placement) or "post-installed". Provide cast-in-place firestop devices prior to concrete placement.
- .4 Provide a round fire-rated cable management device whenever cables penetrate the fire rated walls, where frequent cable changes and additions may occur. The fire-rated cable management device shall consist of a corrugated steel tube with zinc coating, contain an inner plastic housing, intumescent material rings and inner fabric smoke seal membrane. The length of the sleeve shall be 315 mm. The fire-rated cable management device shall contain integrated intumescent firestop wrap strip materials sufficient to maintain the hourly rating of the barrier being penetrated. The fire-rated cable management device shall contain a smoke seal fabric membrane or intumescent firestop plugs sufficient to achieve the L-rating requirements of the barrier type. Install device per the manufacturer's published installation instructions.
- .5 Penetrations in the fire resistance rated walls: Provide fire stopping with ratings determined in accordance with CAN/ULC S115-11.
 - .1 F-Rating: Not less than the fire resistance rating of the wall construction being penetrated.
- .6 Penetrations in horizontal assemblies: Provide fire stopping with ratings determined in accordance with CAN/ULC S115-11.
 - .1 F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
 - .2 T-Rating: When penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
 - .3 W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.
- .7 Penetrations in smoke barriers: Provide fire stopping with ratings determined in accordance with UL 1479 or ASTM E814.
 - .1 L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.
- .8 Mold resistance: Provide penetration fire stopping with mold and mildew resistance rating of 0 as determined by ASTM G21.

2.2 MATERIALS

- .1 Fire stopping and smoke seal systems - general: Asbestos-free systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with ULC-S115, and suitable to actual Project application and installation conditions.
 - .1 Acceptable manufacturers of rated systems:
 - .1 Hilti
 - .2 A/D Fire Protection Systems
 - .3 Tremco
 - .4 Dow Corning
 - .5 3M
 - .6 Or accepted equal
- .2 Firestop fibre: Mineral fibre (complete with galvanized steel insulation clips and) bearing ULC or Warnock Hersey label, in width 25% - 33% larger than the space to be filled. Use one of the following:
 - .1 "Firebarrier Firestopping" by A/D Fire Protection Systems
 - .2 "RXL Safe" by Roxul
 - .3 "Fire-Bloc 1" by M.W. McGill and Associates Limited
- .3 Cable management: Re-penetrable device for installation in wall and floor applications and resists temperatures up to 100°C. Steel with zinc coating, ABS plastic and glass-fiber fabric:
 - .1 "Speed Sleeve CP 653" by Hilti Canada.
- .4 Damming materials, supports and anchorages: To firestopping/smoke and seal manufacturer's recommendations, as required by assembly.
- .5 Sheet metal closures: Galvanized sheet metal closures and fasteners appropriate to adjacent structures to be secured to. Sheet metal to be in accordance with ASTM A653/A653M with ZF75 zinc coating designation.
- .6 Pipe wrap strip: single component intumescent elastomeric strips, flexible firestop wrap strip at existing piping systems. The wrap strip shall be UL Certified and tested to the requirements of ASTM E814 (UL1479) and CAN/ULC-S115.
 - .1 "CP 648E/648S" by Hilti
 - .2 SpecSeal SSW Wrap Strip" by Specified Technologies, Inc. (STI)
 - .3 Fire Barrier Intumescent Wrap Strip by 3M
 - .4 or accepted equal
- .7 Firestop Sealant: flexible, acrylic based firestop sealant, silicone free, for use in fire-rated joints and through penetrations. "CP 606" by Hilti or accepted equal. Size 200 mm x 127mm wide x 50 mm high. Firestop Block to be in accordance with ASTM E814.

3 Execution

3.1 **PREPARATION**

- .1 Remove combustible materials and loose impediment from penetration opening and involved surfaces.
- .2 Remove oil and other free liquids from penetration opening. Clean metal substrates with non-alcohol solvent.

3.2 **INSTALLATION**

- .1 Install firestopping and smoke seal systems in accordance with manufacturer's instructions and fire rated assembly requirements to establish continuity and integrity of fire separations.
- .2 Install primers as recommended by firestop Product manufacturers.
- .3 Install temporary forming, damming and back-up as required. Remove after firestopping and smoke seal materials have achieve initial cure and able to resist displacement.
- .4 Use resilient, elastomeric firestopping systems in the following locations:
 - .1 Openings and sleeves for future use.
 - .2 Penetration systems subject to vibration or thermal movement.
 - .3 Penetration systems in acoustical containment enclosures.
- .5 Trowel and tool exposed firestop Product surfaces to uniform, smooth finish.
- .6 Repair damaged firestopped surfaces to acceptance of Consultant.

3.3 **FIBRE FIRESTOPPING INSTALLATION**

- .1 Install fibre firestopping with minimum 25% to 33% compression in accordance with Product manufacturer's recommendations.
- .2 Butt succeeding sections of firestopping tightly against preceding piece. Do not leave any void.

3.4 **FOAM INSTALLATION**

- .1 Follow manufacturer's installation instructions for damming penetration.
- .2 Seal gaps or cracks left after damming materials are in place.
- .3 Immediately after mixing, dispense liquid foam into penetration opening in accordance with manufacturer's installation instructions.
- .4 Do not overfill penetration openings with liquid foam. Foam expands approximately three times its original volume during cure. Comply with the following:
 - .1 When dispensing liquid foam continuously, be sure the thickness of liquid foam does not exceed 25 mm at any given spot.
 - .2 If opening is not filled when cured foam has completed its expansion, repeat injection and cure procedure until opening is filled to desired level.
- .5 Leave temporary damming in place for twenty-four hours to allow foam to fully cure.

3.5 **SEALANT INSTALLATION**

- .1 Apply sealant from cartridge or with trowel or putty knife from pail as applicable to detail or condition. Ensure sealant contacts with substrates of opening.

3.6 **FIELD QUALITY CONTROL**

- .1 Perform manufacturer's in-line quality control check at least once daily, and upon changing to new lot of material, to ensure performance of both dispensing equipment and foam Product prior to installing penetration seals.
- .2 Inspect cured penetration seal after twenty-four hour cure by removing temporary damming materials to examine seal.
- .3 Cured foam should completely fill penetration. Fill remaining gaps with freshly mixed foam or fire stop sealant. Reinspect after added material has cured twenty-four hours.
- .4 Damming materials required to achieve a specific fire rating must remain in penetration. Sheet metal closures which are shown on Drawings are to be reinstalled after inspections.

3.7 **IDENTIFICATION**

- .1 Identify each firestop penetration assembly with permanent label listing following:
 - .1 Assembly and rating in hours.
 - .2 Date of installation.
 - .3 Installing company's name and telephone number.

3.8 **ADJUSTMENT AND CLEANING**

- .1 Clean up foam or sealant spills following manufacturer's instructions on container label.
 - .2 Trim excess cured foam with a sharp knife or blade if required for finished appearances.
 - .3 Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- End of Section

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 Type "A" conditions: All exposed joints on the exterior and interior of wall envelope and all joints throughout that are subject to movement. The principal locations are as follows:

.1 Perimeter of exterior hollow metal frames and steel channel frames at junctions with adjacent construction.

.2 Control joints in exterior masonry and concrete walls.

.3 Joint between truck dock shelter or door seals and adjacent construction.

.4 Other locations indicated on the Drawings.

.2 Type "B" conditions: All joints on the building interior that are not subject to movement and that require filling for appearance or sanitary reasons. The principal locations are as follows:

.1 Masonry control joints.

.2 Joints between metal frames of all kinds and adjacent construction, in interior partitions.

.3 Masonry wall inside corners in exposed locations; masonry-to-column junctures where masonry is anchored to steel.

.4 Other locations indicated on the Drawings.

.3 Type "C" conditions: Exposed areas on the building interior which require a mildew resistant sealant. The principal locations are as follows:

.1 Joints around washroom accessories, water closets, urinals, lavatories, vanities and shelves.

.2 Joints around counters at walls.

.3 Joints around shower accessories.

.4 Other locations indicated on the Drawings.

.4 Type "D" conditions: expansion and control joints, metal panel joints, curtain wall, perimeter seal around window frames, new and remedial construction.

1.2 **SEALANTS SPECIFIED IN OTHER SECTIONS**

.1 Section 03 30 00: Sealant in "vee" groove control joints.

.2 Section 07 60 00: Sealant within roof flashings.

- .3 Section 08 40 00: Sealant around aluminum entrances, windows, glazed curtain walls or windowwalls, both sides of wall.
- .4 Section 08 80 00: Sealant in conjunction with glazing.
- .5 Section 09 29 00: Sealant in conjunction with acoustically insulated gypsum board partitions.
- .6 Divisions 22 and 23: Packing and sealant around pipe and ductwork penetrations.
- .7 Divisions 26 and 27: Packing and sealant around electrical conduit and equipment penetrations.

1.3 REFERENCES

- .1 Conform to the latest edition of the following:
 - .1 ASTM C920 - Standard Specification for Elastomeric Joint Sealants
 - .2 SCAQMD - State of California's South Coast Air Quality Management District
 - .3 AODA - Accessibility for Ontarians with Disabilities Act

1.4 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit in accordance with Section 01 33 00.
 - .2 Submit as Shop Drawings, printed literature of each sealant Product specified describing composition, together with recommendations or directions for surface preparation, material preparation and material installation.
 - .3 Product data submitted to show validation by the Sealant, Waterproofing and Restoration Institute (SWRI) for exterior sealants.
 - .4 In addition, submit colour charts for each sealant material for colour selection.

1.5 QUALITY ASSURANCE

- .1 Installer qualifications: The Work of this section shall be carried out by an installer having specialized in this Work as its primary business for at least five years, and having performed satisfactorily Work of this type, size and scope. Employ craftsmen who are thoroughly skilled and completely familiar with the specified requirements. Provide the services of a competent foreman or supervisor who shall be available at all times during the progress of the Work of this section.
- .2 Single source: Provide sealants of each joint type from one manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in manufacturers' original unopened containers with manufacturers' labels and seals intact. Labels to identify manufacturer's name, brand name, date of manufacture, grade and type, application directions, and expiry date or shelf life.
- .2 Handle and store materials in accordance with manufacturers' printed directions. Arrange for suitable storage areas. Store flammable materials in safe, approved containers to eliminate fire hazards.

1.7 **PROJECT SITE CONDITIONS**

- .1 Protect adjacent Work from damage resulting from Work of this section. Replace damaged Work at no increase in Contract Price.
- .2 Do not install sealants when ambient air temperature is less than 4°C (40°F) (-28°C (-20°F) for silicones) or when recesses are wet or damp; Provide temporary heated enclosures to comply with this requirement.
- .3 Protect adjacent exposed finished surfaces from damage, by masking or other approved means, prior to performing Work. Remove protection when no longer required and clean adjacent, exposed surfaces of any sealant deposited upon such surfaces.

1.8 **WARRANTY**

- .1 Warrant the Work for three years. Repair leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion or staining adjacent surfaces, occurring during the Warranty Period.

2 **Products**

2.1 **SEALANT**

- .1 General
 - .1 Low VOC: Use sealants with low volatile organic content to comply with SCAQMD Rule 1168
 - .2 Validation: Sealants are to have the validation of Sealants, Waterproofing and Restoration Institute (SWRI).
 - .3 Provide joint sealants that are compatible with backing material, accessories, substrates and adjacent sealants for the intended uses based on the testing, recommendations, experience, and written instructions of the sealant manufacturer.
 - .4 Colours for exposed joint sealants caulking: Provide joint sealant colours as selected by the Consultant from the manufacturer's full range of colours.
- .2 Sealant - type "A" conditions: Multi-component type in polysulphide or polyurethane type, as follows:
 - .1 Multi-component polysulfide: ASTM C920, Type M, Grade NS, Class 25, in standard colours as selected by the Consultant:
 - .1 W.R. Meadows "CM-60-7900-252"
 - .2 Sonneborn "Sonolastic Polysulfide Sealant"
 - .3 Sika "Duoflex NS/SL"
 - .4 Euclid Chemical, "Tammsflex NS/SL"
 - .2 Multi-component polyurethane: ASTM C920, Type M, Grade NS, Class 25, in standard colours as selected by the Consultant:
 - .1 W.R. Meadows "Dualthane 7900-232"
 - .2 Sonneborn "Sonolastic NP 2"

- .3 Tremco "Dymeric" or "Vulkem 227"
- .4 Sika "Sikaflex 2C NS/SL"
- .5 Euclid Chemical, "Eucolastic 2 NS or SL"
- .3 Sealant - type "A" conditions: One-component polyurethane or one-component silicone sealant to ASTM C920, Type S, Grade NS, Class 25, Use NT, M and A in standard colours as selected by the Consultant.
 - .1 Tremco "Dymonic"
 - .2 Sonneborn "NP 1"
 - .3 Dow Corning "CWS or CCS"
 - .4 Bondaflex "PUR 25" (polyurethane) or Bondaflex "SIL 199" (silicone)
 - .5 Euclid Chemical, "Eucolastic 1 NS or SL"
- .4 Sealant - type "A" conditions: Silicone sealant to ASTM C920, Type S, Grade NS, Class 25, Use T, NT and M in standard colours as selected by the Consultant.
 - .1 Dow Corning Corp. "790 Building Sealant" or "795 Building Sealant"
 - .2 GE "Silpruf LM"
 - .3 Tremco "Spectrem 1"
 - .4 Bondaflex "SIL 290"
- .5 Sealant - type "B" conditions: Non-sag, one part, acrylic polymer caulk, in standard colours as selected by the Consultant.
 - .1 Tremco "Mono 555"
 - .2 DAP Inc. "Acrylic Polymeric Sealant"
- .6 Sealant - type "C" conditions: Mildew resistant silicone sealant to ASTM C920, Type S, Grade NS, Class 25, and meeting the requirements of FDA Regulation 21 CFR 177.2600, in standard colours as selected by the Consultant.
 - .1 Dow Corning "786 Mildew Resistant Silicone Sealant" or "Tub Tile and Ceramic"
 - .2 GE Silicones "Sanitary 1700"
 - .3 Sonneborn "Sonolastic Omnipus"
 - .4 Bondaflex "SIL 100 WF"
- .7 Sealant - exterior immersion conditions: Vulkem 171 primer and two-part chemically curing, pour grade Vulkem 245 polyurethane sealant or Bondaflex "PUR 25 with Primer 1000".
- .8 Acoustic Caulking: DAP "Sound Block", Green Glue "Noise Proofing Sealant", LePage "Draft and Acoustic Sealant - Green Series", or accepted equal.

2.2 **ACCESSORIES**

- .1 Primers: As recommended by sealant manufacturers for various substrates, to allow proper adhesion and to prevent staining of adjacent surfaces.

- .2 Joint backing: Round, solid section, skinned surfaced, soft polyethylene foam gasket stock, to be under compression and to suit joint width and anticipated movement. Skin shall be of proper consistency to prevent bonding to sealant.
- .3 Bond breaker: Recommended by sealant manufacturers to prevent bonding of sealant to backing surface of recess.
- .4 Cleaning agents: As recommended by sealant manufacturer.

3 Execution

3.1 **PREPARATION**

- .1 Prepare joints to receive sealant and verify suitability. Failure of sealant in the future, due to claimed unsuitability of joint, will not be valid. Installation of sealant is considered as evidence that joint is suitable to receive sealant.
- .2 Clean recesses to receive sealant, free of dirt, dust, loose material, oil, grease, form release agents and other substances detrimental to sealant's performance. Remove lacquer or other protective coatings from metal surfaces, without damaging metal finish, using oil-free solvents.
- .3 Apply masking tape to metal surfaces adjacent to recesses to prevent smearing or staining of such metal surfaces.
- .4 Depth of recess to receive sealants are not to exceed one-half the joint width up to a maximum of 12 mm and not less than 6 mm at centre of joint.
 - .1 Where depth of recess is in excess of specified depth, place back-up material in recess, forced into place under compression, to provide specified recess depth.
 - .2 Where recess is less than specified depth, cut the back surface of recess to specified recess depth.
- .5 Recess to be dry when sealants are installed. Where recess for sealants is at proper depth, apply bond-preventative material to back surface of recess. Prime sides in accordance with sealant manufacturer's recommendations, to develop proper mechanical adhesion to negate latent moisture.

3.2 **INSTALLATION**

- .1 Use materials as received from manufacturers, without additives or adulterations. Use one manufacturer's Product for each kind of Product specified.
- .2 Mix multi-component sealant until the sealant is thoroughly and uniformly blended and install sealant prior to start of hardening or curing cycle.
- .3 Fill joints completely, regardless of variation of joint widths, and to proper depth as specified. Install sealants under pressure, without smearing adjacent surfaces.
 - .1 Type "A" sealant must have full and uniform contact with, and adhesion to, side surfaces of recess.
 - .2 Type "B" and Type "C" sealants must have full and uniform contact with, and adhesion to, all surfaces of recess.
- .4 Finish face of sealant smooth and even. At recesses in angular surfaces, finish sealant with a flat face, flush with face of material at each side. At recesses in flush surfaces, finish sealant with a concave face, flush with face of material at each side.

- .5 Sealant may be tooled, provided that such tooling does not damage seal nor tear sealant. Surface of sealants to be free from dirt, stain or other defacements and be uniform in colour.
- .6 Acoustical Caulking
 - .1 Apply acoustic sealant as the installation of acoustically insulated partitions proceed to ensure concealment of sealant. Work includes sealing perimeter of partitions, and openings and penetrations through partitions to achieve STC rating shown on Drawings, in accordance with sealant manufacturer's printed directions.
 - .2 Seal as follows
 - .1 At partitions, provide continuous, two 6 mm concealed beads of acoustical sealant under tracks and runners, behind steel studs at perimeter, and wherever Work abuts dissimilar materials.
 - .2 At ceilings, provide continuous, two 6 mm concealed beads of acoustical sealant wherever Work abuts dissimilar materials.
 - .3 Provide double seal at laminated partition faces. Install face layer with 6 mm edge clearance at terminations of Work, and install continuous bead of acoustical sealant all around.
 - .4 At openings and cutouts, fill open spaces between edges of gypsum board and fixtures, cabinets, ducts and other flush or penetrating items, with continuous bead of acoustical sealant.
 - .5 Seal sides and backs of electrical boxes to completely close up openings and joints with a bead of acoustical sealant.
 - .6 Where sound-rated partitions intersect non-rated walls or partitions, extend sound-rated construction to completely close sound flanking paths through non-rated construction. Seal joints between face layers at vertical interior angles of intersecting partitions.
 - .7 Ceiling plenums: Where sound-rated partitions extend through non-sound rated ceilings to structural substrates above, extend the same treatment to that portion of the partition above the ceiling as specified for portion below the ceiling.
 - .8 For double-layer partition applications, install base layer only above ceilings.
 - .3 Where acoustic sealant is applied at exposed joints, apply a covering bead of topping sealant finish to a smooth, shallow concave surface.
 - .4 Remove any excess sealant and smears as Work progresses and leave the Work in a clean condition to Consultant's satisfaction.

3.3 **ADJUSTING AND CLEANING**

- .1 Remove any sealants not complying with requirements specified herein. Re-prepare recesses and install new sealants to provide finish Work complying with requirements specified, at no increase in Contract Price.
- .2 Clean surfaces adjacent to filled joints and remove sealant smears. At metal surfaces, remove masking tape and other residue. Exercise care in cleaning and removal operations, so as not to mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials, at no increase in Contract Price.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 ANSI/NAAMM HMMA-841- Tolerances and Clearances for Commercial Hollow Metal Doors and Frames
- .2 ANSI/NAAMM HMMA-867- Guide Specifications for Commercial Laminated Core Hollow Metal Doors and Frames
- .3 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
- .4 ASTM A924/A924M - Standard Specification for Steel Sheet, Zinc-Coated Galvanized or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- .5 ASTM D4726 - Standard Specification for Rigid PVC Exterior Profile Extrusions Used for Assembled Windows and Doors
- .6 CAN4-S104-M - Standard Method for Fire Tests of Door Assemblies
- .7 CAN4-S105-M - Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104
- .8 CSA W47.1 - Certification of Companies for Fusion Welding of Steel
- .9 CSA W59-M - Welded Steel Construction (Metal Arc Welding)
- .10 NFPA 80 - Standard for Fire Doors and Other Opening Protective
- .11 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **SUBMITTALS**

.1 Shop Drawings

- .1 Submit in accordance with Section 01 33 00. Clearly show in detail, gauges of metal Work, assemblies, large screen frame sections and assembly details, fastenings, hardware cutouts and reinforcing, anchorage and finish.
- .2 Indicate doors and frames which are fire rated.
- .3 Submit manufacturer's Product data brochure as part of Shop Drawing submittal.

1.4 **COORDINATION**

- .1 Coordinate with finish hardware Supplier to ensure proper preparation of hollow metal doors and frames for finish hardware.
- .2 Coordinate with electrical division for doors requiring conduits.

1.5 **DELIVERY, STORAGE AND HANDLING**

- .1 Protect Work against rust and damage during manufacture and delivery. Handle carefully to prevent distortion and wracking.
- .2 Protect hollow metal Work from damage. Replace damaged Work which cannot be satisfactorily repaired, restored or cleaned. Store materials on site in a manner to prevent damage.

2 Products

2.1 **MANUFACTURERS**

- .1 Source doors and frames from one of the following:
 - .1 Fleming Door Products Limited
 - .2 Artek Door
 - .3 Baron Metal Industries
 - .4 Daybar Industries Limited

2.2 **MATERIALS**

- .1 Sheet steel: Commercial grade sheet steel conforming to ASTM A653/A653M, with ZF75 zinc-iron alloy coating designation. Sheet steel thicknesses specified are base metal thicknesses prior to galvanizing.
- .2 Frame Anchors: Commercial grade steel conforming to ASTM A653/A653M, Type B with minimum G90 (Z275).

2.3 **HOLLOW METAL DOORS (AND TRANSOM PANELS)**

- .1 General:
 - .1 Doors in general use areas:
 - .1 Interior and Exterior: 18 Gauge skin thickness - Polystyrene Insulated - Tack Welded & Filled Edges.
 - .2 Doors in high security or sensitive facilities such as Police Stations where additional security is required:
 - .1 Exterior: 16 Gauge skin thickness - Steel Stiffened
 - .3 Provide 1-3/4" doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces without visible joints or seams on exposed faces unless otherwise indicated.
- .2 Exterior Doors:
 - .1 Medium duty: Insulated, polystyrene core. Minimum R-Value 2.6 in accordance with ASTM C1363 in thermally broken frame. Thermal performance maximum U-factor 0.39. Refer to Door Schedule for fire rating.
 - .2 Heavy duty: Insulated, stiffened hollow steel core with polyurethane insulation in accordance with ASTM C1029. Minimum R-value 3.4 in accordance with ASTM C1363 in thermally broken frame. Thermal performance maximum U-factor 0.29. Refer to Door Schedule for fire rating.

- .3 Interior Doors:
 - .1 Medium duty: Manufacturer's standard kraft-paper honeycomb or one-piece polystyrene core, securely bonded to both faces.
 - .2 Heavy duty: Stiffened hollow steel core with mineral fibre semi-rigid blanket and batt insulation in accordance with ASTM C592 or ASTM C553, Type 1.
- .4 Adhesive:
 - .1 Honeycomb core and steel components: Heat-resistant, spray grade resin reinforced neoprene/rubber based, low viscosity, contact cement meeting manufacturer's requirements and testing in accordance with UL/ULC certification requirements.
 - .2 Interlocking edge seams for honeycomb cores: Resin reinforced polychloroprene (RRPC), fire resistance, high viscosity, sealant/adhesive meeting manufacturer's requirements and tested in accordance with UL/ULC certification requirements.
 - .3 Adhesive for Steel Stiffened Core: water based neoprene or solvent based neoprene or two component epoxy or acceptable equal.
- .5 Interior stiffeners: 0.91 mm thick (20 ga) steel.
- .6 Sound deadening and insulating material: Semi-rigid fibreglass, 24 kg/m³ minimum density, to fill core space.
- .7 Top caps: Rigid PVC extrusions conforming to CGSB 41-GP-19Ma. Fire labelled exterior doors to have factory installed flush steel top caps.
- .8 Glazing stops: 1.5 mm thick (16 ga) steel, formed, drilled and countersunk for fastenings.

2.4 **DOOR ACCESSORIES**

- .1 Door louvres: Vee shaped sight tight, with double flat frames, with 40% minimum free area, of W25 galvanized steel sheet with manufacturer's standard shop primer finish in grey colour; Airvector "T20F", Kreuger "600A", K.N. Crowder "SDL-V90", or M.W. McGill "DG 2000".
- .2 Fusible link door louvres: 1.6 mm (16 ga) cold rolled steel, fire actuated fusible link closure mechanism, minimum 25% free louvre area, baked enamel finish in colour selected by Consultant, listed and bearing the mark of ULC or Warnock Hersey. Accepted manufacturers: E. H. Price, Airflow, or K.N. Crowder or accepted equal.
- .3 Screws: Tamperproof stainless steel screws with countersunk flat head.
- .4 Door bumpers: In accordance with ANSI/BHMA A156.16, Type 6-180, grey neoprene.
- .5 Hardware reinforcement: 3.4 mm thick (10 ga) steel.

2.5 **HOLLOW METAL DOOR FRAMES**

- .1 Exterior Frames: Fabricated or hot-dip zinc coated steel that complies with ASTM A653/A653M, coating designation G90.
 - .1 Minimum 16-gauge thick steel sheet.

- .2 Thermal break frames: Tested for thermal performance in accordance with NFRC 100 and resistance to air infiltration in accordance with ASTM E283. Where indicated provide thermally broken frame profiles for use in both masonry and drywall construction. Fabricate with 1/16" positive thermal break and integral vinyl weatherstripping.
- .2 Interior Frames: Fabricated from cold-rolled steel sheet complying with ASTM A1008/1008M.
 - .1 Minimum 16-gauge thick steel sheet.
 - .2 Fire rated frames: Fabricate frames in accordance with NFPA 80 listed and labeled by a qualified testing agency for fire protection ratings indicated.
 - .3 Frame jambs shall extend to surface of finish floor only. Provide frame jambs with 2-piece adjustable floor anchors.
 - .4 Hardware reinforcement: Fabricate with reinforcement plates from same material as frames.
 - .5 Conduit in hollow metal frames: To CSA C22.2 No. 83-M. EMT galvanized cold rolled steel tubing.
- .3 Frame Anchors
 - .1 Frames in masonry: Adjustable "T-strap" anchors and base anchor.
 - .2 Frames in precast (concrete): Countersunk galvanized expansion bolts complete with base anchors, and spacers behind hollow metal frame.
 - .3 Frames in steel channel sub-frames: Countersunk fluorocarbon coated self drilling screws complete with spacers behind hollow metal frame.
 - .4 Labeled frames: To conform to ULC or Warnock Hersey requirements.
 - .5 Frames in gypsum board partitions: Steel anchor clips and adjustable base anchors of suitable design securely welded inside each jamb.
 - .6 Floor anchors: Minimum 3.5 mm thick adjustable hot dip galvanized base anchors with two holes for bolting to floor.

2.6 **LIGHT OPENINGS AND GLAZING**

- .1 Refer to Section 08 80 00 for glazing types and applications.
- .2 Stops and mouldings: Provide stops and mouldings around glazed lites where indicated. Form corners of stops and mouldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- .3 Mouldings for glazed lites in doors and loose stops for glazed lites in frames: Minimum 20 gauge, fabricated from same material as door face sheet in which they are installed.
- .4 Fixed frame mouldings: Formed integral with hollow metal frames, minimum 16 mm high unless otherwise indicated. Provide fixed frame mouldings and stops on outside of exterior and on secure side of interior doors and frames.

- .5 Preformed metal frames for light openings: Manufacturer's standard frame formed of cold rolled steel sheet with baked enamel or powder coated finish. Approved for use in doors of fire protection rating indicated. Match pre-finished door paint colour where applicable.

2.7

FABRICATION

- .1 Finish Work free from warp, open seams, buckles, weld and grind marks and other surface defects detrimental to attainment of a good paint finish in field. Form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- .2 Arc weld joints in accordance with CSA W59-M to produce a finished unit, square, true and free of distortion. Continuous weld joints unless specified otherwise. Execute welding by a firm fully approved by Canadian Welding Bureau to requirements of CSA W47.1.
- .3 Ream and remove burrs from cutouts and from drilled and punched holes.
- .4 Doors that do not require labels shall have label holes properly filled at the factory prior to shipping to Site.
- .5 Hollow Metal Doors and Transoms
 - .1 Doors: Flush swing type of sizes to details, schedules and reviewed Shop Drawings with cutouts for glass and grilles and reinforced to receive hardware fastenings.
 - .1 Blank, reinforce, drill and tap doors for mortised, template hardware. Where required, reinforce doors for surface-mounted hardware and door closers.
 - .2 Provide inverted, recessed, spot welded channels at top and bottom of doors. Provide PVC top caps on exterior doors.
 - .3 Provide cutouts with framing, glass stop mouldings and division bars where openings are required.
 - .4 Glass stops: Drill and countersink glass stops, secure with stainless steel tamper-proof flat head screws spaced at maximum 150 mm o.c. Provide stainless steel stops for stainless steel doors.
 - .5 Door seams:
 - .1 Laminated doors: Adhesive assisted lock seam.
 - .2 Steel stiffened doors: Continuous welded edges.
 - .2 Exterior Insulated Doors:
 - .1 Vertical edges:
 - .1 Vertical edges to be mechanically interlocked with hairline seam, continuously welded, filled and ground smooth full height of door.
 - .2 Top and bottom edges:
 - .1 Reinforced tops and bottoms of doors with continuous steel channel minimum 16 gauge, extending full width of door and welded to face sheet.

- .2 Doors with inverted top channel to include steel top cap welded in place with web of channel flush with face sheets of door.
 - .3 Plastic or composite fillers shall not be used.
 - .3 Transoms: Fabricate from same materials and construction and finish in same manner as doors.
- .6 Frames and Screens
 - .1 Welded frames: Weld flush face joints continuously. Grind, fill, dress and make smooth, flush and invisible.
 - .1 Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping. Spreader bars are for bracing only and are not to be used to size the frame opening.
 - .2 Furnish exterior door frames with continuously welded integral steel weather drip at head of frame.
 - .2 Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - .3 Floor anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - .4 Where frames are set in masonry or concrete, supply adjustable anchors to trade installing frame.
 - .5 Fabricate frames for installation in gypsum board partitions with steel anchors. Minimum number of anchors for each jamb is as follows:
 - .1 4 anchors for frames up to 2285 mm.
 - .2 5 anchors for frames from 2285 mm to 2440 mm.
 - .3 5 anchors, plus one additional for each 600 mm over in height for frames over 2440 mm.
 - .6 Frames in previously placed concrete, masonry, precast or structural steel: Anchors located at maximum 150 mm from top and bottom of each jamb, and intermediate anchors at maximum 660 mm o.c.
 - .7 Prepare each door opening for single stud rubber door silencers. Three for single door openings located in strike jamb and two for double door openings located in head.
- .7 Thermally broken door frames:
 - .1 For conditions where extreme temperature differences occur, use thermally broken commercial knocked-down or welded steel frames to decrease thermal conductivity.
 - .2 Manufactured from 16 gauge paintable galvalume steel.
 - .3 171.4 mm jamb depth.

- .4 Where thermally broken welded frame is required, ensure welds do not cause thermal transfers between interior and exterior surfaces of frame sections.
- .5 Fabricate interior and exterior sections of thermally broken frames with continuous PVC thermal break separation.
- .6 Thermally broken sections shall not be assembled with screws, grommets or other fasteners.
- .7 Closed sections (mullions and centre rails) of thermally broken frames to be factory insulated with 24 kg/m³ of loose batt type fiberglass material.
- .8 Fire Rated Doors and Frames
 - .1 Fabricate doors and frames for hourly rating noted on door schedules in conformance with CAN4 S104-M and CAN4 S105-M. Furnish door and frames with the appropriate label of a testing organization accredited by Standard Council of Canada in conformance with the foregoing standards.
 - .2 Label the entire assembly of fire rated screens containing doors.
 - .3 Locate fire rating label on doors on hinged edge midway between top hinge and head of door. Locate fire rating label on frames in door rebate.
 - .4 Mortise, reinforce, drill and tap doors to receive template hardware and reinforce for surface mounted hardware, all as per requirements of foregoing standards.
- .9 Insulated hollow metal transom panels: Same as for hollow metal door construction complete with drip flashings on exterior panels.
- .10 Preparation for security system: Hollow metal doors will be monitored to a central security system as indicated on Drawings. Prepare frames and doors to accommodate concealed rotary switch hinge (C.R.S.) at the centre hinge point. Provide frame with metal mortar guard at back side of hinge and with a 19 mm diameter rigid galvanized steel conduit from top of mortar guard to 300 mm above door head.

3 Execution

3.1 **INSTALLATION**

- .1 Building-in of hollow metal frames in masonry is specified in Section 04 22 00 - Concrete Unit Masonry.
- .2 Setting of hollow metal frames:
 - .1 Erect door frames, (glazed screen and borrowed light frames) plumb, square and level, maintaining widths and heights.
 - .2 Brace frames solidly in position while being built into masonry. Install temporary wood spreaders at mid-height of door frames, full width, until adjacent masonry Work is complete.
 - .3 Pack the door jamb and head voids which occur in exterior walls with specified insulation.
 - .4 Tap structural steel to coincide with fastener spacing on hollow metal door frame. Place spacer at each fastener location and install fastener.
 - .5 Tighten fastener, with head flush to frame. Apply metal filler to fastener head. Sand filler flush to frame and prepare for paint finish.

- .3 Installation of doors and finish hardware is specified in Section 08 71 05 - Installation of Doors and Finish Hardware.
- .4 Door Hardware and Painting
 - .1 Install door hardware supplied by Section 08 71 00 - Finish Hardware.
 - .2 Install door hardware in accordance with hardware templates and manufacturer's written instructions.
 - .3 Install louvres, glazing and silencers.
 - .4 Finish paint in accordance with Section 09 91 00 Painting.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- .2 Be responsible for supplying and installing a door system that is complete in all respects and smoothly operating. Provide all components and accessories as specified or as required to meet this requirement.

1.2 **DEFINITIONS**

- .1 Operation cycle: One complete cycle of a door begins with the door in the closed position. The door is then moved to the open position and back to the closed position.
- .2 NEMA ICS: National Electrical Manufacturers Association Industrial Control and Systems standard.

1.3 **DESIGN CRITERIA**

- .1 Design exterior doors to withstand the following specified (unfactored) wind loads in the closed position, with a maximum deflection under full design load of L/240 of the span:
 - .1 1.54 kN/m² positive (inward, toward the interior of the building)
 - .2 1.68 kN/m² negative (outward, toward the exterior)
- .2 Design operators to function against loading consequential to the foregoing.
- .3 Use the same design criteria where interior doors can be subjected to wind forces due to building arrangement.

1.4 **CODES AND REGULATIONS**

- .1 For electrical equipment and installation thereof, comply with all local and provincial laws, and with all other mandatory requirements. Be responsible to ensure an installation which is in compliance with all such laws and regulations, and all changes or alterations required by the authorized inspector of the authority having jurisdiction made without charge to the Owner.
- .2 It is the door manufacturer's responsibility to ensure that specified colour coding is acceptable to local jurisdiction.

1.5 **QUALITY ASSURANCE**

- .1 Installer: Retain door manufacturer or an installation specialist company licensed or franchised by door manufacturer.

1.6 **SUBMITTALS**

.1 Shop Drawings

- .1 Submit in accordance with Section 01 33 00.
- .2 Show and describe in detail:
 - .1 Detailed door assemblies.

- .2 Door elevations, sections and details, tracks, hardware and operating components, dimensions, gauges, finishes.
 - .3 Door operators, make, and horsepower rating.
 - .4 The relationship of the foregoing components to adjacent construction.
 - .5 Complete electrical schematics and wiring diagrams and sequence of door operation.
 - .3 Prepare Shop Drawings on one standard size drawing sheet. Standard "cuts" or stock drawings will not be acceptable.
 - .4 Confirm with a note that exterior doors meet the design requirements specified.
- .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data in accordance with Section 01 33 00.
 - .2 Indicate the following:
 - .1 "As-Built" straight line wiring diagrams showing electrical connections and control circuitry.
 - .2 Instructions explaining operation.
 - .3 Lubrication chart indicating lubrication points and type of lubricant recommended for equipment.
- 1.7 **HANDLING, STORAGE AND PROTECTION**
 - .1 Handle components with care. Protect against damage, dirt, disfigurement and weather.
 - .2 Store on site off the ground, and in a covered location.
- 1.8 **WARRANTY**
 - .1 Warrant Work of this section against defects and deficiencies for a period of three years from date Work is certified as substantially performed in accordance with the general conditions of the Contract.
 - .2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective Work satisfactory to the Consultant and at no expense to the Owner.
- 2 Products
- 2.1 **OVERHEAD DOORS**
 - .1 Sectional doors are made of anodized tubular extrusions fastened with self-tapping screws which have a stop notch. The extrusions shall have a minimum diameter of 159 mm at the perimeter of the door. The top-to-bottom end of the aluminum extrusions shall be doubled at each end in order to obtain a minimum support of 159 mm. Doors 4.27 m wide and over will have 45 mm horizontal reinforcement integrated into the aluminum extrusions.

- .2 Acceptable Products
 - .1 " Polytite P175/P175T" by Richard-Wilcox
 - .2 Or equal from Upwardor, Garaga Inc. or Wayne Dalton.
- .3 Component Minimum Requirements
 - .1 Tubular aluminum extrusions are 1.6 mm thick, clear anodized in accordance with ASTM B209 and ASTM B209M and have additional 3.2 mm thickness where hinges are fastened.
 - .2 Bottom door section: Double-walled in 26-gauge, G60 galvanized steel. Polyurethane injected with a total thickness of 45 mm.
 - .3 Paneling 5/8" (16 mm) thick, triple-wall extruded polycarbonate clear panels, R= 2.5 ft² hF/Btu (U=2.271 W/ m²K), light transmission 74%, SHGC= 0.75 retained with polyethylene gaskets.
- .4 Hardware
 - .1 Track: 12 gauge galvanized steel, 76 mm. Horizontal track is reinforced with a steel angle of 50 mm x 50 mm.
 - .2 Hinges: 13 gauge galvanized steel.
 - .3 Rollers: 75 mm diameter with 10 ball bearings.
 - .4 Struts for large doors (if applicable): Doors 3759 mm wide or larger shall come with 22-gauge galvanized steel horizontal struts and 13-gauge double hinges at each end.
 - .5 Torsion-type springs: The lifting system will consist of all the parts and accessories required for its installation. Doors weighing more than 454 kg (hardware included) must be approved by a professional installer approved by the manufacturer to choose the hardware.
 - .6 Counterbalance: Job rated torsion springs helically wound from oil tempered steel wire for a minimum 100,000 cycle quality. Provide a cycle counter in the control panel.
 - .7 Locking device: Individual electrical interlock bolts designed to accommodate a card reading device. Provide a limit switch in each door to cut off power to door when interlock bolts are engaged. Card readers are supplied by the Owner.
 - .8 Hand chain: "Endless", heavy chrome plated steel.
 - .9 Weatherstripping to head, jambs and meeting rails: Factory applied, of type to ensure a weathertight seal. Design weatherstripping assembly for easy replacement when weatherstrip is worn. The weatherstripping shall be made of a semi-circular TPE tubing. Weatherstripping on the exterior side of the door jamb and lintel shall be an aluminum extrusion and a double-edged strip of arctic vinyl.

2.2 DOOR FABRICATION

- .1 Provide framing required to support doors, tracks and operators from structure.
- .2 Fabricate bottom section panels as follows, with:
 - .1 Plain exterior and plain interior steel facing.

- .2 Space between facings solidly filled with foamed-in-place insulation, fully face bonded to steel.
- .3 All ends closed and sealed.
- .4 Top and bottom edges rebated to fit tightly together, and to provide weathering.
- .5 Top panel sufficiently stiffened to carry load of panels below.
- .3 There shall be no visible welds, bolts, screws.
- .4 Fabricate the Work true to dimensions and square. Accurately fit joints and intersecting members with adequate fastenings.

2.3 **ELECTRIC OPERATORS AND CONTROLS**

- .1 Controls for Non-Loading Dock Doors:
 - .1 Control cabinet: NEMA 12-Oil and Dust Tight by Allen Bradley, Ralston or Hammond, of size that provides easy access for removal of all components, with a face mounted fused disconnect switch.
 - .1 Interior pushbuttons: "OPEN-CLOSE-STOP", momentary contact (maintained pressure). Housing: NEMA 12-Oil and Dust Tight (NEMA 1-General Purpose) (NEMA 4-Watertight) (NEMA 7-Explosion Proof) (NEMA 9-Explosion Proof)
 - .2 Exterior pushbuttons: "OPEN-CLOSE-STOP", momentary contact (maintained pressure). Housing: NEMA 4-Watertight.
 - .3 Pull cord switches: Crouse-Hinds AFC 210 complete with safety coded polyethylene pull cords.
 - .4 Timer: Adjustable unit with range of one-half second to ninety seconds. Reset each time an opening control is activated during timer cycle.
 - .5 Starter: Size 1 reversing starter with electro mechanical interlocks.
 - .6 Door heater limit switch: To enable door heater to operate as soon as exterior door rises, Provide 120 V limit switch which will provide a dry contact closure when door is not in the fully closed position.
 - .7 Photo-electric control: Unit consisting of modulated light transmitter assembly and modulated light receiver assembly. The receiver shall feed modulated signal back to electric eye amplifier mounted in control cabinet. Mount to provide horizontal beam within range of bus driving through. Mount at interior side of door opening.
 - .2 Induction loops: Solid state and self tuning inductive device. The system for actuation shall be unbalancing an inductive circuit by the entrance of mass of metal. Each loop detector unit shall handle no more than two loops at any given location. Loop detector shall have internal adjustable setting for time delay.
 - .3 Wire: Type RW90, 208V, not less than #12 AWG for power wiring, and #14 AWG for control.
 - .4 Conduit: Rigid galvanized steel with compression fittings.
 - .5 Control voltage: 24 V.

2.4 **FABRICATION**

- .1 Fabricate Work with materials and with component dimensions and gauges, reinforcing, attached anchors and fastenings of adequate strength to prevent warping, buckling, opening of joints and seams, loosening of hardware, distortion and displacement within limits of intended and specified use.
- .2 Conceal and weld connections wherever possible.
- .3 Fit joints and junctions between components tightly and in true planes.
- .4 Isolate from each other dissimilar metals, and metal from concrete or masonry to prevent electrolysis.

2.5 **SHOP FINISHING OF DOOR SYSTEM**

- .1 Phosphatize all galvanized metal surfaces to provide for adhesion of finish paint. Clean ferrous metal surfaces except working parts of machinery and faying surfaces and prime with a rust inhibitive primer. Clean supplementary steel supports and likewise, prime with a rust inhibitive primer.
- .2 Apply in the shop, specified paint system to a minimum dry film thickness of 100 microns (4 mils) in accordance with paint finisher's standards. For baked system, bake components prior to foam insulation application.

3 Execution

3.1 **INSTALLATION**

- .1 Supply information and templates required for installation Work. Assist and/or supervise setting of anchorage built into Work of other sections.
- .2 Drill, tap and cut frames and other Work as required to install doors, tracks, operators, hardware, fittings, etc., and Provide necessary bolts, anchors, inserts, and supplementary framing and supports required to complete the Work.
- .3 Provide material required to suspend tracks from walls or roof steel including members between joists.
- .4 Do not use fasteners which penetrate through walls.
- .5 Furnish inserts and anchoring devices which must be set in concrete or built in masonry for the installation of doors. Provide setting drawings, templates and printed instructions for the installation of the anchorage devices.
- .6 Install units to fit tight at edges of jambs and heads of frames and ensure smooth and free operation under all conditions of operation. Leave in proper condition in all respects.

3.2 **ELECTRICAL WORK**

- .1 Provide wiring, conduit and fittings, and interconnect all electrical components of door system, back to master control panel. Terminate wiring in master control panel and tag.
- .2 Provide equipment or contacts necessary for interlocking doors and levellers in a manner such that door does not close if leveller is not in down position or such that leveller cannot be raised if door is closed.
- .3 Where conduit is installed in slab, coordinate with Section 03 35 00.

- .4 Identify control and indicating devices on front panel of door control cabinets with lamacoid nameplates.
- .5 Nameplates shall be laminated phenolic plastic, white front with black core, with lettering etched through the outer covering. Letters to be black.
- .6 Tag motors, limit switches, etc, with brass tags indicating component number or function.
- .7 Identify conductors at all points of connection with Wieland Type Z wire markers. The identification shall correspond to the Shop Drawings.
- .8 Identify components, including inside of control cabinet.
- .9 Colour coding: Utilize the following throughout:
 - .1 Red - Phase A
 - .2 Black - Phase B
 - .3 Blue - Phase C
 - .4 Green - Ground
 - .5 White - Neutral
 - .6 Orange - Control
 - .7 Yellow - Interlock

3.3 **FIELD TOUCH-UP**

- .1 Touch up prepainted finishes disturbed during transport and installation using a spray formulation of the baked enamel paint.

3.4 **LUBRICATION**

- .1 Upon completion of erection of units and operating equipment, lubricate moving parts before operation.
- .2 Grease all sprockets, bearings, cables, link chains and guides. Lubricant shall be as recommended by the manufacturer.

3.5 **ADJUSTMENT AND DEMONSTRATION**

- .1 Test-operate doors and demonstrate the operation of same at the time of acceptance of the completed Work.
- .2 Adjust Work to provide free-running, tightly closing and properly counterbalanced operation. Ensure that installation is free from warp, twist, or other distortion.
- .3 Clean Work on completion of installation.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- | | | |
|-----|--------------------------|---|
| .1 | CAN/CGSB-12.8-M | - Insulating Glass Units |
| .2 | CAN/CGSB-12.3-M | - Flat, Clear Float Glass |
| .3 | CAN/CGSB-12.4-M | - Heat Absorbing Glass |
| .4 | CAN/CGSB-12.1-M | - Tempered or Laminated Safety Glass |
| .5 | CAN/CGSB-12.10-M | - Glass, Light and Heat Reflecting |
| .6 | CAN/CGSB-1.108-M | - Bituminous Solvent Type Paint |
| .7 | CAN/CSA G40.20/ G40.21-M | - Welded Structural Quality Steel/Structural Quality Steels |
| .8 | CAN/CGSB 19.24-M | - Multi-Component, Chemical-Curing Sealing Compound |
| .9 | ASTM A446/A446M | - Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hop Dip Process, Structural (Physical) Quality |
| .10 | NAAMM AMP-505 | - The National Association of Architectural Metal Manufacturers, Applied Coatings |
| .11 | NAAMM AMP-501 | - The National Association of Architectural Metal Manufacturers, Finishes for Aluminum |
| .12 | AODA | - Accessibility for Ontarians with Disabilities Act |

1.3 **SUBMITTALS**

.1 Samples

- .1 Submit in accordance with Section 01 33 00.
- .2 Submit duplicate sample sections of all component parts of entrances, curtain wall, windows, glass and spandrel panels, finished in specified colours. Sizes of samples as follows:
- | | |
|----|-----------------------------------|
| .1 | Extruded shapes: 300 mm |
| .2 | Each type of glass: 300 mm square |

.2 Shop Drawings

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

- .2 Show fabrication and erection details of all components and accessories. Show the following on the Shop Drawings:
 - .1 Interface conditions with adjoining works.
 - .2 Sealant locations and joint detail including joint back-up.
 - .3 Interior structure and/or reinforcements.
 - .4 Extruded framing system for all members (plans and sections, in half full size, if not of the manufacture specified and drawn). Show thermal breaks and what material.
 - .5 Glazing and glass stop details, vinyl or neoprene mouldings (in half full size), and all anchorage and assembly fixings.
 - .6 Ventilator details showing hardware locations and a note confirming that operating hardware is accessible for unobstructed hand operation.
 - .7 List of materials used for every component.
- .3 Indicate how thermal expansion and contraction are to be accommodated and to what degree. Show connections to adjacent construction and provision made for structural deflections, contractions, expansion and other normal movement.

1.4 **GENERAL DESIGN**

- .1 Make thorough examination of all Drawings and details, check interfacing with Work of other Contracts and other factors influencing the engineering design and performance of the Work and be fully cognizant of requirements.
- .2 Drawings and Specifications do not intend to identify or solve the requirements of thermal, structural, vapour and air movement, methods of anchorage, flatness and other requirements. Be responsible for all of these aspects. Base design on the "rainscreen principle" as advocated by National Research Council of Canada (NRC).
- .3 Design to withstand without failure, the positive and negative forces imposed by wind, earthquake, temperature and shrinkage stress, deflections of the supporting or adjacent structures, all within deflection limitations governed by the design of the supporting structure. Calculate external pressure of suction due to wind on part or all of the surface of the units in accordance with the Ontario Building Code.

1.5 **DESIGN IN SUCH A WAY THAT COMPLETED INSTALLATION IS FREE FROM RATTLES, WIND WHISTLES AND NOISE DUE TO THERMAL AND STRUCTURAL MOVEMENT AND AIR PRESSURE DELIVERY, HANDLING AND STORAGE**

- .1 Transport materials to the job site storage compound in such a manner as to prevent in-transit damage. These measures shall include, but not limited to, crating, polyethylene wrapping system, etc.
- .2 Store in a dry, protected area on site, in original undamaged containers with manufacturers labels and seals intact.
- .3 Provide interleaving protection between glass. Keep glass and interleaving dry and store cases in clean, cool, dry areas with temperatures above the dewpoint. Circulation of cool, dry air in storage areas is essential. Open cases and inspect units periodically for moisture accumulation. Do not store glass in direct sunlight without an opaque protective covering over same.

- .4 Remove damaged or unsatisfactory materials from the site and replace with new materials to the satisfaction of the Consultant at no cost to the Owner.

1.6 **PROTECTION**

- .1 Protect the Work of this trade from damage. Protect Work of other trades resulting from the Work of this section.
- .2 Install at the factory, strippable coatings on all exposed surfaces of aluminum. Leave coating and protective wrappings on the surfaces through the period that other trades work proceed on the building. Remove on completion of the Work.
- .3 Comply with unpacking procedures as recommended by framing and glass manufacturers.
- .4 Make good all damaged Work caused by failure to provide adequate protection. Remove unsatisfactory Work and replace at no expense to the Owner.

1.7 **WARRANTY**

- .1 Warrant Work of this section against defects and deficiencies for the periods specified below from date Work is certified as substantially performed in accordance with the general conditions of the Contract.
- .2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective Work satisfactory to the Consultant and at no expense to the Owner.
- .3 Warrant the Work as follows:
 - .1 Work in general: Two-year warranty against defects and failure of system, and to remain completely weathertight and air and water leakproof within the tolerances and limits specified.
 - .2 Insulating units: Five-year warranty against breakage due to faulty workmanship or materials, loss of air seal and condensation.
 - .3 Tinted or reflective units: Ten-year warranty against peeling or becoming defective due to normal weather conditions.
 - .4 Anodized finish: Five-year warranty against fading, coating conversion and coating separation from metal.
 - .5 Fluoropolymer finish: Five-year warranty against peeling, checking, blistering or cracking, and be nonconvertible; fading shall be within ± 5 NBS.

2 Products

2.1 **MATERIALS**

- .1 Basic material: Aluminum Association Alloy AA6063-T5 for extruded shapes; commercial quality aluminum sheet for formed shapes.
- .2 Doors: Single glazed. Use one of the following Products:
 - .1 Kawneer "350"
 - .2 Alumicor "400" series

- .3 Doors: Insulating glass in thermally broken frames. Use one of the following Products:
 - .1 Kawneer "Insulclad 260"
 - .2 Alumicor "Institutional Insuldoor"
- .4 Windows: Use one of the following Products:
 - .1 Kawneer "516 Series"
 - .2 Alumicor "970 Series"
- .5 Windows: Top hung, bottom projected out window, complete with claw handles and a pivot shoe roto operator, with aluminum insect screens; use one of the following:
 - .1 Kawneer 526 Isoport
 - .2 Alumicor 1350
- .6 Aluminum Interior Screens and Swing Doors:
 - .1 Aluminum Framing: "Elite Glazing System" by PC350, or similar, with same or better physical properties and performance criteria.
 - .2 Aluminum Swing Doors without electrical devices:
 - .1 "Series 200-P2" by PC350, or similar, with same or better physical properties and performance criteria.
 - .3 Aluminum Swing Doors with electrical devices:
 - .1 "Series 200-P5" by PC350, or similar, with same or better physical properties and performance criteria.
 - .4 Finishes: To be selected by Consultant from manufacturer's full range.
- .7 Column covers and trim rings: Aluminum plate, roll formed curved 3 mm thick; two panels opposing; reveal (open) joints; columns with supports of Z275 galvanized support struts and clip assembly designed and engineered to hold the assembly in place.
- .8 Insulated metal back pan: Minimum 0.76 mm thick (22 gauge) galvanized steel face sheet with rigid fibreglass or mineral wool insulation core of thickness shown.
- .9 Stools, sills and cover plates: Extruded aluminum and brake formed sheet stock.
- .10 Aluminum Finish
 - .1 Anodized finish: Treat all visible interior aluminum surfaces except as noted otherwise under "Laminated Coating Finish" with a clear (colour) anodic oxide finish in accordance with AMP-501, AA-M12C22A41 (AA-M12C22A42).
 - .2 Laminated coating finish: Aluminum Association Designation AALIX, manufacturer's standard factory applied baked, polyvinylidene fluoride Kynar 500, 70% solid finish system, consisting of cleaning, conversion coating, prime coating and finish coating. The finish coat shall be Valspar Inc. "Fluoropon", ICI Devoe-Durkee Division SCM Corp. "Nubelar" or PPG Industries "Duranar".

2.2 **SPANDREL PANEL BACK-UP**

- .1 Material: Minimum 0.76 mm thick (22 gauge) galvanized steel face sheet with rigid fibreglass insulation core of thickness shown bonded to same, supplemented by mechanical fasteners as applicable.

2.3 **GLASS AND GLAZING MATERIALS**

- .1 Glass Component Types
 - .1 Float glass, clear glazing quality, 6 mm thickness to CAN/CGSB-12.3-M.
 - .2 Tempered glass, clear glazing quality, 6 mm thickness, to CAN/CGSB-12.1-M, Type 2, Class B, Category II.
 - .3 Heat strengthened glass, glazing quality, 6 mm thickness, to U.S. Federal Spec. DD-G-1403, Type HS.
- .2 Insulating units: Conforming to CAN/CGSB-12.8-M. Glass to be clear, with a Low "E" coating on the #2 surface, and composed of minimum 6 mm thick heat strengthened glass outboard lite and minimum 6 mm thick clear float glass inboard lite.
- .3 Glazing Materials
 - .1 Tape: Tremco "Polyshim II" or approved equivalent.
 - .2 Backer rod: Closed cell foam polyethylene rod, outsized minimum 25% larger than joint width and compatible with joint sealant.
 - .3 Neoprene setting blocks: Durometer hardness of 85 \pm 5, Shore A.
 - .4 Silicone spacer blocks: Durometer hardness of 55 \pm 5 Shore A.
 - .5 Gaskets: Extruded EPDM.

2.4 **ACCESSORIES**

- .1 Perimeter sealant: One part silicone neutral cure low modulus sealant, GE Silicones "Silpruf SCS 2000" or equal by Dow Corning. Colour as selected by the Consultant from standard colour selection.
- .2 Screws, bolts and fasteners: Self tapping electrozinc plated or cadmium plated steel for aluminum to aluminum contact and stainless steel for aluminum to steel contact.
- .3 Steel reinforcements and anchors: Conforming to CAN/CSA-G40.20/G40.21-M, Grade 300W hot-dip galvanized to CSA G164-M requirements.
- .4 Isolation coating: Henry "410-02" bituminous paint or zinc chromate paint.
- .5 Thermal break material: Polyvinylchloride, of semi-rigid durometer hardness of 80, plus or minus 5, located on the external side of the glass pane.
- .6 Door weatherstripping: Heavy duty mohair pile material designed for easy removal and replacement when worn, complete with adjustable fixing to ensure a full "wipe" of the threshold below.
- .7 Compressible filler: Ceramar by W.R. Meadows or CPD Closed Cell Foam.
- .8 Airseal transition membrane: Soprema "Soprasolin" or W.R. Grace "Permabarrier", in width sufficient to properly bridge and seal joints around windows. Provide stainless fasteners and bars necessary to keep membrane in place.

- .9 Foamed-in-place air seals: Class 1, single component polyurethane foam conforming to CAN/ULC-S710.1, with flame spread rating of twenty or less and smoke developed of twenty-five or less. Density of 20.8 to 28.8 kg/m³, "Zerodraft Foam Sealant" by Canam Building Envelope Specialists Inc., or "Great Stuff Pro" by Dow Chemical Company, or "LEF" by Tremco, or approved alternative.
- .10 Backpan insulation: Semi-rigid glass fibre thermal insulation as follows:
 - .1 Owens Corning "AF530"
 - .2 Roxul "RXL 40"
 - .3 Fibrex Insulation, Inc. "Curtain Wall Type 4"
 - .4 Ottawa Fibre "OFI 48"
- .11 Loose insulation: Loose fibreglass or mineral wool.
- .12 Temporary strips: 25 mm wide, light reflecting, easily removable, pressure sensitive tape applied over all glass. Doors shall have two cross stripes at eye level, windows and curtain wall shall have corner to corner cross stripes from aluminum frames.
- .13 Safety decals: 25 mm wide pressure sensitive tape applied at eye level on the No. 4 surface of all glass lites in curtain wall at ground floor level. Design as selected by the Consultant.

2.5 **FABRICATION**

- .1 General
 - .1 Form all sections true to detail, free from defects impairing appearance, strength and durability.
 - .2 Fabricate frames with thermal breaks.
 - .3 Mullions and frames shall be tubular extruded shapes with sharp, well defined corners.
 - .4 Overall assembled profiles shall be as detailed on the Drawings. Curtain wall glazing shall be replaceable from the exterior while window glazing shall be replaceable from the interior.
 - .5 Make provision at all sealed horizontals to lead moisture accumulation to the exterior. Provide drainage leads in the pressure plates and horizontal snap-on covers for this purpose.
 - .6 Pressure plates shall be of extruded aluminum with integrally aligned sockets to receive and hold the latch bulbs of the snap-on face caps.
 - .7 Form continuous sills, stools and flashings with intermediate clips, anchorages and reinforcing and as much as possible, be shop assembled. Furnish all filler and closure pieces as required.
 - .8 Locate thermal break on the exterior side of the glazing and secure by snap-in methods without the use of any metallic fasteners which could reduce the effectiveness of the thermal barrier.
 - .9 Make provision in the Work for vertical and horizontal expansion and contraction and structural deflections.

- .10 Mitre and closely fit all corners of formed Work. Apply back-up sealants on the inside of joints. Provide drainage towards the exterior at the bottom of all glazing rebates.
- .11 Attach all anchorages to the warm side.
- .12 Carry out all welding with argon shielded electric arcs to ensure complete fusion of the metal.

.2 **Doors**

- .1 Aluminum doors shall have square snap-on glazing beads designed for EPDM glazing gaskets.
- .2 Equip doors with full weatherstripping at perimeter. Install weatherstripping throughout the full length and width of the doors at jambs and heads.
- .3 Fabricate doors and frames complete with all necessary internal reinforcements, cutouts, recesses, mortising or milling operations required for a rigid assembly and to accommodate finish hardware. All connections shall ensure adequate strength.
- .4 Fabricate frames with joints accurately fitted and securely jointed together in a manner to ensure tightly fitting joints. Internally seal corners of frames and all joints exposed to water penetration using a material compatible to resist flow at the high surface summer temperatures to be experienced by the metal.

.3 **Doors - Barrier Free Access**

- .1 Prepare doors where indicated to accommodate power operators and pushbutton controls to allow barrier-free access. Provide a barrier-free logo above pushbutton.
- .2 Coordinate as required for the satisfactory installation of finish hardware by Section 08 71 05.

.4 **Insulated Spandrel Panel Back-Up**

- .1 Form panels with offset edge flange to provide flush surface at edge of pan. Bond insulation to panel back-up with daubs of mastic adhesive.
- .2 Provide integral reinforcing and stiffeners as required.
- .3 Weld corners of panels and grind smooth or butter corner joints with butyl sealant.

2.6 **PROTECTION OF METALS**

- .1 Provide protection against galvanic action wherever dissimilar metals are in contact, either by painting the contact surfaces with a heavy coat of zinc chromate primer, or by the application of an appropriate sealant or tape.
- .2 Protect aluminum which is to be in contact with cured concrete with zinc chromate primer or bituminous paint, and wherever crevices between the contact surfaces may entrap moisture or other corrosive elements.

3 Execution

3.1 **INSPECTION OF JOB CONDITIONS**

- .1 Inspect existing conditions upon which Work of this section is dependent. Report to the Consultant in writing any defects or discrepancies. Commencement of Work implies acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Windows

- .1 Set units in their correct location, level, square and plumb and at proper elevations, with the nominal face of the framing aligned in a single vertical plane. Fasten and anchor framing in place.
- .2 Accurately measure glass openings and calculate glass size based on manufacturer's installation tables allowing for proper edge engagement, rabbet width, rabbet depth and expansion.

.2 Assembly and Anchorage

- .1 Anchor component parts securely in place by bolting, welding or other permanent mechanical attachment system, which will comply with performance requirements and permit movement as intended or necessary. Install slip-joint linings where required to ensure movement as per design.
- .2 Allow for complete adjustment in anchorage for levelling and positioning of units during installation.
- .3 Where welding is unavoidable for exposed non-ferrous Work during erection of curtain wall assembly, comply with CSA W59-M and recommendations of fully certified firm to CSA W47.1 for the particular metals and alloys being welded. Use methods and welding rods which will not distort members and will result in closest possible colour match. Grind exposed surfaces smooth, using wheels and compounds which are free of iron and other substances which would result in stains or discoloration of surfaces. Restore finishes after welding and grinding.

.3 Erection Tolerances

- .1 Limit variations from plumb, level or dimensioned angle to the following:
 - .1 3 mm maximum deviation in storey height, or in 3000 mm vertical run, or in 6000 mm horizontal run.
 - .2 6 mm maximum deviation in 12000 mm in any direction.
- .2 Limit variations from location (theoretical calculated positions in plan or evaluation based on established floor lines and column lines), including variations from plumb and level, to the following:
 - .1 9 mm total maximum deviation for member at any location.
 - .2 3 mm maximum change in deviation for member for 3000 mm run, any direction.

.3 Limit offsets in end-to-end and edge-to-edge alignment of adjoining and consecutive members, which form planes, continuous runs and profiles, to the following:

.1 1.5 mm maximum offset in flush alignment, including those which are to be 12 mm or less out-of-flush, and including those which are separated 50 mm or less by a reveal or protrusion in plane of wall.

.4 **Doors**

- .1 Install doors plumb, square, level, free from warp, twist and superimposed loads.
- .2 Secure Work adequately and accurately to structure in the required position, in a manner not to restrict thermal movement.
- .3 Provide compressible filler over aluminum work at locations shown on Drawings.
- .4 Use aluminum or long-life coated steel screws, nuts, bolts, washers, rivets and all other fastening devices, colour to match doors and frames where exposed to view.

3.3 **GLAZING**

- .1 Use extruded gaskets for door and sidelight glazing.
- .2 Thoroughly wipe all surfaces receiving glazing materials with a cloth dampened in xylol to assure a clean surface.
- .3 Use glazing tape for glass and aluminum spandrel panels and spacer blocks..
- .4 At horizontal mullions and frames secure lites with screw applied pressure plates into the main grid members. Mitre glazing tape at all end joints, corners and at junctions. Screw fasteners shall be 1/4-20 machine screws. Contain glazing tape on pressure plates with a rigid polyvinyl chloride spacer. Internal seal shall be bulb type silicone extrusions.
- .5 Place setting blocks at quarter points from each corner of glass. Centre glass in opening and press firmly against tape. Roll-in inside resilient extrusion.

3.4 **JOINT SEALANT AND SEALS**

- .1 Pre-application conference: Arrange with the sealant manufacturer(s) for a visit to the job site by one of its technical representatives before beginning the sealing installation to discuss with the Contractor and the Consultant the procedures to be adopted, to analyze site conditions and inspect the surfaces and joints to be sealed, in order that recommendations may be made, should adverse conditions exist. Discuss the following items:
 - .1 Weather conditions under which Work will be done.
 - .2 Anticipated frequency and extent of joint movement.
 - .3 Joint design.
 - .4 Number of beads to be used in the sealing operation.
 - .5 Have manufacturer(s) send report to the Consultant.

.2 Joint Sealant

.1 At interior and exterior joints between aluminum framing and adjacent Work of others execute the following Work:

- .1 Install backer rod as required to provide sealant joints of proper form, thickness-to-width ratios, and to provide bond break at back side of sealant. Where backer rod cannot be used, use bond breaker tape to back side of sealant joint substrate.
- .2 Clean substrate surfaces to which sealant is to bond and apply sealant primers as recommended by sealant manufacturer.
- .3 Seal joints continuous to produce weatherproof and visually acceptable joint installation.

.2 Install backer rod between butt glazed insulating and spandrel glass units, and between units to adjacent structures as shown. Seal joints continuous to produce weatherproof and visually acceptable joint installation.

.3 Seal all joints required for a weatherproof installation and against air/vapour leakage. Use materials in strict accordance with the manufacturer's printed instructions, and applied only by tradesmen specially trained or experienced in their use. Before applying sealants, completely remove all mortar, dirt, dust, moisture and other foreign matter from surfaces it will contact. Mask adjoining surfaces when required, to maintain a clean and neat appearance. Total sealing compounds to fill the joint and provide a smooth finished surface.

.4 Refer to and comply with workmanship requirements of Section 07 92 00.

.3 Foamed-In-Place Air Seals

.1 Prior to application, remove mortar, dirt, dust, moisture and other foreign matter from joints to be sealed.

.2 Apply seal in accordance with manufacturer's directions. Fill all joints. Trim off excess seal.

.4 Airseal Transition Membrane

.1 Apply primer and airseal transition membrane in accordance with membrane manufacturer's instructions. Use primer in conjunction with adhesive if part of system.

.2 Re-prime surfaces not covered with transition membrane during the same working day.

.3 Overlap airseal transition membrane 75 mm minimum. Lap in the direction of waterflow.

.4 Coordinate the airseal transition with adjacent parts of the Work.

3.5 **CLEAN UP**

.1 Maintain the units in a clean condition throughout construction period, so that they will be without deterioration or damage at time of Owner's acceptance. Select methods of cleaning which will promote achievement of uniform appearance and stabilized colours and textures for materials that weather or age with exposure.

- .2 Immediately before time of Substantial Performance, wash glass thoroughly, inside and out.
- .3 Do not use steel wool, wire brushes or steel scrapers on finished surfaces.
- .4 Daily during this Work, and on completion, remove from the job site, all rubbish, debris, broken glass, temporary safety markings and excess materials resulting from this Work.
- .5 Remove protective covering and coating from aluminum surfaces, inside and out, and clean all surfaces, remove all labels, temporary stripes and protective devices and polish all glass surfaces, immediately prior to final acceptance of the Work by the Consultant.

End of Section

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1 General

1.1 **FINISH HARDWARE**

- .1 Supply finish hardware, complete with templates, installation instructions, screws, expansion shields, anchors and other related accessories, and schedule delivery to avoid delaying the progress of the Work. Deliver hardware to the job site packaged, labelled and cross-referenced to the hardware schedule in such a manner that all items may be readily located to their scheduled location on the Work.
- .2 Hardware is listed at the end of this section.

1.2 **REQUIREMENTS OF REGULATORY AGENCIES**

- .1 Use ULC listed and/or Warnock Hersey International labelled hardware for doors in fire separations and exit doors.

1.3 **QUALITY ASSURANCE**

- .1 Standards: Comply with standards specified in this section.
- .2 Qualifications of manufacturers: Products supplied under this Section shall be from manufacturers regularly engaged in manufacture of similar items and with history of successful production acceptable to the Consultant.

1.4 **SUBMITTALS**

- .1 Submit the following as Shop Drawings in accordance with Section 01 33 00:
 - .1 Detailed finish hardware list reviewed by a qualified AHC member of American Society of Hardware Consultants. List all items proposed to be furnished and delivered under this Section.
 - .2 Manufacturer's specifications, catalogue cuts and other data required to demonstrate compliance with specified requirements.
- .2 Following review, the Consultant will return two copies to the Contractor. If copies are marked "Revised as Noted - Do Not Resubmit" or "Reviewed as Submitted", make photocopies and distribute to the following:
 - .1 Section 08 11 13 - one copy
 - .2 Section 08 40 00 - one copy
 - .3 Section 08 71 05 - one copy
- .3 Identify each hardware item by manufacturer, manufacturer's catalogue number, material, function, finish and location of item in Work.
- .4 Review of hardware list by Consultant shall not relieve Contractor from responsibility for furnishing all required finish hardware.

1.5 **SAMPLES**

- .1 Deliver physical samples of approved finish hardware items to Consultant within fifteen Calendar Days.
- .2 Identify each sample by label indicating applicable Specification paragraph or line number, brand name and number, finish and hardware package number.

- .3 Substitute new samples for those rejected by Consultant.
- .4 Consultant will retain samples until completion of Project, at which time, samples will be returned to Supplier.
- .5 Do not deliver any hardware to Site until all samples have been approved.

1.6 **PRODUCT HANDLING**

- .1 Packaging and marking: Individually package each unit of finish hardware, complete with proper fastenings and appurtenances, clearly marked on outside to indicate contents and specific locations in the Work.
- .2 Replacements: In the event of damage, immediately make all repairs and replacements necessary to approval of Consultant and at no additional cost to Owner.

1.7 **MAINTENANCE**

- .1 Maintenance data: Submit maintenance data, parts list and manufacturer's instructions for each type of door closer, lockset, latchset, door holders and fire exit hardware for incorporation into maintenance manual specified in Section 01 33 00.
- .2 Brief maintenance staff regarding proper care, cleaning and general maintenance.
- .3 Supply four sets of wrenches for door closers, locksets and fire exit hardware.

1.8 **DELIVERY AND STORAGE**

- .1 Store finish hardware in locked, clean and dry area on site.
- .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .3 Maintain inventory list with hardware schedule.

1.9 **HARDWARE LIST**

- .1 The Supplier shall thoroughly check the hardware list forming part of this section and shall bring to the attention of the Consultant any errors or omissions therein.
- .2 Confirm degrees of swing for door holders and closers.

1.10 **EXISTING HARDWARE**

- .1 All existing hardware that are noted on Drawings to be replaced shall be returned to the Owner.

1.11 **DOOR SCHEDULES**

- .1 The Supplier shall thoroughly check the door schedules and Working Drawings to ensure that hardware listed can be used as specified in accordance with building codes and function. Bring to attention of the Consultant any errors or omissions therein.
- .2 Doors shown on Drawings and omitted from the schedules shall be included on the detailed finish hardware list.

1.12 **WARRANTY**

- .1 Warrant all exit devices for three years and door closers for ten years.

2 Products

2.1 **GENERAL**

- .1 Manufacturers: Products listed in the hardware schedule are from the first manufacturers listed below. Alternative Suppliers other than those listed will not be considered.

- | | | |
|----|-------------------------------|----------------------------|
| .1 | Hinges: | Hager Hinge Canada |
| .2 | Door closers: | LCN |
| .3 | Cylinders: | Schlage |
| .4 | Locksets/latchsets/deadlocks: | Schlage |
| .5 | Exit devices: | Von Duprin |
| .6 | Overhead door stops/stays: | Glynn-Johnson |
| .7 | Flatware: | Gallery Specialty Hardware |
| .8 | Weatherstrip/threshold: | Aluminum Door Supplier |

- .2 Fasteners: Furnish all finish hardware with all screws, bolts and other fasteners of suitable size and type necessary to anchor hardware in position for trouble-free service under heavy duty usage.

- .1 Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors acceptable to Consultant, depending on material to which hardware is to be applied and recommendations of hardware manufacturer.
- .2 Fastenings shall harmonize with hardware as to material and finish.
- .3 Exposed screws for installing hardware shall have Phillips or Robertson heads.
- .4 Finishes: Hardware shall match finish of locksets. Take special care to coordinate all various manufactured items furnished under this section, to ensure an acceptable uniform finish.

2.2 **MATERIALS**

- .1 Full Mortise Hinges

- .1 Non-removable pins at outswinging exterior doors.
- .2 Ball bearing type "BB".

- .2 Exit Devices/Mullions

- .1 Exterior doors equipped with exit devices must have security deadlatching and cylindrical dogging.
- .2 All doors equipped with exit devices to have lever trim to match lock/latchsets.

- .3 Locksets/Latchsets/Strikes

- .1 All mortise sets to come complete with three point anti-friction latchbolt, thru-bolted trim.
- .2 All mortise levers to be solid stainless steel or forged brass as specified.

.4 Door Closers

- .1 Use full through bolt fastening, "CTB". With "Top Jamb" application, supply arm through bolt fastening.
- .2 Spring power is to be of proper size to operate door efficiently. All door closers to be supplied as multi-sized. For exterior doors, supply closers multi-sized but pre-adjusted to size 4 for "Top Jamb" application, or size 5 for "Parallel Arm" application. For interior doors, supply closers multi-sized but pre-adjusted to size 3 for "Regular Mount" or "Top Jamb" application or size 4 for "Parallel Arm" application. It is the responsibility of Section 08 71 05 to make final adjustment on the door closers. This final adjustment is to include closing speed, latching speed and backcheck.
- .3 All door closers are to be supplied with full cover and are to be of a complementary design from one model type to the next. Door closers are to be of the same manufacturer throughout the Project.
- .4 Finish door closers supplied for all exterior door locations and for wet or damp interior door locations are to be with special rust inhibitor paint protection, "SRI".
- .5 Where specified for labelled wood fire doors, supply through bolts "CTB" for installing closers.
- .6 Supply screws for door closer arms/brackets of sufficient length to penetrate jamb head seals and still provide adequate securement to the frame surface.
- .7 Protect all door closers, except those having a built-in stop system such as "DS (Door Saver) or "CUSH" (Cushion Stop) models, with an auxiliary door stop. Such auxiliary stops shall be as specified, and may include either overhead, floor or wall mounted types.

.5 Automatic Entrance System

- .1 Complete system supplied by this section as specified in the hardware schedule.

.6 Overhead Door Stops/Stays

- .1 Where an overhead door holder is to be used in conjunction with a door closer, provide stop only, or stop with hold open as specified. Where a door closer is not required, use a friction type, non-friction type, or non-friction with hold open type device as specified.
- .2 Supply screws for the jamb brackets for overhead door holders/stays of sufficient length to penetrate jamb head seals and still provide adequate securement to the frame surface.
- .3 All surface mounted overhead door holders/stays are to be supplied with through bolts for the door attachment.

.7 Kickplates/Armour Plates

- .1 1.2 mm minimum thickness stainless steel, Type 304, #4 finish, rounded corners, free of rough or sharp edges; drill for countersunk fixing with stainless steel flat head screws flush with finished surface. Supply with 3M tape only where specified.
- .2 Where door pulls are scheduled on one side of door and push plates on other side issue installation instructions so that the pull is secured through door from reverse side and countersunk flush with door prior to installation of push plate.

.8 Wall Stops

- .1 Furnish wall stops of height to engage doors.
- .2 Where wall stops cannot be used, use overhead door stops and/or floor stops as specified. Adjust to proper degree of stop.

2.3 **KEYING**

- .1 All locksets, panic hardware and key switches will be supplied complete with Medeco high security, removable core cylinders, master keyed to a grand master key system. Supply cylinders less cores. Supply 50 temporary cores for use during the construction period which shall be master keyed and keyed differently.
- .2 Supply the following:
 - .1 Three keys for each permanent cylinder core
 - .2 Two keys for each construction (temporary core)
 - .3 Three construction master keys
 - .4 Twelve grand master keys
 - .5 Thirty-six sub master keys

2.4 **KEY CONTROL AND KEY CABINET**

- .1 Provide one only Moore Key Control System AWC 150S.

2.5 **FINISHES - DESCRIPTION**

- .1 605 Polished Brass
- .2 606 Satin Brass
- .3 612 Satin Bronze
- .4 613 Oil Rubbed Bronze
- .5 618 Polished Nickel (on brass or bronze base metal)
- .6 619 Satin Nickel (on brass or bronze base metal)
- .7 622 Flat Black/Anodized Black (on brass or bronze base metal))
- .8 625 Polished Chrome (on brass or bronze base metal)
- .9 626 Satin Chrome (on brass or bronze base metal)
- .10 628 Clear Anodized/Painted Aluminum (anodized)
- .11 629 Polished Stainless Steel
- .12 630 Satin Stainless Steel
- .13 631 Flat Black Steel/Anodized Black Steel
- .14 632 Polished Brass Steel
- .15 633 Satin Brass Steel

.16	639	Satin Bronze Steel
.17	640	Oil Rubbed Bronze Steel
.18	645	Polished Nickel Steel
.19	646	Satin Nickel Steel
.20	651	Polished Chrome Steel
.21	652	Satin Chrome (on steel base metal)
.22	666	Polish Brass Aluminum
.23	667	Satin Brass Aluminum
.24	668	Satin Bronze Aluminum
.25	669	Polish Nickel Aluminum
.26	670	Satin Nickel Aluminum
.27	671	Flat Black /Anodized Black Aluminum
.28	672	Polish Chrome Aluminum
.29	677	Polish Brass (painted/powder coat)
.30	678	Satin Brass (painted/powder coat)
.31	680	Satin Bronze (painted/powder coat)
.32	689	Clear Anodized/Painted Aluminum
.33	693	Flat Black (painted/powder coat)
.34	695	Oil Rubbed Bronze (painted/powder coat)
.35	702	Satin Chrome Aluminum
.36	703	Oil Rubbed Bronze Aluminum
.37	ALUM	Extruded Aluminum Mill Finish (thresholds)

3 Execution

3.1 **DELIVERY**

- .1 Stockpile all items sufficiently in advance to ensure their delivery to the site in a timely manner to ensure orderly progress of Work.

3.2 **INSTALLATION INSTRUCTIONS**

- .1 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their Work to receive hardware.
- .2 Furnish manufacturer's instructions for proper installation of each hardware component.
- .3 Fully adjust all non-sized or universal door closers in strict accordance with the manufacturer's printed instructions for spring power closing speed, latching speed and backcheck at the time of installation.

3.3 **EXAMINATION**

- .1 Confirm kickplate and threshold sizes before ordering.
- .2 Do not use wall stops on drywall, demountable or moveable partitions.

3.4 **KEY SECURITY**

- .1 Deliver to, and install all cylinders at the jobsite.
- .2 Key all doors to receive locks according to an approved key schedule.

3.5 **INSTALLATION**

- .1 Hardware installation is specified in Section 08 71 05 – Installation of Doors and Finish Hardware.

3.6 **ADJUSTMENT**

- .1 Coordinate with hardware installer and adjust all items of hardware to operate smoothly. If a manufacturer's representative has done this Work, forward written confirmation of same.
- .2 Prepare or replace any hardware found defective.

3.7 **HARDWARE SCHEDULE**

- .1 As per list following this Section. Hardware schedule was prepared by Spyder SC.
- End of Section

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DOOR HARDWARE

08 71 00

PROJECT: 
CITY OF TORONTO
TORONTO PARAMEDIC SERVICES FLEET MAINTENANCE STATION UPGRADE
1116 King St West,
Toronto, Ontario

ARCHITECT: 
175 Galaxy Blvd, Unit 100
Toronto, Ontario

Prepared By: Alex Bekmansourov
Date: November 28, 2025
Revised:
Revised:

Architectural Hardware Finishes

Steel	Stainless Steel	Brass/Bronze	Aluminum	Painted/Powder Coat	US/CAN#
Clear Anodized / Painted Aluminum					
			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					

Door Types & Handing

Abbreviations

RH – Right Hand

LH – Left Hand

RHR – Right Hand Reverse

LHR – Left Hand Reverse

RHRA – Right Hand Reverse Active

LHRA – Left Hand Reverse Active

RHA – Right Hand Active

LHA – Left Hand Active

RHRA/LHRA – Right & Left Hand Reverse Active

RHA/LHA – Right & Left Hand Active

DA- Double Acting

DE – Double Egress

SS- Single Slider

BP – Bi-Parting Slider

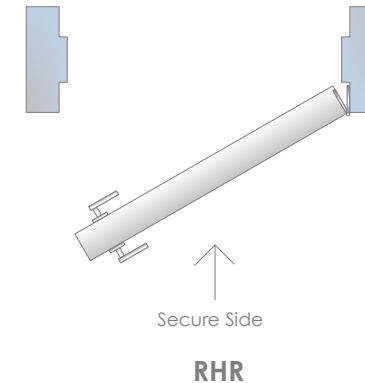
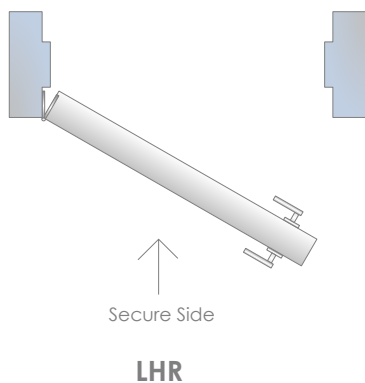
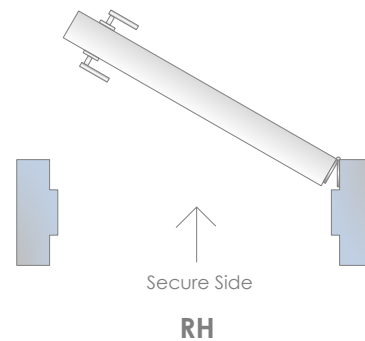
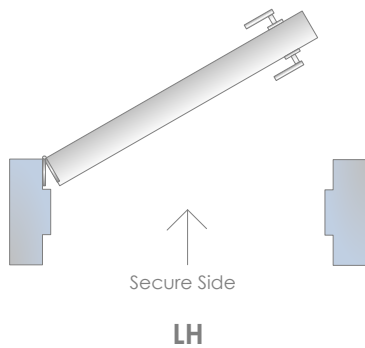
BP – Bi-Passing Slider

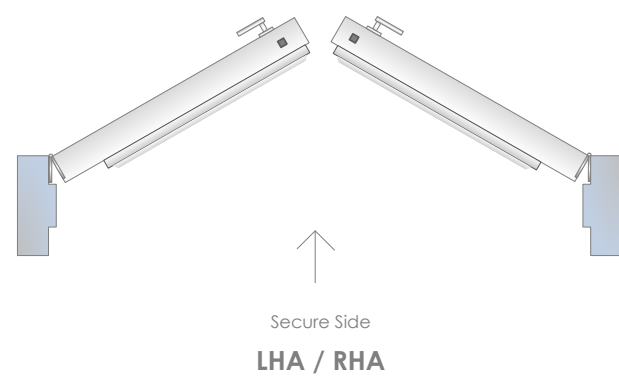
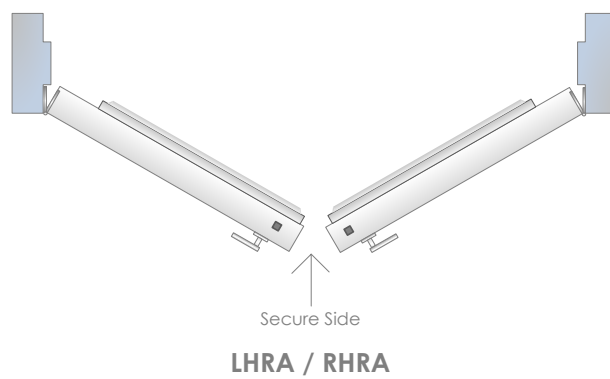
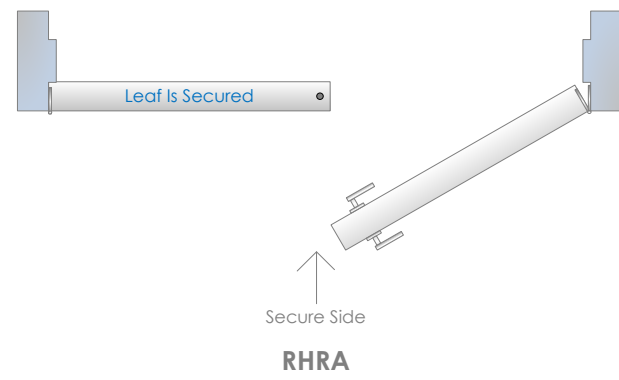
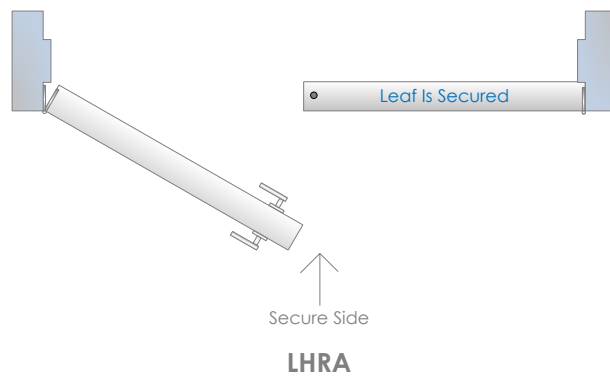
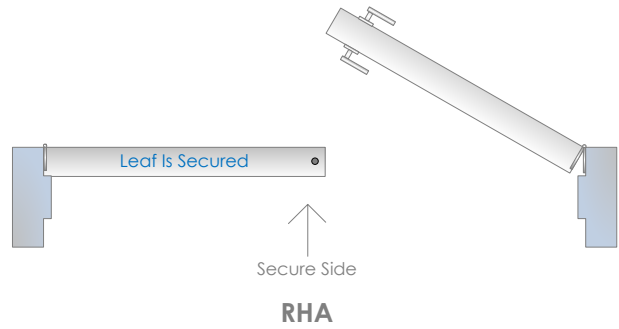
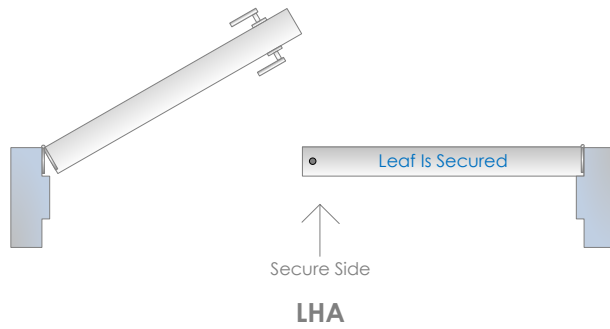
BF – Bi-Folding Slider

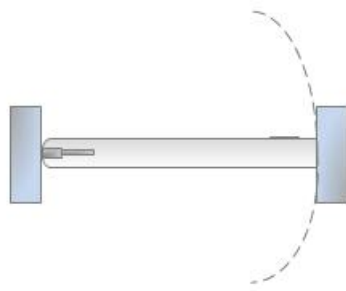
TS – Telescopic Slider

PKT – Pocket Slider

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







DA-DOUBLE
ACTING



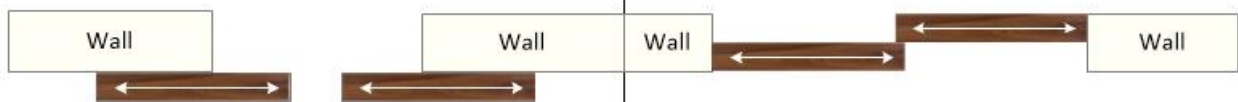
DE-DOUBLE
EGRESS



PKT - POCKET SLIDER



SS - SINGLE SLIDER or
BARN SLIDER



BP - BI-PARTING



BPS - BI-PASSING

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
SCWD = Solid Core Wood Door
HCWD = Hollow Core Wood Door
FGD = Frameless Glass Door
FRP = Fiberglass Reinforced Plastic 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
¾ 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

Installation Instructions:

Installation instructions have been provided for convenience only. Although we do our best to ensure these documents are accurate and up to date, it is ultimately the responsibility of the installer to ensure they are using the correct instructions for the product they are installing. Use of the installation instructions provided is done so at one's own risk and Spyder SC takes no responsibility to their accuracy.

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



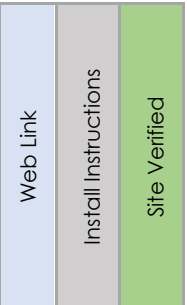
Heading# 1

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1 **Door#** 101 **Location:** Exterior from Stair B 101 **Handing:** RHR



By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Exit Device	98L-NL-F x 996L-NL-R/V x 06 x 626/630 - 4'0	630	Von Duprin	X	X		<input type="checkbox"/>
1	Rim Cylinder Housing	80-116	626	Schlage	X			<input type="checkbox"/>
1	Electric Strike	6300 x 12/24VCD	630	Von Duprin	X	X		<input type="checkbox"/>
1	Closer	4111-LH (LCN / ST 2779)	689	LCN	X	X		<input type="checkbox"/>
1	Overhead Stop	104S	630	Glynn Johnson	X	X		<input type="checkbox"/>
1	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Weatherstrip	W-13 – 1 @ 965 & 2 @ 2135	628	KN Crowder	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 965	BLK	KN Crowder	X			<input type="checkbox"/>
1	Threshold	CT-10 x 965	628	KN Crowder	X			<input type="checkbox"/>

By Security Supplier

1	Card Reader	To Suit Building System (24V)	BLK					<input type="checkbox"/>
1	Door Contact	To Suit Building System						<input type="checkbox"/>
1	Access Controller	To Suit Building System						<input type="checkbox"/>
1	Motion REX	To Suit Building System						<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- Final commissioning of all access control items, such as but not limited to electric strikes, Rex sensors, Door contacts, Electrified Panics, Relays & Maglocks is the responsibility of the security provider

End of Heading



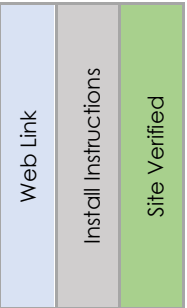
Heading# 2

Opening Information

Opening Type:	Single	Opening Size:	Existing Door x Existing Frame	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1 **Door#** 101A **Location:** Stair B 101 from Garage 102 **Handing:** LHR



By Hardware Supplier

1	Exit Device Trim	996L-NL-R/V x 06	626	Von Durin	X			
1	Rim Cylinder Housing	80-116	626	Schlage	X			<input type="checkbox"/>
1	Wrap Around Plate	90CW	630	Schlage	X			
1	Electric Strike	6300 x 12/24VCD	630	Von Duprin	X	X		<input type="checkbox"/>

By Security Supplier

1	Card Reader	To Suit Building System (24V)	BLK					<input type="checkbox"/>
1	Door Contact	To Suit Building System						<input type="checkbox"/>
1	Access Controller	To Suit Building System						<input type="checkbox"/>
1	Motion REX	To Suit Building System						<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- Final commissioning of all access control items, such as but not limited to electric strikes, Rex sensors, Door contacts, Electrified Panics, Relays & Maglocks is the responsibility of the security provider

*Remove Existing TP Trim and Install New Lever Trim into Existing Exit Device. Patch as Required.

*BALANCE OF EXITING HARDWARE TO REMAIN.

End of Heading



Heading# 3

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	102	Location:	Exterior from Garage 102	Handing:	LHR
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Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Exit Device	98L-NL-F x 996L-NL-R/V x 06 x 626/630 – 4'0	630	Von Duprin	X	X		<input type="checkbox"/>
1	Rim Cylinder Housing	80-116	626	Schlage	X			<input type="checkbox"/>
1	Mortise Cylinder	80-110	626	Schlage	X			<input type="checkbox"/>
1	Electric Strike	6300 x 12/24VCD	630	Von Duprin	X	X		<input type="checkbox"/>
1	Overhead Stop	104S	630	Glynn Johnson	X	X		<input type="checkbox"/>
1	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Weatherstrip	W-13 – 1 @ 965 & 2 @ 2135	628	KN Crowder	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-13S x 965	BLK	KN Crowder	X			<input type="checkbox"/>
1	Threshold	CT-10 x 965	628	KN Crowder	X			<input type="checkbox"/>

By Automatics Supplier – PACKAGE #1 – PUSH BUTTONS UPGRADED TO TOUCHLESS WAVE (UPGRADE EXTRA)

1	Auto Operator (SNG)	BESAM SW200i – Push Side Mount - RH	628		X			<input type="checkbox"/>
2	Push Button	CM60/4-WT	630	Camden	X			<input type="checkbox"/>
2	Surface Mount Box	CM-79	630	Camden	X			<input type="checkbox"/>
1	Logic Relay	CX-33		Camden	X			<input type="checkbox"/>

By Security Supplier

1	Card Reader	To Suit Building System (24V)	BLK					<input type="checkbox"/>
1	Door Contact	To Suit Building System						<input type="checkbox"/>
1	Access Controller	To Suit Building System						<input type="checkbox"/>
1	Motion REX	To Suit Building System						<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- 120VAC is required at the head of the door for all handicap door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires.
- Final commissioning of all access control items, such as but not limited to electric strikes, Rex sensors, Door contacts, Electrified Panics, Relays & Maglocks is the responsibility of the security provider
- Operators Push/Pull Side Location indicated above is based on visually preferred location, however if on-site conditions prevent the installation of the operators on the side indicated above the installer must mount the operator on the side which does not impede with the door opening at least 90 degrees.

-----End of Heading-----

Heading# 4

Opening Information

Opening Type:	Single	Opening Size:	Existing Door x Existing Frame	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1 **Door#** 103 **Location:** Garage 102 to Washroom 103 **Handing:** RH

Web Link

Install Instructions

Site Verified

By Hardware Supplier

1	Privacy Latchset	ND40S x RHO x 626	626	Schlage	X		
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*BALANCE OF EXITING HARDWARE TO REMAIN. *Modify Door as Required.

-----End of Heading-----

Heading# 5

Opening Information

Opening Type:	Single	Opening Size:	Existing Door x Existing Frame	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1 **Door#** 104 **Location:** Garage 102 to/from Office 104 **Handing:** DA

Web Link

Install Instructions

Site Verified

*REMOVE SURFACE BOLT & PATCH AS REQUIRED.

*BALANCE OF EXITING HARDWARE TO REMAIN. *Modify Door as Required.

-----End of Heading-----



Heading# 6

Opening Information

Opening Type:	Single	Opening Size:	Existing Door x Existing Frame	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	105	Location:	Garage 102 to Storage 105	Handing:	LH
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Web Link	Install Instructions	Site Verified
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By Hardware Supplier

1	Storeroom Lockset	ND80BDC x RHO x 626	626	Schlage	<input checked="" type="checkbox"/>			
1	Wrap Around Plate	42CW	630	Schlage	<input checked="" type="checkbox"/>			

By Locksmith

1	Permanent Core/Cylinder	Permanent Medeco Core/Cylinder Provided by City Locksmith Listed Below.	626	Medeco	<input type="checkbox"/>			<input type="checkbox"/>
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*BALANCE OF EXITING HARDWARE TO REMAIN.

Notes:

- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. **(Existing Key System must be Confirmed & Verified with Facility & it's Locksmith prior to ordering Locks to ensure compatibility and client keying preference, *locks may need be ordered in FSIC or Conventional Cylinder Style)**
- Permanent Cores & Cylinders to be Provided by Approved City Locksmiths: Reillys Lock & Security Systems and/or ABC Security Access Systems and/or Gunnebo

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

Heading# 7

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	106	Location:	Garage 102 to Office 106	Handing:	RH
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Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Office Lockset	ND50BDC x RHO x 626	626	Schlage	X			<input type="checkbox"/>
1	Closer	4011-RH (LCN/ST 1544)	689	LCN	X	X		<input type="checkbox"/>
1	Drop Plate	4020-18	689	LCN				<input type="checkbox"/>
1	Overhead Stop	104F (with Hold Open)	630	Glynn Johnson	X	X		<input type="checkbox"/>
2	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 965	BLK	KN Crowder	X			<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. **(Existing Key System must be Confirmed & Verified with Facility & it's Locksmith prior to ordering Locks to ensure compatibility and client keying preference, *locks may need be ordered in FSIC or Conventional Cylinder Style)**
- Permanent Cores & Cylinders to be Provided by Approved City Locksmiths: Reillys Lock & Security Systems and/or ABC Security Access Systems and/or Gunnebo

-----End of Heading-----



Heading# 8

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	107	Location:	Exterior from Garage 107	Handing:	RHR
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Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Exit Device	98EO x 630 - 4'0	630	Von Duprin	X	X		<input type="checkbox"/>
1	Closer	4111-RH (LCN / ST 2779)	689	LCN	X	X		<input type="checkbox"/>
1	Overhead Stop	104S	630	Glynn Johnson	X	X		<input type="checkbox"/>
1	Kickplate	GSH 80A – 203 x 929 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Weatherstrip	W-13 – 1 @ 965 & 2 @ 2135	628	KN Crowder	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-13S x 965	BLK	KN Crowder	X			<input type="checkbox"/>
1	Threshold	CT-10 x 965	628	KN Crowder	X			<input type="checkbox"/>

By Security Supplier

1	Door Contact	To Suit Building System						<input type="checkbox"/>
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Notes:

- EXIT ONLY (NO OUTSIDE ACCESS)

-----End of Heading-----



Heading# 9

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	108	Location:	Garage 107 to Office 108	Handing:	LH
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Web Link	Install Instructions	Site Verified
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By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Office Lockset	ND50BDC x RHO x 626	626	Schlage	X			<input type="checkbox"/>
1	Closer	4011-RH (LCN/ST 1544)	689	LCN	X	X		<input type="checkbox"/>
1	Drop Plate	4020-18	689	LCN				<input type="checkbox"/>
1	Overhead Stop	104F (with Hold Open)	630	Glynn Johnson	X	X		<input type="checkbox"/>
2	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 965	BLK	KN Crowder	X			<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. **(Existing Key System must be Confirmed & Verified with Facility & it's Locksmith prior to ordering Locks to ensure compatibility and client keying preference, *locks may need be ordered in FSIC or Conventional Cylinder Style)**
- Permanent Cores & Cylinders to be Provided by Approved City Locksmiths: Reillys Lock & Security Systems and/or ABC Security Access Systems and/or Gunnebo

-----End of Heading-----

Heading# 10

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	109	Location:	Garage 107 to Lunch Room 109	Handing:	RH
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Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Classroom Lockset	ND70BDC x RHO x 626	626	Schlage	X			<input type="checkbox"/>
1	Closer	4011-RH (LCN/ST 1544)	689	LCN	X	X		<input type="checkbox"/>
1	Drop Plate	4020-18	689	LCN				<input type="checkbox"/>
1	Overhead Stop	104F (with Hold Open)	630	Glynn Johnson	X	X		<input type="checkbox"/>
2	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 965	BLK	KN Crowder	X			<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. **(Existing Key System must be Confirmed & Verified with Facility & it's Locksmith prior to ordering Locks to ensure compatibility and client keying preference, *locks may need be ordered in FSIC or Conventional Cylinder Style)**
- Permanent Cores & Cylinders to be Provided by Approved City Locksmiths: Reillys Lock & Security Systems and/or ABC Security Access Systems and/or Gunnebo

-----End of Heading-----





Heading# 11

Opening Information

Opening Type:	Single	Opening Size:	Existing	STC Rating	None
Door Material:	Existing	Frame Material:	Existing	Fire Rating	None

1 Total Openings

1	Door#	110	Location:	Garage 107 to B.F Washroom 110	Handing:	LH
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Web Link

Install Instructions

Site Verified

By Hardware Supplier

1	Storeroom Lockset	ND80BDC x RHO x 626	626	Schlage	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	Electric Strike	8300 x 801	630	HES	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	Emergency Key Cabinet	EB-02	RD	Canropa	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

By Automatics Supplier – PACKAGE #5

1	Auto Operator (SNG)	BESAM SW100 – Pull Side Mount - RH	628		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	Push to Lock Kit	CX-WC13XFM	630	Camden	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	Emergency Call Kit	CX-WEC10K2	630	Camden	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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***BALANCE OF HARDWARE TO REMAIN. – INSTALL NEW E/S IN EXISTING ASA PREP.**

Notes:

- 120VAC is required at the head of the door for all handicap door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires.
- Refer to STC rating of the wall in Architectural layout G1002
- Operators Push/Pull Side Location indicated above is based on visually preferred location, however if on-site conditions prevent the installation of the operators on the side indicated above the installer must mount the operator on the side which does not impede with the door opening at least 90 degrees.
- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. **(Existing Key System must be Confirmed & Verified with Facility & it's Locksmith prior to ordering Locks to ensure compatibility and client keying preference, *locks may need be ordered in FSIC or Conventional Cylinder Style)**
- Permanent Cores & Cylinders to be Provided by Approved City Locksmiths: Reillys Lock & Security Systems and/or ABC Security Access Systems and/or Gunnebo.

End of Heading

Heading# 12

Opening Information

Opening Type:	Single	Opening Size:	Existing Door x Existing Frame	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1 **Door#** 111 **Location:** Garage 107 to Boiler Room 111 **Handing:** RHR

Web Link

Install Instructions

Site Verified

By Hardware Supplier

1	Storeroom Lockset	ND80BDC x RHO x 626	626	Schlage	X			
1	Wrap Around Plate	42CW	630	Schlage	X			

By Locksmith

1	Permanent Core/Cylinder	Permanent Medeco Core/Cylinder Provided by City Locksmith Listed Below.	626	Medeco				□
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*BALANCE OF EXITING HARDWARE TO REMAIN.

Notes:

- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. **(Existing Key System must be Confirmed & Verified with Facility & it's Locksmith prior to ordering Locks to ensure compatibility and client keying preference, *locks may need be ordered in FSIC or Conventional Cylinder Style)**
- Permanent Cores & Cylinders to be Provided by Approved City Locksmiths: Reillys Lock & Security Systems and/or ABC Security Access Systems and/or Gunnebo

End of Heading





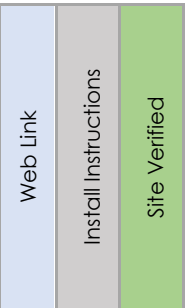
Heading# 13

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	112	Location:	Exterior from Stair A 112	Handing:	LHR
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By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Exit Device	98L-NL-F x 996L-NL-R/V x 06 x 626/630 - 4'0	630	Von Duprin	X	X		<input type="checkbox"/>
1	Rim Cylinder Housing	80-116	626	Schlage	X			<input type="checkbox"/>
1	Mortise Cylinder	80-110	626	Schlage	X			<input type="checkbox"/>
1	Electric Strike	6300 x 12/24VCD	630	Von Duprin	X	X		<input type="checkbox"/>
1	Closer	4111-LH (LCN / ST 2779)	689	LCN	X	X		<input type="checkbox"/>
1	Overhead Stop	104S	630	Glynn Johnson	X	X		<input type="checkbox"/>
1	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Weatherstrip	W-13 – 1 @ 965 & 2 @ 2135	628	KN Crowder	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 965	BLK	KN Crowder	X			<input type="checkbox"/>
1	Threshold	CT-10 x 965	628	KN Crowder	X			<input type="checkbox"/>

By Security Supplier

1	Card Reader	To Suit Building System (24V)	BLK					<input type="checkbox"/>
1	Door Contact	To Suit Building System						<input type="checkbox"/>
1	Access Controller	To Suit Building System						<input type="checkbox"/>
1	Motion REX	To Suit Building System						<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- Final commissioning of all access control items, such as but not limited to electric strikes, Rex sensors, Door contacts, Electrified Panics, Relays & Maglocks is the responsibility of the security provider

-----End of Heading-----



Heading# 14

Opening Information

Opening Type:	Single	Opening Size:	New Door x Existing Frame	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	3/4 HR

1 Total Openings

1	Door#	112A	Location:	Stair A 112 from Garage 102	Handing:	RHR
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Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP (CONFIRM PRIOR TO ORDERING)	630	Hager	X			<input type="checkbox"/>
1	Exit Device	98L-NL-F x 996L-NL-R/V x 06 x 626/630 - 3'0	630	Von Duprin	X	X		<input type="checkbox"/>
1	Rim Cylinder Housing	80-116	626	Schlage	X			<input type="checkbox"/>
1	Mortise Cylinder	80-110	626	Schlage	X			<input type="checkbox"/>
1	Electric Strike	6300 x 12/24VCD	630	Von Duprin	X	X		<input type="checkbox"/>
1	Closer	4011-LH (LCN/ST 1544)	689	LCN	X	X		<input type="checkbox"/>
1	Drop Plate	4020-18	689	LCN				<input type="checkbox"/>
1	Overhead Stop	104S	630	Glynn Johnson	X	X		<input type="checkbox"/>
1	Kickplate	GSH 80A – 203 x Ex Door Width (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 965	BLK	KN Crowder	X			<input type="checkbox"/>

By Security Supplier

1	Card Reader	To Suit Building System (24V)	BLK					<input type="checkbox"/>
1	Door Contact	To Suit Building System						<input type="checkbox"/>
1	Access Controller	To Suit Building System						<input type="checkbox"/>
1	Motion REX	To Suit Building System						<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- Final commissioning of all access control items, such as but not limited to electric strikes, Rex sensors, Door contacts, Electrified Panics, Relays & Maglocks is the responsibility of the security provider

-----End of Heading-----





Heading# 15

Opening Information

Opening Type:	Single	Opening Size:	New Door x Existing Frame	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	3/4 HR

1 Total Openings

1	Door#	112B	Location:	Stair A 112 from Garage 107	Handing:	RHR
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Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP (CONFIRM PRIOR TO ORDERING)	630	Hager	X			<input type="checkbox"/>
1	Exit Device	98L-NL-F x 996L-NL-R/V x 06 x 626/630 - 3'0	630	Von Duprin	X	X		<input type="checkbox"/>
1	Rim Cylinder Housing	80-116	626	Schlage	X			<input type="checkbox"/>
1	Mortise Cylinder	80-110	626	Schlage	X			<input type="checkbox"/>
1	Electric Strike	6300 x 12/24VCD	630	Von Duprin	X	X		<input type="checkbox"/>
1	Closer	4011-LH (LCN/ST 1544)	689	LCN	X	X		<input type="checkbox"/>
1	Drop Plate	4020-18	689	LCN				<input type="checkbox"/>
1	Overhead Stop	104S	630	Glynn Johnson	X	X		<input type="checkbox"/>
1	Kickplate	GSH 80A – 203 x Ex Door Width (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 965	BLK	KN Crowder	X			<input type="checkbox"/>

By Security Supplier

1	Card Reader	To Suit Building System (24V)	BLK					<input type="checkbox"/>
1	Door Contact	To Suit Building System						<input type="checkbox"/>
1	Access Controller	To Suit Building System						<input type="checkbox"/>
1	Motion REX	To Suit Building System						<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- Final commissioning of all access control items, such as but not limited to electric strikes, Rex sensors, Door contacts, Electrified Panics, Relays & Maglocks is the responsibility of the security provider

End of Heading



Heading# 16

Opening Information

Opening Type:	Single	Opening Size:	Existing Door x Existing Frame	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	113	Location:	Exterior from Garage 107	Handing:	RHR
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Web Link	Install Instructions	Site Verified
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*BALANCE OF EXITING HARDWARE TO REMAIN.

*EXIT ONLY NO OUTSIDE ACCESS.

By Security Supplier

1	Door Contact	To Suit Building System							
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-----End of Heading-----

Heading# 17

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45 – Dutch Door	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1 **Door#** 113A **Location:** Garage 107 to Parts Storage 113 **Handing:** RH

Web Link

Install Instructions

Site Verified

By Hardware Supplier

4	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Storeroom Lockset	ND80BDC x RHO x 626	626	Schlage	X			<input type="checkbox"/>
1	Flush Bolts	FB458	626	Ives	X			<input type="checkbox"/>
1	Closer	4011-RH (LCN/ST 1544)	689	LCN	X	X		<input type="checkbox"/>
1	Drop Plate	4020-18	689	LCN				<input type="checkbox"/>
1	Overhead Stop	104F (With Hold Open)	630	Glynn Johnson	X	X		<input type="checkbox"/>
1	Floor Stop	GSH 209	626	Gallery	X			<input type="checkbox"/>
1	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 1067	BLK	KN Crowder	X			<input type="checkbox"/>
1	Dutch Door Shelf	By HM Door Provider						

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. (Existing Key System should still be verified with facility prior to ordering Locks to ensure compatibility)

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



Heading# 18

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	114	Location:	Garage 102 to Locker Room 114	Handing:	LH
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Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Classroom Lockset	ND70BDC x RHO x 626	626	Schlage	X			<input type="checkbox"/>
1	Closer	4011-LH (LCN/ST 1544)	689	LCN	X	X		<input type="checkbox"/>
1	Drop Plate	4020-18	689	LCN				<input type="checkbox"/>
1	Overhead Stop	104S	630	Glynn Johnson	X	X		<input type="checkbox"/>
2	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 927	BLK	KN Crowder	X			<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. (Existing Key System should still be verified with facility prior to ordering Locks to ensure compatibility)

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



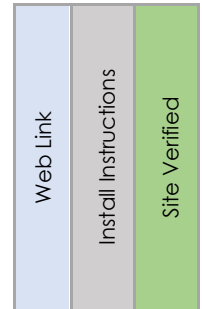
Heading# 19

Opening Information

Opening Type:	Single	Opening Size:	Existing Door x Existing Frame	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

7 Total Openings

1	Door#	O/H-1	Location:	Exterior from Garage 102	Handing:	O.H
1	Door#	O/H-2	Location:	Exterior from Garage 102	Handing:	O.H
1	Door#	O/H-3	Location:	Exterior from Garage 102	Handing:	O.H
1	Door#	O/H-4	Location:	Exterior from Garage 107	Handing:	O.H
1	Door#	O/H-5	Location:	Exterior from Garage 107	Handing:	O.H
1	Door#	O/H-6	Location:	Exterior from Garage 107	Handing:	O.H
1	Door#	O/H-7	Location:	Exterior from Garage 107	Handing:	O.H



***ALL HARDWARE BY OVERHEAD DOOR PROVIDER.**

-----End of Heading-----



Heading# 20

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	3/4 HR

1 Total Openings

1 **Door#** 201 **Location:** Stair B 201 from Office Area 202 **Handing:** RHR

Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4"	652	Hager	X			<input type="checkbox"/>
1	Exit Device	98L-BE-F x 996L-BE-R/V x 06 x 626/630 x 4'0	630	Von Duprin	X	X		<input type="checkbox"/>
1	Closer	4011-LH (LCN/ST 1544)	689	LCN	X	X		<input type="checkbox"/>
1	Drop Plate	4020-18	689	LCN				<input type="checkbox"/>
1	Overhead Stop	104S	630	Glynn Johnson	X	X		<input type="checkbox"/>
1	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 965	BLK	KN Crowder	X			<input type="checkbox"/>

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



Heading# 21

Opening Information

Opening Type:	Single	Opening Size:	Existing Door x Existing Frame	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1 **Door#** 203 **Location:** Office Area 202 to Server Room 203 **Handing:** LH

Web Link

Install Instructions

Site Verified

By Hardware Supplier

1	Storeroom Lockset	ND80BDC x RHO x 626	626	Schlage	X			
1	Wrap Around Plate	42CW	630	Schlage	X			

By Locksmith

1	Permanent Core/Cylinder	Permanent Medeco Core/Cylinder Provided by City Locksmith Listed Below.	626	Medeco				<input type="checkbox"/>
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*BALANCE OF EXITING HARDWARE TO REMAIN.

Notes:

- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. **(Existing Key System must be Confirmed & Verified with Facility & it's Locksmith prior to ordering Locks to ensure compatibility and client keying preference, *locks may need be ordered in FSIC or Conventional Cylinder Style)**
- Permanent Cores & Cylinders to be Provided by Approved City Locksmiths: Reillys Lock & Security Systems and/or ABC Security Access Systems and/or Gunnebo

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



Heading# 22

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	3/4 HR

1 Total Openings

1 **Door#** 204 **Location:** Stair A 204 from Office Area 202 **Handing:** LHR

Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4"	652	Hager	X			<input type="checkbox"/>
1	Exit Device	98L-BE-F x 996L-BE-R/V x 06 x 626/630 x 4'0	630	Von Duprin	X	X		<input type="checkbox"/>
1	Closer	4011-RH (LCN/ST 1544)	689	LCN	X	X		<input type="checkbox"/>
1	Drop Plate	4020-18	689	LCN				<input type="checkbox"/>
1	Overhead Stop	104S	630	Glynn Johnson	X	X		<input type="checkbox"/>
1	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 965	BLK	KN Crowder	X			<input type="checkbox"/>

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



End of Heading



Heading# 23

Opening Information

Opening Type:	Single	Opening Size:	Existing Door x Existing Frame	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	1	Location:	Stair B 101 from Garage 102	Handing:	LHR
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Web Link

Install Instructions

Site Verified

By Hardware Supplier

1	Exit Device	98L-F x 996L-NL-R/V x 06	626	Von Durin	X			
1	Rim Cylinder Housing	80-116	626	Schlage	X			<input type="checkbox"/>
1	Wrap Around Plate	90CW	630	Schlage	X			

By Security Supplier

1	Door Contact	To Suit Building System						<input type="checkbox"/>
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By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- Final commissioning of all access control items, such as but not limited to electric strikes, Rex sensors, Door contacts, Electrified Panics, Relays & Maglocks is the responsibility of the security provider

*Install New Exit Device, Patch as Required.

*BALANCE OF EXITING HARDWARE TO REMAIN. – **HARDWARE TO BE CONFIRMED PRIOR TO ORDERING.**

End of Heading



Heading# 24

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	205	Location:	Office Area 202 to Office 205	Handing:	RH
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Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Office Lockset	ND50BDC x RHO x 626	626	Schlage	X			<input type="checkbox"/>
1	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Floor Stop	GSH 209	626	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Auto Door Bottom	434APKL x 965	MIL	Pemko	X	X		<input type="checkbox"/>
By Locksmith								
1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>

Notes:

- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. **(Existing Key System must be Confirmed & Verified with Facility & it's Locksmith prior to ordering Locks to ensure compatibility and client keying preference, *locks may need be ordered in FSIC or Conventional Cylinder Style)**
- Permanent Cores & Cylinders to be Provided by Approved City Locksmiths: Reillys Lock & Security Systems and/or ABC Security Access Systems and/or Gunnebo

-----End of Heading-----



Heading# 25

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	206	Location:	Office Area 202 to Office 206	Handing:	RH
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Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Office Lockset	ND50BDC x RHO x 626	626	Schlage	X			<input type="checkbox"/>
1	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Floor Stop	GSH 209	626	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Auto Door Bottom	434APKL x 965	MIL	Pemko	X	X		<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. **(Existing Key System must be Confirmed & Verified with Facility & it's Locksmith prior to ordering Locks to ensure compatibility and client keying preference, *locks may need be ordered in FSIC or Conventional Cylinder Style)**
- Permanent Cores & Cylinders to be Provided by Approved City Locksmiths: Reillys Lock & Security Systems and/or ABC Security Access Systems and/or Gunnebo

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



Heading# 26

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1	Door#	207	Location:	Office Area 202 to Kitchenette 207	Handing:	LH
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Web Link	Install Instructions	Site Verified
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By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Classroom Lockset	ND70BDC x RHO x 626	626	Schlage	X			<input type="checkbox"/>
1	Closer	4011-LH (LCN/ST 1544)	689	LCN	X	X		<input type="checkbox"/>
1	Drop Plate	4020-18	689	LCN				<input type="checkbox"/>
1	Overhead Stop	104F (with Hold Open)	630	Glynn Johnson	X	X		<input type="checkbox"/>
2	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 965	BLK	KN Crowder	X			<input type="checkbox"/>

By Locksmith

1	Permanent Core	Permanent Medeco Core Provided by City Locksmith	626	Medeco				<input type="checkbox"/>
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Notes:

- Lever Replacement Locks specified above all come with SFIC System with a plastic construction core for the facility/city locksmith to replace with permanent cores after construction. **(Existing Key System must be Confirmed & Verified with Facility & it's Locksmith prior to ordering Locks to ensure compatibility and client keying preference, *locks may need be ordered in FSIC or Conventional Cylinder Style)**
- Permanent Cores & Cylinders to be Provided by Approved City Locksmiths: Reillys Lock & Security Systems and/or ABC Security Access Systems and/or Gunnebo

-----End of Heading-----

Heading# 27

Opening Information

Opening Type:	Single	Opening Size:	965 x 2135 x 45	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1 Total Openings

1 **Door#** 208 **Location:** Office Area 202 to Gender Neutral Washroom 208 **Handing:** LH

Web Link

Install Instructions

Site Verified

By Hardware Supplier

3	Heavy Weight Hinge	BB1168 – 4 ½" x 4" NRP	630	Hager	X			<input type="checkbox"/>
1	Privacy Latchset	ND40S x RHO x 626	626	Schlage	X			<input type="checkbox"/>
1	Closer	4011-LH (LCN/ST 1544)	689	LCN	X	X		<input type="checkbox"/>
1	Drop Plate	4020-18	689	LCN				<input type="checkbox"/>
1	Overhead Stop	104S	630	Glynn Johnson	X	X		<input type="checkbox"/>
2	Kickplate	GSH 80A – 203 x 927 (Rounded Corners) – 3M TAPE	630	Gallery	X			<input type="checkbox"/>
1	Smoke / Sound Seal	W-66 x 5400	BLK	KN Crowder	X			<input type="checkbox"/>
1	Door Sweep	W-24S x 965	BLK	KN Crowder	X			<input type="checkbox"/>

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

END OF SCHEDULE



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 Receive and install hollow metal doors and plastic laminate doors (and transoms).
 - .2 Receive and install finish hardware in all doors listed in finish hardware schedule appended to Section 08 71 00. Receive templates from finish hardware Supplier.
 - .3 Final adjustment on door closers including closing speed, latching speed and backcheck.
- .2 Obtain up-to-date finish hardware schedule and keep a copy in a three-ring binder at the jobsite. Make schedule available to the Consultant upon request. Record any changes made to hardware schedule at the site.
- .3 Keep a copy of all reviewed catalogue cuts and samples, if any, and have same readily available to the Consultant upon request.

1.1 **REFERENCE**

- .1 Conform to the latest edition of the following:
 - .1 AODA - Accessibility for Ontarians with Disabilities Act

1.2 **QUALITY ASSURANCE**

- .1 The Subcontractor performing the Work of this section shall be a firm specializing in the installation of commercial doors and high quality building finish hardware, both electrified and non-electrified.
- .2 Give assistance at the place of the Works to organize hardware storeroom and supply qualified staff to correctly categorize, mark, and arrange each item in groups to enable efficient dispensing in specified hardware groups for each door to installation trades.
- .3 Provide qualified staff at the place of the Works promptly to assist installation trades subsequent to being requested and to ensure that hardware is being correctly installed.

1.3 **DELIVERY, STORAGE AND HANDLING**

- .1 Receive and store doors and finish hardware. It must be noted that hollow metal doors are in two types, namely standard hollow metal with stiffened/insulated core, and fire rated hollow metal. Likewise, solid core wood doors come in both standard and fire rated assemblies. Ensure that such units are identified accordingly to ensure installation at their intended points of usage.
- .2 Jointly make an inventory of finish hardware with the hardware Supplier.
- .3 Handle, store and protect doors and finish hardware in accordance with requirements specified in Section 08 13 00 and Section 08 14 10.

1.4 **PRE-INSTALLATION MEETING**

- .1 Prior to start of hardware installation, arrange for a Project site meeting of all parties associated with Work of this section. Presided by Consultant, meeting to include General Contractor, Hardware Consultant, Hardware Supplier, Hardware Installer and Security System Supplier/Installer.
- .2 In the meeting, review Specifications for Work included under this section and determine a complete understanding of requirements and responsibilities relative to Work included, storage and handling of materials, installation of materials, latest installation techniques, sequence and quality control, interfacing with Division 26, and other matters affecting the installation, so as to permit compliance with the intent of this section.

1.5 **WARRANTY AND MAINTENANCE DOCUMENTS**

- .1 Collect warranty and maintenance documents from finish hardware Supplier as specified in Section 08 71 00. Submit the foregoing documents upon Substantial Performance in accordance with Section 01 33 00.

2 **Products**

2.1 **MATERIALS**

- .1 (Not used)

3 **Execution**

3.1 **DOORS**

- .1 Install doors to swing shut with minimum clearances of 1.6 mm at heads, 2 mm at jambs and 6 mm over finished floor surfaces. Check with door schedule for conditions requiring greater clearance from floor for air movement.
- .2 Install doors to swing freely but not loosely on their hinges, to close tightly and evenly on their frames without binding or rattling in the latched position.
- .3 Do not install warped, twisted or other defective doors.
- .4 Field trimming or cutting of wood doors is not permitted. All cutouts for mortise hardware, grilles and glass, and all bevelling and prefitting shall have been done in the door manufacturer's plant.
- .5 Secure plastic laminate transoms with concealed pins at head and clips at bottom corners.

3.2 **FINISH HARDWARE**

- .1 Install building finish hardware in accordance with finish hardware schedule appended to Section 08 71 00. Carefully examine Section 08 71 00 for installation requirements specific to Section 08 71 05.
- .2 Consider hardware manufacturers recommended mounting heights as a general guide unless conditions such as intermediate rails, line of glass light, etc. dictate otherwise. Installer must carefully check manufacturers' installation instructions packed with hardware Products. In particular, the installation heights when using mullions and/or vertical rod devices may be predetermined by certain manufacturers.

- .3 Hardware Location:
 - .1 Hardware location dimension shall be as follows; measured from finish floor to centre line of hardware unless indicated otherwise:
 - .1 Locksets/latchsets centre line of strike: 1034 mm
 - .2 Deadlocks/mortise night latch: 1524 mm
 - .3 Exit devices (centre line of strike): 1000 mm
 - .4 Push plates: 1000 mm
 - .5 Door pulls: 1000 mm
 - .2 Hardware locations are to pre-determined standard industry recommendations. On custom doors, mount hardware across intermediate rail to meet architectural design considerations.
- .4 Protect installed hardware from damage.
- .5 Install kickplates on four sides with continuous pressure-sensitive two-sided adhesive tape supplied with hardware.
- .6 Thresholds: Site measure openings before cutting. Set thresholds on two continuous beads of sealant conforming to Section 07 92 00.
- .7 Door closers and holders: Install door closers in such a manner that door opening is unaffected and that maximum swing is permitted. Prior to installing closer to the door, it is the responsibility of the installer to:
 - .1 Index the arm attachment so as to properly position the arm to the closer.
 - .2 Adjust the back check positioning valve in order to maintain an effective backcheck range.
- .8 Weatherstripping of Doors
 - .1 Install weatherstripping effectively to tightly seal entire perimeter of doors. Secure in place with non-ferrous "Tec" screws, in accurate alignment.
 - .2 Maintain integrity of weatherseal at head of doors fitted with closers. Adapt weatherstripping as required to achieve specified performance and provide any necessary accessories.

3.3 **ELECTRIFIED HARDWARE**

- .1 Install electrified hardware and associated devices in accordance with manufacturers recommendations.
- .2 Provide interconnecting wiring to power operators and controls back to panel in door framing for power connection by electrical division.
- .3 All wiring will be supplied and installed by electrical division including conduit, boxes and other electrical appurtenances, including connections and terminations.
- .4 Be responsible for ensuring that all wiring work is done in accordance with the Suppliers wiring diagrams and directions.
- .5 Arrange for testing and commissioning of system by the distributor of the system.

3.4 **INSPECTION**

- .1 Coordinate with finish hardware Supplier who provides inspection service during hardware installation and upon completion.
- .2 Adjust or rectify finish hardware items found to be improperly installed. Remove defective materials and replace with new materials supplied by the finish hardware Supplier at no cost to the Owner.

3.5 **CLEANING**

- .1 Wipe clean doors and frames of dust created from the door and hardware installation process.
- .2 Clean and polish all items of hardware and leave free from disfigurement.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror
- .2 CAN/CGSB-12.1-M - Tempered or Laminated Safety Glass
- .3 CAN/CGSB-12.3-M - Flat, Clear Float Glass
- .4 CAN/CGSB-12.8-M - Insulating Glass Units
- .5 CAN/CGSB-12.11-M - Wired Safety Glass
- .6 CAN/CGSB-19.2-M - Glazing Compound, Non-Hardening, Modified Oil Type
- .7 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **SUBMITTALS**

- .1 Shop Drawings: Submit Shop Drawings in accordance with Section 01 33 00 Submittals, for fabrication and erection of glazing elements indicating materials, thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.

.2 Samples:

- .1 Submit one 300 x 300 mm sample of each type of glass in accordance with Section 01 33 00.

.3 Certificates: Submit manufacturer's certification that glass and glazing materials are compatible.

- .1 Submit compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.
- .2 Compatibility test report from manufacturer of insulating glass edge sealant, indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, setting blocks, edge blocks and any other material that contacts or can affect the edge seal.

1.4 **DELIVERY, HANDLING AND STORAGE**

- .1 Deliver materials to the site in original crates and containers with the maker's name and brand distinctly marked thereon and with glass labeled as to types. Do not remove labels on glass until after Work is accepted by the Consultant.

- .2 Store materials within the building, in a clean, dry location. Fully protect materials from damage until ready for use.

2 Products

2.1 **MATERIALS**

.1 Fire Rated Glazing:

- .1 Thickness: 8 mm overall.
- .2 Weight: 4 lbs./sq.ft.
- .3 Approximate Visible Transmission: 85%.
- .4 Approximate Visible Reflection: 9%
- .5 Fire-Rating: 20 minutes to 3 hours for doors; 20 minutes to 90 minutes for other applications.
- .6 Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
- .7 STC Rating: Approximately 38 dB.
- .8 Surface Finish:
 - .1 Standard Grade is polished for a surface quality that is comparable to alternative fire-rated ceramics marketed as having a premium finish.
 - .2 Premium Grade is finish ground and polished on both surfaces to provide superior surface quality, improving overall clarity and providing a surface that is unmatched by alternative products.
- .9 Positive Pressure Test: UL 10C; passes.
- .10 Labeling: Permanently label each piece of glazing with the manufacturer's logo, cUL logo and fire rating in sizes up to 3,325 sq. in.
- .11 Fire Rating: Fire rating classified and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ULC Standards CAN4 S-104 and CAN4 S-106.
- .12 Glazing Compound for Fire-Rated Glazing Materials
 - .1 Glazing Tape: Closed cell PVC foam, maximum water absorption by volume of 2%. Glass panels exceeding 1,393 sq. inches for 90 minute ratings must be glazed with fire-rated glazing tape supplied by the manufacturer.
 - .2 Glazing Compound: DAP 33 putty.
 - .3 Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S, Grade NS, Class 25 with additional movement capability of 50% in both extension and compression (total 100%):
 - .1 "Dow Corning 795" by Dow Corning Corp.
 - .2 "Silglaze-II 2800" by General Electric Co.
 - .3 "Spectrum 2" by Tremco Inc.

- .4 Setting Blocks: Neoprene, EPDM or silicone, tested for compatibility with glazing compound, of 70 to 90 Shore A hardness.
- .5 Cleaners, Primers and Sealers: As recommended by glazing manufacturer.
- .2 Tempered Glass: conforming to CAN/CGSB-12.1-M, Type 2, Class B, clear float glass fully tempered horizontally to achieve net strength of not less than 4 to 5 times greater than regular annealed glass. Free from roller and tong marks.
 - .1 Thickness: 6 mm or 12 mm or as indicated on Drawings
 - .2 Finish: Clear, Low iron
- .3 Laminated Tempered Glass: conforming to CAN/CGSB-12.1-M, Type 1, Class B, Consisting of two layers 6 mm thick, with 1.5 mm clear polyvinyl butyral interlayer, overall thickness 13 mm.
 - .1 Thickness: minimum 13 mm or as indicated on Drawings
- .4 Float Glass: conforming to CAN/CGSB-12.3-M, glazing quality.
 - .1 Finish: polish
 - .2 Thickness: minimum 6 mm or as indicated on Drawings
- .5 Insulating glass: Factory sealed double glazed units conforming to CAN/CGSB-12.8-M as manufactured. Both panes to consist of clear float glass conforming to CAN/CGSB-12.3-M. (Panes to be float glass conforming to CAN/CGSB-12.3-M; tinted (grey) (bronze) exterior and clear interior, both 6 mm¹/₄" thick). The insulating unit panes shall be joined with a metal edge spacer along all edges ensuring a dehydrated air space with argon gas, and hermetically sealed at the periphery with a factory applied continuous flexible sealer.
 - .1 Manufacturer: PPG Canada Inc., AFG Glass Inc., Guardian Glass, Cardinal Glass, Versalux Glass or accepted equal.
- .6 Mirrors: Conforming to ASTM C1503, normal use (high humidity use) 6 mm¹/₄" thick float glass with process deposit of five silver coats, three copper coats and final protective seal, and with ground and polished round edges:
 - .1 Cushion: PVC pressure sensitive foam tape, 6 mm¹/₄" thick with adhesive one side.
 - .2 Concealed clips: Type 302 stainless steel, vandal-proof.
 - .3 Adhesive: "Mirror Mastic" by Palmer Products Corporation or accepted equal.

2.2 **ACCESSORIES**

- .1 Glazing compound (fire doors): Putty.
- .2 Glazing tape: 440 polyisobutylene-butyl tape by Tremco Ltd.
- .3 Spacer shims and setting blocks: Neoprene, Shore "A" Durometer hardness 70-90, 100 mm long, wide enough to extend from fixed stop to opposite face of glass and of height suitable to provide adequate glazing "bite" for setting blocks. Neoprene, Shore "A" 40 to 50 Durometer hardness, of adequate thickness to provide correct glass to face clearance of at least 3 mm for spacer shims. For glass in fire rated doors (screens) use ULC approved fire-resistant setting blocks and spacer shims.

- .4 Glazing channel (for interior glazing): Black extruded neoprene or PVC channel gaskets, of size to suit glazing.
- .5 Glazing compound: One-part clear silicone. GE Canada "Silpruf SCS 2000", Dow Corning "795" or Tremco "Spectrum 2".

3 Execution

3.1 **INSPECTION OF JOB CONDITIONS**

- .1 Inspect openings and frames prepared by other trades into which glass is to be installed. Notify the Consultant in writing, of any conditions which will preclude proper installation. Do not glaze unsatisfactory locations until such conditions have been made good. Commencement of Work implies acceptance of existing conditions.
- .2 Obtain glass dimensions on the job site. Glass shall be 4 mm less than the rebate size in either dimension, with allowance for edge spacers, shims and setting blocks.
- .3 Free rabbets, stops and glass edges of dirt, moisture, oil and other foreign matter detrimental to or obstructing glazing material.

3.2 **GLASS INSTALLATION**

- .1 Check that all openings and stops to be painted are primed before commencing Work.
- .2 At completion of the Work, replace at own expense, glass provided under this section which is broken due to loose setting, binding in the frame, pinched by glazing clips, inadequate or improper use of setting blocks, improper workmanship or other causes.

3.3 **INTERIOR GLAZING**

- .1 Standard hollow metal doors: Install glass with continuous glazing channels on glass edges. Set glass and secure in place with stops butted tight to glazing channels. Screw stops to door with countersunk fluorocarbon coated oval head screws.
- .2 Standard wood doors: Install glass with continuous glazing channels on glass edges. Set glass and secure in place with stops butted tight to glazing channels. Secure stops to door with screws provided, with heads slightly below glass stop surface.
- .3 Standard hollow metal frames for screens and borrowed lights: Place setting blocks and spacers as required to support glass. Use a minimum of two setting blocks, locate at one-quarter points. Locate spacers at jamb edges of glass, uniformly spaced at 600 mm o.c. maximum, and 300 mm maximum from top and bottom.
- .4 Fire rated hollow metal doors: Set glass on continuous setting block with 6 mm gap between glazing stops and embed in putty in accordance with NFPA 80 requirements. All exposed joints between the metal and glass shall be struck and pointed.

3.4 **EXTERIOR GLAZING**

- .1 Apply setting blocks at quarter points on all four sides of openings.
- .2 Cut glazing tape to proper length and set against permanent stops approximately 0.8 mm below sightline. Install horizontal strips first, extend over entire width of opening before applying vertical strips. Weld corners together by butting tape and dabbling with sealant.
- .3 Remove backing paper from tape prior to setting glass.
- .4 Apply continuous heel bead between glass and sash.

- .5 Place glass in opening, press tightly and evenly against glazing tape.
- .6 Apply continuous glazing tape on removable stop. Place and screw stop in place with fluorocarbon coated oval head screws. Apply elastomeric sealant cap bead over top between glass and removable stop.

3.5 **MIRROR INSTALLATION**

- .1 Install with concealed, tamperproof clips, or 100% adhesive method. If clips are used, install cushion tape completely around perimeter of mirror back, set in concealed location within 25 mm of edge. Apply adhesive in strict accordance with manufacturer's printed instructions.
- .2 Where inset in ceramic tile, maintain a mirror-to-tile joint width of not more than 2 mm all around. Otherwise, remove mirror and replace same to satisfy the joint requirement, all at no cost to the Owner.

3.6 **IDENTIFICATION OF GLAZING**

- .1 Provide on one side of all glass lites, temporary, easily removable, large safety decals, immediately after glass installation. Maintain safety markings until final clean-up. Remove all markings at time of final clean-up.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- | | | |
|----|--------------------------|--|
| .1 | ASTM A653/653M | - Standard Specification for Sheet Steel, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process |
| .2 | ASTM A568/A568M | - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for |
| .3 | ASTM C1396/C1396M | - Standard Specification for Gypsum Board |
| .4 | ASTM C475/C475M | - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board |
| .5 | ASTM C645 | - Standard Specification for Nonstructural Steel Framing Members |
| .6 | ASTM C1002 | - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs |
| .7 | CAN/CSA-G40.20/ G40.21-M | - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels |
| .8 | SSPC | - The Society for Protective Coatings, "Steel Structures Painting Manual, Vol. 2" |
| .9 | AODA | - Accessibility for Ontarians with Disabilities Act |

1.3 **QUALITY ASSURANCE**

- .1 Retain workmen skilled in gypsum board work to perform Work of this section in accordance with this Specification and the latest printed directions of the manufacturer.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials in original packages, containers and bundles bearing brand and manufacturer's name. Handle materials with care to prevent damage thereto. Store in a covered area off the ground, on flat, smooth, dry surfaces.
- .2 Protect this Work against damage at all times. Protect from moisture until ready for use.

1.5 **PROJECT/SITE CONDITIONS**

- .1 In cold weather and during period of gypsum board application and joint finishing, maintain temperatures within the building uniformly within the range of 13°C to 21°C (55°F to 70°F). Also provide adequate ventilation to eliminate excessive moisture within the building during this same period.

2 Products

2.1 **STEEL FRAMING SYSTEM**

- .1 Manufacturer:
 - .1 Bailey Metal Products Limited
 - .2 Canadian Gypsum Co. Limited (CGC)
 - .3 Or accepted equal
- .2 Main runner channels: 38 mm x 19 mm, cold rolled galvanized steel channels, weighing not less than 0.8 kg/m conforming to ASTM A568/568M and ASTM A653/653M.
- .3 Metal furring channels: 22 mm winged flange type, cold rolled galvanized steel channels conforming to ASTM A568/568M and ASTM A653/653M.
- .4 Metal studs: Standard gypsum board screw-on stud system complete with floor and ceiling runners conforming to ASTM A568/568M, ASTM C645 and ASTM A653/653M. Size: 32 mm wide x depths shown on Drawings. Use 20 gauge for abuse-resistant board.
- .5 Shaftwall framing: "C-H" studs complete with "J" runners and "E" studs as required, all hot-dip galvanized.
- .6 Hangers: 5 mm diameter pencil rods or 32 mm x 3 mm galvanized steel flat bars to CSA A82.30-M.
- .7 Tie wire: Not less than No. 18 gauge galvanized wire.
- .8 Screw fasteners: in accordance with ASTM C1002, Type S, corrosion resistant.
- .9 Wall Reinforcement:
 - .1 Provide fire retardant treated wood blocking and minimum 18 gauge sheet steel secured between studs for additional reinforcement and supports for wall mounted fixtures, equipment and accessories. The same requirements shall be applied to ceiling mounted items. Coordinate with General Contractor for weight of items to be supported and revise steel gauge accordingly to ensure proper support.
 - .2 Provide additional wall reinforcement to support future adult change table designed for a minimum load of 1.33 kN and baby change table designed to support a 0.22 kN load applied to it

2.2 GYPSUM BOARD

.1 Standard Gypsum board:

- .1 12.9 mm and 15.9 mm thick, or as indicated on Drawings, with tapered and rounded edge for joint filling, and in 1200 mm wide sheets of maximum practical lengths to minimize end joints, in accordance with ASTM C1396/C1396M:
- .2 Acceptable Manufacturer
 - .1 "ToughRock" by Georgia Pacific Canada (GP)
 - .2 "Sheetrock" by CGC
 - .3 "ProRoc Regular Gypsum Board" by CertainTeed
 - .4 Or accepted equal

.2 Fire Rated Gypsum Board

- .1 Gypsum board shall conform to the flame spread rating requirements of the Ontario Building Code.
- .2 For fire rated assemblies, conforming to ASTM C1396/C1396M
- .3 Size: 12.7 mm, 15.9 mm, 19.1 mm or 25.4 mm thick, unless indicated otherwise, Type "X" or "C"
- .4 Acceptable Manufacturer
 - .1 Sheetrock Firecode Core Type C by CGC Inc
 - .2 ToughRock Fireguard Type X or C by Georgia Pacific Canada
 - .3 AirRenew Essential Type X LAQ Gypsum Board by CertainTeed Gypsum Inc.
 - .4 Or accepted equal

.3 Interior Ceiling Board

- .1 In accordance with ASTM C1396 and CAN/CSA-A82.27
- .2 Size: 12.7 mm thick, 1220 x 2440 mm sheets, unless indicated otherwise
- .3 Acceptable Manufacturer
 - .1 "Easi-Lit Lightweight Drywall" by CertainTeed Gypsum Inc.
 - .2 "Sheetrock Interior Ceiling Board" by CGC Inc.
 - .3 "ToughRock CD Ceiling Board" by Georgia Pacific Canada
 - .4 Or accepted equal

.4 Moisture and Mould-Resistant Gypsum Board

- .1 To ASTM C1396M, score of 10 with moisture and mould resistant core and paper surfaces.
- .2 12.7 mm or 15.9 mm thick and of maximum practical lengths to minimize end joints, unless indicated otherwise.

- .3 Acceptable Manufacturer
 - .1 M2Tech Moisture and Mold Resistant Type X Gypsum Board by CertainTeed
 - .2 Sheetrock Mould Tough Type X Interior Panel by CGC Inc.
 - .3 DensArmor Plus High Performance Interior Panel or ToughRock Mold-Guard by Georgia Pacific Canada.
 - .4 ProRock Moisture Resistant Gypsum Board by CertainTeed
 - .5 Or accepted equal
- .5 Cement Board
 - .1 In accordance with ASTM C1396/C1396M
 - .2 Size: 12.7 mm thick, or as indicated on Drawings
 - .3 Acceptable Manufacturer
 - .1 "Durock Cement Board" by CGC Inc
 - .2 "Permabase" by Unifix Inc distributed by CertainTeed Gypsum Inc or National Gypsum.
 - .3 Or accepted equal
- .6 Accessories
 - .1 External corner reinforcement: Domtar "Metal Corner Bead", CGC "Dur-A-Bead", CertainTeed "AquaBead Corner Reinforcement" or GP equal.
 - .2 Casing beads: 0.56 mm (25 gauge) galvanized steel designed to accept the specified thickness of gypsum board.
 - .3 Joint reinforcement tape (gypsum board): Domtar "Joint Tape" CGC "Perf-A-Tape", CertainTeed "FibaTape" or GP equal, conforming to ASTM C475.
 - .4 Joint reinforcement tape (backer board): Glass mesh.
 - .5 Joint filler, topping cement: For gypsum board, use manufacturer's high grade premixed compound. For composite and cementitious backer board, use board manufacturer's high grade premixed compound for waterproof exposure.
 - .6 Control joint strip: Roll formed zinc coated metal with a tape protected void, 6 mm wide throat x 11 mm deep with flanges for embedding in joint compound.
- .7 Floor Underlayments: "Levelrock 25000 by CGC or accepted equal.
- .8 Acoustic insulation: QuietZone Acoustic Batt by Owens Corning, "Sustainable Insulation Noise Reducer" by CertainTeed, "Thermafiber Sound Attenuation Fire Blanket" by Thermafiber Inc., "SAFB" by Fibrex Insulations, Inc. or "AFB" by Rockwool. Size as indicated on Drawings.
- .9 Acoustic sealant and spray: Tremco "Acoustical Sealant", PRC "PR181", U.S.E.-Hickson "Kop●R●100" or Wilrep "SilenSeal" (water based), "CP 506 Smoke and Acoustic Sealant" or "CP 572 Smoke and Acoustic Spray" by Hilti Canada, or accepted equal. Covering bead at exposed applications shall be a material compatible with acoustic sealant, suitable for painting, as supplied by acoustic sealant manufacturer.

- .10 Screws and Nails:
 - .1 Backer board screws: "Hi-Lo" bugle head Type S point concrete backer board screws, corrosion resistant.
 - .2 Gypsum board screws: 5 mm x 25 mm (No. 6 gauge) x 1" long for metal furring application and 5 mm x 32 mm (No. 6 gauge) x 1-1/4" long for metal stud application. Screws shall be self-drilling, case hardened, with socket countersunk heads to ASTM C1002, Type S.
 - .3 Screws for gypsum board on wood studs: 5 mm (No. 6 gauge) x length to penetrate minimum 16 mm into wood. Screws shall conform to ASTM C1002, Type W.
 - .4 Nails for exterior gypsum board sheathing on wood framing: Roofing type, galvanized.
- .11 Inserts for concrete slabs
 - .1 Ceiling Wire X-CW or Ceiling Clip X-CC by Hilti Canada, Tie wire anchors, Red Head TW-1614 by ITW Canada Inc., Parabolt Wire Hanger distributed by Acrow-Richmond Ltd., T-14 Eyebolt by Ramset Ltd. or Tie Wire Drive TW-932 by Isometric Ltd or accepted equal.
- .12 Adhesive
 - .1 Adhesive for gypsum board on rigid insulation: 3M No. 2166 or ICI Devoe D.W.24.
 - .2 Adhesive for gypsum board on masonry or concrete walls: Joint filler mixed with water in accordance with manufacturer's directions.
- .13 Supplementary steel supports: Steel conforming to Section 05 50 00 of this Specification.
- .14 Metal deck flute closure: Moulded to deck profile; moulded cellular neoprene or rubber closure pieces at non-rated locations and fire rated closed cell neoprene conforming to ASTM D1056 or D2056 at fire rated locations.
- .15 Access doors: Refer to Section 08 31 00 Access Doors and Panels

2.3 **FRAMING SYSTEMS**

- .1 Acceptable products: Model CFS-TTS "Firestop Top Track Seal" by Hilti Canada or accepted equal.
- .2 Slip-type head joints: Deflection track.
- .3 Firestop top track seal: One-piece, pre-formed, polyurethane foam based, firestop seal for use with standard head-joint top tracks and bottom-joint tracks, and slip-type head joints in fire-rated construction at top of bottom of partition to maintain continuity of the fire resistance rated assembly. Provide in width and configuration required to accommodate depth and installation of studs and designed to saddle over the top track or under the bottom track.
 - .1 Track seal shall be UL 2079 tested for specific fire rated construction conditions conforming to construction assembly type, space requirements and fire-rating required for each application.
 - .2 Performance Requirements:

- .1 Movement: +/- 50%
- .2 Surface burning characteristics in accordance with CAN/ULC S102-10:
 - .1 Flame spread: 15
 - .2 Smoke developed: 35
- .3 Mold-mildew performance in accordance with ASTM G21-96, Class 0.
- .4 VOC content: 0.16 lb/gallon

3 Execution

3.1 **SUSPENSION SYSTEM**

- .1 Locate anchorage points in reinforced concrete floor slab underside (35 MPa compressive strength) in accordance with gypsum board manufacturers' suspension requirements. Drill holes with carbide-tipped drill bits conforming to ANSI B94.12-M. Install anchors; minimum installation depth and method of expansion as recommended by anchor manufacturer.
- .2 DO NOT secure hangers to metal deck or mechanical ducts. Hang grillage for suspended gypsum board ceilings independent of walls, pipes, ducts. Securely anchor to the building structural framing or slab.
 - .1 Space hangers at 1200 mm maximum centres along the carrying channels, and not more than 150 mm from ends.
 - .2 Place supplementary steel supports as required to maintain hanger spacing and to keep metal deck and mechanical ducts free from hangers being secured to.
- .3 Space carrying channels at maximum 1200 mm centres and not less than 25 mm nor more than 150 mm from boundary walls.
 - .1 Run the channels transverse to structural framing members.
 - .2 Where splices are necessary, lap members at least 200 mm and wire each end with two loops.
 - .3 Avoid clustering or lining up splices. Attach to rod hangers by bending hanger sharply under bottom flange of runner and securely wire in place with a saddle tie.
- .4 Install furring channels transverse across carrying channels or other supports.
 - .1 Space at 400 mm centres and not less than 25 mm nor more than 150 mm from boundary walls, openings, interruptions in ceiling continuity and change in direction.
 - .2 Secure to each support with clips or equivalent attachment.
 - .3 Splice joints by nesting and tying channels together or with custom splicers.
 - .4 Level to a maximum tolerance of 3 mm over 3600 mm.
 - .5 Reinforce wherever necessary for the proper support of luminaires, access hatches, ceiling grilles, outlet boxes, ventilating outlets and all other openings.
 - .6 Provide special furring as required at recessed lights.

- .5 Provide expansion/control joints in ceilings, furring and panelling where stresses are likely to develop, such as at the following locations:
 - .1 At abutting structural elements
 - .2 At dissimilar walls and ceilings
 - .3 At dissimilar backup interface at structural expansion and control joints
 - .4 At wings of "L", "U" and "T" shaped ceiling areas
 - .5 At 9000 mm maximum spacing in continuous runs
- .6 Form control joints using continuous furring channels along each side of joint locations, and filling control joint space with specified joint strip, secured in place, making straight joints. Temporarily tape control joint "V" grooves in preparation for joint filling.

3.2 **STEEL STUDS AND FURRING**

- .1 Install tracks at floors, ceilings and underside of deck over, align accurately and secure to structure at 600 mm centres maximum. Avoid piercing metal deck.
- .2 Close opening between top track and steel deck flutes on all full height partitions and bulkheads with specified deck flute closure. Install carefully and compress into place to close flute openings.
- .3 Place studs vertically at 400 mm o.c. and not more than 50 mm from abutting walls, openings and each side of corners. Install studs and secure to tracks.
- .4 Arrange for mechanical and electrical horizontal runs within walls to be installed simultaneously with partitions.
- .5 Provide freedom for deflection under beams and deck to prevent transmission of structural loads to studs, or install 50 mm deep telescoping top tracks.
- .6 At openings, install horizontal track to accommodate intermediate studs. Cut out flanges at each end of track, turn up webs and screw to studs. Install intermediate studs above and below openings at same spacing as wall studs.
- .7 Provide double studs at all hollow metal door jambs. Secure at top and bottom and brace back to adjacent studs at mid-point.
- .8 Provide control joints in gypsum board partitions where stresses are likely to develop, such as at the following locations:
 - .1 At abutting structural elements
 - .2 At dissimilar backup interface
 - .3 At dissimilar walls and ceilings
 - .4 At structural expansion and control joints
 - .5 At door and other openings
 - .6 At 9000 mm maximum spacing in continuous runs
- .9 Form control joints using double studs back to back on each side of joint locations, and filling control joint space with specified joint strip secured in place, making straight joints. Temporarily tape control joint "V" grooves in preparation for joint filling.

3.3 WALL REINFORCEMENT

- .1 Provide and install backing and/or reinforcing within steel stud gypsum partitions for items being hung from or anchored to such partitions or furring.
- .2 Verify location of supports within gypsum board and provide information in ample time to ensure supports are provided in the correct locations. Do not install gypsum board until wood blocking or other reinforcements are installed. Remove and reinstall gypsum board at no extra cost to the Owner where this requirement is not complied with.
- .3 Provide galvanize stud reinforcements in moist areas. Do not use wood blocking for this purpose. Mount additional reinforcement horizontally or at an angle and secure between studs to support the load of and shear forces imposed by items installed upon the Work of this Section. Such items include, but not limited to the following:
 - .1 Washroom accessories
 - .2 Miscellaneous specialties
 - .3 Manufactured components
 - .4 Fitments and fixtures
 - .5 Architectural woodwork and other millwork components
 - .6 Minor mechanical and electrical work; heavy mechanical and electrical equipment shall be self-supporting.
 - .7 Fire hose cabinets
 - .8 Access panels
 - .9 Handrails
 - .10 Coat hooks
 - .11 Wall hung cabinets
 - .12 Shelving
 - .13 Owner supplied equipment

3.4 GYPSUM BOARD ON METAL SUSPENSION, STEEL STUDS AND FURRING

- .1 Erect gypsum boards vertically or horizontally, whichever results in fewer end joints. Locate edge or end joints over supporting members. Stagger vertical joints over different studs on opposite sides of partitions.
- .2 Locate vertical joints at least 300 mm from the jamb lines of openings.
- .3 Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1.6 mm open space between boards. Do not force into place.
- .4 Position boards so that both tapered edge joints abut, and mill-cut or field-cut where end joints abut. Do not place tapered edges against cut edges or ends.
- .5 Attach gypsum board to framing (and blocking) as required for additional support at openings and cutouts.

- .6 Do not locate joints within 200 mm of corners or openings, except where control joints are shown at jamb lines or where openings occur adjacent to corners in the partition/wall layout. Where necessary, place a single vertical joint over the centre of wide openings.
- .7 Where feasible, and where recommended by manufacturer, install gypsum board with "floating" corner construction, unless isolation of the intersecting boards is indicated or unless control or expansion joints are indicated.
- .8 Drive screws with a power screw-gun and set with the countersunk head slightly below the surface of the board.
- .9 In the case of double layers of gypsum board, screw first layer to studs and furring, laminate second layer to first using joint filler as an adhesive. Stagger joints between first and second layers. Brace face layer until adhesive has dried.
- .10 Install fire rated gypsum board to provide the fire ratings shown. Conform to applicable ULC/Warnock-Hersey designs and to manufacturer's specifications. Provide corner beads on all external corners.
- .11 Receive access panels from mechanical division and install in gypsum board assemblies. Coordinate locations with mechanical division.

3.5 **ACCESSORIES**

- .1 Erect plumb, or level, with minimum joints.
- .2 Corner reinforcing bead: Install along all external angles. Secure with screws at 225 mm o.c. Apply filler over flanges flush with nose of the bead and extending at least 75 mm onto surface of board each side of corner. When filler dries, apply a thin coat of topping cement and blend onto adjoining surfaces.
- .3 Casing beads: Install where wallboard butts against a surface having no trim concealing the juncture. Secure with screws at 300 mm o.c. Apply filler over flange flush with nose of the bead and extending at least 75 mm onto surface of board. When dry, apply a thin coat of topping cement and blend onto adjoining surfaces.
- .4 Recess channels and trim: Secure recess channels and special metal trim to substrate. Provide casing beads full height on wallboard edges at recess channels and metal trim.

3.6 **JOINT TAPING, FINISHING**

- .1 Apply a coat of joint filler over board each side of joint and embed reinforcing tape. Cover edges of embedded tape with a thin coat of joint filler and complete joint with a final coat of topping cement feathered at least 200 mm each side of joint and cambered to a maximum thickness of 1.6 mm.
- .2 Fill any gaps between boards at internal corners with joint filler, allow to dry. Apply thin coat of joint filler over board 50 mm on each side of corner. Embed angularly creased reinforcing tape and cover edges of tape with a thin coat. Apply second coat over tape on one side of corner and allow to dry before covering tape on other side. Apply finish coat of topping cement.
- .3 Fill screw holes and depressions over each screw and nail head with joint filler/topping cement.
- .4 After topping cement has dried, sand surface lightly with No. 00 sandpaper and leave smooth, ready for painting. Apply second coat of filler if required.
- .5 Finish work smooth, seamless, plumb, true, flush and with square, plumb, neat corners.

- .6 Remove control joint "V" groove tape.

3.7 **JOINT TREATMENT OF BACKER BOARD - TILED AREAS**

- .1 Pre-fill joints of board with thin-set mortar and embed glassfibre tape. Press to a smooth finish. Allow to cure.
- .2 Provide control joint around ceiling perimeter, in addition to locations outlined earlier in this section.

3.8 **FINISHING**

- .1 Finishing shall conform to the following ASTM C840 finish levels:
 - .1 Level 0: For temporary construction.
 - .1 No taping, finishing or corner beads required.
 - .2 Level 1: Gypsum board in areas above ceilings, concealed spaces, service corridors and other areas not open to public view, and in areas where sound and smoke control is required.
 - .1 All joints and angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
 - .3 Level 2: Where water resistant gypsum backing board (ASTM C630) is used as tile substrate, in warehouse storage or similar areas where surface appearance is not a primary concern.
 - .1 All joints and angles shall have tape embedded in joint compound and have one separate coat of joint compound wiped with joint knife and leaving a thin coating over the tape and fastener heads. Cover accessories by one coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges shall be acceptable.
 - .4 Level 3: Gypsum board in areas to receive heavy or medium texture finishes before final painting or where heavy grade wall coverings are to be applied as the final decoration. Do not use where smooth painted surfaces or light to medium wall coverings are specified.
 - .1 All joints and angles shall have tape embedded in joint compound and two separate applications of joint compound over all joints, angles and fastener heads. Cove accessories with two separate coats of joint compound. Joint compounds shall be smooth and free of tool marks and ridges. Cover the prepared surface with a drywall primer prior to the application of the final decoration.
 - .5 Level 4: Gypsum board in areas where flat paints, light textures (or backed wall coverings) are to be applied. Adequately conceal joints and fasteners if wall covering material is lightweight, contains limited pattern, has a gloss finish or combination of these finishes.
 - .1 All joints and angles shall have tape embedded in joint compound and have three separate coats of joint compound over all joints, angles and fastener heads. Cover accessories with three separate coats of joint compound. All joint compounds shall be free of tool marks and ridges. Cover the prepared surface with a drywall primer prior to the application of the final decoration, and repair if required.

.6 Level 5: Where gloss, semi-gloss or non-textured flat paints are specified.

.1 Equal to level 4 and, in addition, apply a skim coat. Immediately shear off excess material leaving a film covering the paper. Cover the prepared surface with a drywall primer prior to the application of the final decoration.

3.9 **ACOUSTICAL CAULKING**

.1 Refer to Section 07 92 00 Joint Sealant.

3.10 **CUTTING, DRILLING AND PATCHING**

.1 Cut, drill and patch gypsum board as may be necessary to accommodate the work of other trades.

3.11 **PROTECTION BOARD**

.1 Neatly cut boards in straight line. Position in place and butt together in moderate contact with 3 mm gap between boards.

.2 Predrill and screw in place keeping a fastener distance of 19 mm from edge of board, and in accordance with manufacturer's directions.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 ASTM C920 - Standard Specification for Elastomeric Joint Sealants
.2 TTMAC - Terrazzo, Tile and Marble Association of Canada
.3 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **QUALITY ASSURANCE**

- .1 Retain a Subcontractor regularly engaged in installing ceramic tile for a minimum of five years, and whom has had a minimum of three successful installations of the type called for in this section, each at least three years old. Likewise Subcontractor shall be a member in good standing of the Terrazzo, Tile and Marble Association of Canada (TTMAC).
.2 Submit upon Consultant's request, documented evidence of compliance with the foregoing.

1.4 **SUBMITTALS**

.1 Submit in accordance with Section 01 33 00.

.2 Samples

- .1 Submit sample panels of each type, colour, texture, size and pattern of tile.
.2 Submit grout samples for approval by Consultant. Grout samples to match each tile colour, unless otherwise specified.
.3 Approved samples shall be used as minimum standard for all Work under this section and installed Work must match samples in every respect.

.3 Certification: Submit certification for each type of floor tile as follows:

- .1 Provide tile products manufactured and tested in accordance with ANSI A137.1 as appropriate to the Basis-of-Design Materials listed in this Section and on the Drawings.
.2 Slip Resistance: Provide materials having a minimum Dynamic Coefficient of Friction (DCOF) of 0.42 dry and, wet in accordance with ANSI A137.1 when tested using BOT 3000 Digital Tribometer or minimum 0.45 dry and wet in accordance with DIN 51130 with minimum R9 Class Slip Resistance.
.3 Certification shall have been conducted by a nationally recognized independent testing laboratory acceptable to the Consultant.

1.5 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials in adequate crates or containers with manufacturer's name and Product description clearly marked thereon.
- .2 Handle and store tiles in a manner to avoid chipping, breakage or the intrusion of foreign matter. Take precautions to protect the mortar and grout admixtures from freezing or from excessive heat.

1.6 **MAINTENANCE**

- .1 Upon completion of Work, deliver maintenance tiles in quantities equivalent to 5% to nearest full carton of each tiled wall and floor, including fittings, as required for Owner's future maintenance purposes.
- .2 Obtain maintenance tiles and fittings from the same production run as tiles and fittings installed. Put in heavy duty boxes and clearly label.

1.7 **MAINTENANCE GUIDE**

- .1 Submit four copies of TTMAC Maintenance Guide latest edition, for inclusion in the Owner's Maintenance Manual in accordance with Section 01 33 00. Give specific warning of any maintenance practice or materials which may disfigure the finished Work.

1.8 **WARRANTY**

- .1 Warrant Work of this section against defects and deficiencies for a period of two years from date Work is certified as substantially performed in accordance with the general conditions of the Contract.
- .2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective Work satisfactory to the Consultant and at no expense to the Owner.
- .3 Defects shall include but not limited to loss of bond, loosening, cracking, splitting, warping and deformations.

2 Products

2.1 **MATERIALS**

- .1 Material and colour schedule: Refer to finish schedule on Drawings. It must be noted that the finish schedule is for the purpose of establishing minimum standards for material types and/or colours for this Project. Except where specified otherwise, other Products are acceptable provided that the quality and/or colour represented in the schedule are fully matched to the approval of the Consultant.
- .2 Floor tiles: Porcelain ceramic tiles complete with trim fittings including bullnosed tiles for floors at doors where tile meets other finishes thinner than the porcelain tile, and 100 mm coved base units to match tiles. Types as follows:
 - .1 Floor (PFT-1):
 - .1 Through body unglazed porcelain tile.
 - .2 Colour: Mica, Matte.
 - .3 Size (s):
 - .1 PFT-1: 300 x 600 mm x 9 mm

- .2 PFT-1a: 150 mm x 150 mm x 9 mm
- .3 PFT-1b: 300 mm x 300 mm x 9 mm
- .4 Slip Resistance: DCOF- 0.50min. dry/wet in accordance with ANSI A137.1, when tested to BOT 3000 Digital Tribometer.
- .5 Manufacturer: Emotion by Division 9 (D9) or accepted equal
- .2 Floor (PFT-3): Match existing. Provide samples for selection by Consultant.
- .3 Washroom Floors (PFT-4):
 - .1 Through body unglazed porcelain tile.
 - .2 Colour: Cool porcelain white (200), Smooth (V)
 - .3 Size: 300 mm x 600 mm x 12 mm
 - .4 Slip Resistance: R10 in accordance with DIN 51130.
 - .5 Acceptable Manufacturer: Core Collection Terra by Mosa or accepted equal
- .3 Wall tiles: Glazed ceramic wall complete with trim fittings including integral coves, sanitary caps and beads. Types as follows:
 - .1 Washroom (CWT-1):
 - .1 Collection: Colour & Dimension.
 - .2 Size: 100 mm x 400 mm
 - .3 Colour: Artic White, Matte
 - .4 Acceptable Manufacturer: Olympia Tile or accepted equal.
 - .2 Walls (CWT-2): Match existing. Provide samples for selection by Consultant.
 - .3 Washroom Accent:
 - .1 Collection: Colour & Dimension.
 - .2 Size: 100 mm x 400 mm
 - .3 Colour: Taupe, Matte (CWT-3); Dark Grey, Matte (CWT-4)
 - .4 Acceptable Manufacturer: Olympia Tile or accepted equal.
- .4 Levelling coat: Latex liquid and factory mixed cement/powder.
 - .1 Daltile "Laticrete 3701/226"
 - .2 Mapei "Kerabond/Keralastic"
 - .3 Kiesel "Servoflex-Trio-Supertech": Flexible full transfer thinset and medium bed mortar
- .5 Waterproof membrane: Meeting ANSI 118.10 Specification for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation.
 - .1 Mapei "Mapelastic" with Mapei reinforcing mesh

- .2 Laticrete "9235"
- .3 Kiesel "DMS-1K Schnell SuperTech": Fast setting, one component, cement based waterproofing and sealing sleeves and strips
- .6 Wall waterproofing membrane
 - .1 8 mil thick, sheet applied polyethylene waterproofing membrane with polypropylene anchoring fleece laminated on both sides, conforming to ANSI 118.10 for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation.
 - .2 Seaming membrane: Provide 4 mil thick membrane for joints, seams and corners. Width as required for the installation.
 - .3 Accessories: Provide accessories as required for the installation or as recommended by manufacture.
 - .4 Product(s):
 - .1 Schluter "KERDI"
 - .2 or accepted equal
- .7 Crack suppressant membrane: Fabric or mesh reinforced, meeting TTMAC requirements.
 - .1 Mapei "Mapelastic"
 - .2 Laticrete "9235"
 - .3 Kiesel "DMS-1K Schnell SuperTech": Fast setting, one component, cement based waterproofing with sealing sleeves and strips
- .8 Setting Bed and Thin-set:
 - .1 Thin set liquid latex-portland cement mortar: Field mixed, high strength thin bed mixture of latex-additive portland cement-filler powder.
 - .1 For tiles 200 mm x 200 mm or less in size:
 - .1 Mapei "Kerabond/Keralastic"
 - .2 Laticrete "4237/211"
 - .3 Flextile "41/silica sand and cement"
 - .4 Kiesel "Servoflex-Trio-Supertech": Flexible full transfer thinset and medium bed mortar
 - .5 Schuler "All-Set" or "Fast-Set"
 - .6 Or accepted equal
 - .2 For tiles over 200 mm x 200 mm up to 300 mm x 300 mm in size:
 - .1 Mapei "Kerabond / Keralastic"
 - .2 Laticrete "4237 / 211"
 - .3 Flextile "53 / 44"

- .4 Kiesel "Servoflex-Trio-Supertech": Flexible full transfer thinset and medium bed mortar
- .5 Schuler "All-Set" or "Fast-Set"
- .6 Or accepted equal
- .3 For 330 mm x 330 mm tiles, use a full contact thin set mortar:
 - .1 Mapei "Ultracontact"
 - .2 Kiesel "Servoflex-Trio-Supertech": Flexible full transfer thinset and medium bed mortar
- .4 Polymer modified portland cement grout: Field mixed, high strength polymer modified portland cement/sand for floors; unsanded for wall applications. Colour to match tiles.
 - .1 Grout line width greater than 5 mm
 - .1 Mapei "Ultracolor Plus"
 - .2 Laticrete "Floor grout with 1776 additive"
 - .3 Flextile "PM 600 Grout"
 - .4 Kiesel "Servoflex F": Universal flexible, water and stain repellent grout
 - .2 Grout line width between 1.5 mm to 3 mm
 - .1 Mapei "Ultracolor Plus"
 - .2 Laticrete "Wall grout with 1776 additive"
 - .3 Flextile "PM 500 Grout"
 - .4 Kiesel equal.
- .9 Uncoupling Membrane
 - .1 3 mm thick, orange, high-density polyethylene membrane incorporating a grid structure of 12 mm x 12 mm square cavities cut back in dovetail configuration. Polypropylene fleece laminated to its underside of HDPE layer. Provide waterproofing seaming membrane for seams and corners: 0.1 mm thick, orange polyethylene membrane, with polypropylene fleece laminated on both sides.
 - .1 Accepted manufacturer: Schluter "Ditra" or accepted equal.
- .10 Edge protection and transition strips:
 - .1 (TH-4a): Anodized aluminum profile with textured, sloped exposed surface, tapered leading edge and integrated grout joint spacer. Transition strips shall form a smooth transition where tile abuts another flooring surface.
 - .1 Material and Finish: Satin Anodized Aluminum
 - .2 Height: 12.5 mm
 - .3 Ramp length: 64 mm.

- .4 Accepted manufacturer: Schluter "RENO-RAMP-K" or accepted equal.
- .2 (TH-5a): Ball-and-socket hinged profile with sloped exposed surface, tapered leading edge, integrated trapezoid-perforated anchoring leg and integrated grout joint spacer. Transition strips shall form a smooth transition where tile abuts another flooring surface.
 - .1 Material and Finish: Satin Anodized Aluminum
 - .2 Height: as required to coordinate with tile selection and setting system selected.
 - .3 Ramp length: as required.
 - .4 Accepted manufacturer: Schluter "RENO-V" or accepted equal.
- .3 (TH-6a): Transition between floorings of different heights, smooth profile.
 - .1 Material and Finish: Polished Brass
 - .2 Height: for elevation differences of 7.8 mm to 13.5 mm. Select height as required to coordinate with tile selection and setting system selected.
 - .3 Ramp length: as required.
 - .4 Installation method: self adhesive
 - .5 Accepted Manufacturer: Profilitec "Leveltec RPR" or accepted equal.
- .4 (TH-7a): Transition between floorings of different heights, smooth and grooved profile.
 - .1 Material and Finish: Stainless Steel Polished
 - .2 Height: for elevation differences of 3 mm to 14 mm. Select height as required to coordinate with tile.
 - .3 Length: as required.
 - .4 Installation method: pre-drilled with flathead screw
 - .5 Accepted Manufacturer: Profilitec "Leveltec RP" or accepted equal.
- .5 Transition for same-height, hard-surface floor coverings, installed in the existing joint cavity, overlapping adjoining surface materials. To be used in existing floors on both sides of the transition. Example: ceramic tile to ceramic tile, ceramic tile to VCT, etc.
 - .1 Material and Finish: Stainless Steel
- .6 Accepted manufacturer: Schluter "RENO-T" or accepted equal.Tile edge protection
 - .1 For outside corners and edges of walls: aluminum, L-shaped profile, integrated trapezoid perforated anchoring leg and integrated grout joint space. Finish: Anodized aluminum.
 - .1 Accepted manufacturer "Jolly" by Schluter as supplied by Centura or accepted equal

- .2 For floors: stainless steel, L shaped profile with 3.2 mm wide top edge visible surface, integrated trapezoid perforated anchoring leg, and integrated grout joint spacer.
 - .1 Accepted manufacturer: "SCHIENE by Schluter" or accepted equal
 - .11 Floor sealer and protective coating: Compatible with tiles installed as recommended by tile manufacturer, to protect tile from yellowing, powdering, scuffing, acid, alkalis, calcium chloride and detergent dulling.
 - .12 Use epoxy grout or approved grout sealer for all tiled floors.
 - .13 Prefabricated control and expansion joints: Provide "Movement Joint Profiles" by Schluter or approved alternative in styles and sizes to suit application and as approved by Consultant.
- 3 Execution
 - 3.1 **PREPARATION OF SURFACES**
 - .1 Ensure surfaces are thoroughly clean, dry and sound. Remove oil, wax, grease, dirt, paint, form release agent, and other foreign material that may impair proper tile bond to wall and floor surfaces. Use mechanical methods such as sanding for walls or bead blasting for floors.
 - .2 On surfaces to be waterproofed, prepare concrete substrate in accordance with waterproofing manufacturer's preparation standards.
 - .3 Ensure substrates are structurally sound, level and plumb, within a maximum tolerance of 3 mm in 2.4 m for vertical surfaces, and horizontal surfaces within a maximum tolerance of 6 mm in 3 m from finished levels of the surface, or better.
 - .4 Trowel apply a levelling coat on uneven surfaces, or surfaces which do not guarantee a plumb or level finish to the tile, at a minimum of 6 mm thick.
 - .5 Do not set tile on surfaces containing frost. Maintain temperature to a minimum of 10°C (50°F) during installation. Maintain temperature above freezing until mortar and grout have properly cured. The lower the temperature, the longer tile curing will take.
 - 3.2 **FLOOR CONTROL JOINTS**
 - .1 Clean control joints occurring in slab areas to receive tile and blow clean with compressed air. Use a vacuum to avoid spreading dust in areas to be tiled. Grout flush to slab with cement compound using same materials as specified for levelling coat.
 - 3.3 **TILE LAYOUT**
 - .1 Lay out Work to produce a symmetrical pattern with minimum amount of cutting. Ensure cut tile at room perimeter is not less than one-half full size.
 - 3.4 **WATERPROOFING MEMBRANE**
 - .1 Prepare substrate in accordance with waterproofing manufacturer's directions.
 - .2 Where tiles are to be installed in waterproofing system, apply system and tiles in accordance with manufacturer's recommendation.
 - .3 Ensure full, complete, and permanent bond. Build up system where necessary to ensure positive slope to drain.

- .4 Reinforce intersections, projections, openings, and other locations as required, with fine glass fibre mesh reinforcing.
- .5 Terminate membrane in reglets wherever possible, except for control joints and grout joints.
- .6 Apply with a trowel on prepared substrate to a total dry film thickness of 635 microns (25 mils) in accordance with manufacturer's directions. Carry up walls to 100 mm high.
- .7 In the case of reinforcing mesh or fabric, embed mesh or fabric while the first coat is fresh and apply a second coat on the mesh or fabric in accordance with manufacturer's written directions.

3.5 **INSTALLATION**

- .1 Mix thin set mortar and grout components to proportions and methods specified by mortar and grout manufacturer, to achieve maximum bond strength within the capacity of the mortar or grout.
- .2 Use mortar and grout within their pot life as specified by manufacturer.
- .3 For Tiles Less Than 200 x 200 mm In Size
 - .1 Apply mortar with a notched trowel using a scraping motion to work the material into good contact with surface to be covered. A trowel having notches approximately 4 x 4 x 4 mm is recommended. Back of tiles must have 95% mortar coverage.
 - .2 Apply only as much thin set mortar that can be covered within twenty minutes or while surface of thin set mortar is still fresh. Discard thin set mortar that has skinned over and apply fresh thin set mortar. Set tiles in place and beat with a small beating block as necessary to ensure a proper contact of the thin set mortar to the back of the tile and also to level the tiled surface. Align tile to show uniform joints and then allow to set until firm, refer to thin set mortar manufacturer's written instructions. Clean excess thin set mortar from surface of tile with a damp cloth or sponge while the thin set mortar is fresh.
- .4 For Tiles 200 mm x 200 mm or Larger
 - .1 Apply thin set mortar with the flat side of a notched trowel using a scraping motion to key in the mortar into good contact with surface to be covered. A trowel notches approximately 8 mm x 8 mm x 8 mm is recommended, comb in one direction. Back of tiles must have 95% mortar coverage.
 - .2 Install with back-buttering to achieve good adhesion.
- .5 Lay out Work so that fields are centred on areas, with no tiles of less than half-size used at room perimeter.
- .6 Maintain heights of panels in full courses to nearest indicated dimension.
- .7 Align joints of wall tile with floor tile.
- .8 Make joints between tile uniform, plumb, straight, true, even and with adjacent tile flush.
- .9 Provide fittings (base, wall caps and wall corner units) to complement tile system. Install edge protection at external vertical corners.

.10 Installation Methods

- .1 Tile on concrete floor slab: Install ceramic tile floor, base fittings with thin set mortar in accordance with TTMAC Installation Manual, Detail 311F, latest edition.
- .2 Tile on cementitious board ceilings in dry areas: Install ceramic tile with thin set mortar in accordance with TTMAC Installation Manual, Detail 315C, latest edition.
- .3 Tile on concrete or masonry walls: Install tile and fittings with thin set mortar in accordance with TTMAC Installation Manual, Detail 303W, latest edition. Install wall tile full height unless shown otherwise.
- .4 Tile on gypsum board walls in dry areas: Install ceramic tile and fittings with thin set mortar in accordance with TTMAC Installation Manual, Detail 304W, latest edition.
- .5 Tile on cementitious board walls in wet areas: Install ceramic tile and fittings with thin set mortar in accordance with TTMAC Installation Manual, Detail 305W, latest edition.
- .6 Tile on stairs: Install tile, fittings, and risers with thin set mortar in accordance with TTMAC Installation Manual, Detail 318S, latest edition.
- .7 Tile on wood subfloor in dry area: Install tile, fittings, and risers with thin set mortar in accordance with TTMAC Installation Manual, Detail 313F, latest edition.
- .11 Tile control joints: Provide 6 mm wide control joints in tiled floors where shown and directly over control joints in floor slab or masonry walls, in accordance with TTMAC Installation Manual, Detail 301MJ, latest edition. Apply sealant as specified.
- .12 Cut and fit tile neatly to piping, fittings, projections and around recesses for recessed washroom accessories. Where surface mounted equipment and accessories are to be installed on tiled surfaces, extend tile over surfaces. Make cut edges smooth, even and free from chipping. Chipped and broken edges are not acceptable.
- .13 Cut circular cutouts for pipe and drain penetrations by core drilling only.
- .14 If existing tiles, those to remain, are damaged during demolition and removal Work, provide new tiles to match existing tiles. Prepare substrate and install new tiles as specified for new Work of this Section.

3.6 **GROUTING**

- .1 Do not proceed with grouting until at least forty-eight hours after tile has set to prevent displacement of tiles.
- .2 Ensure grout is applied to the full thickness of the tile.
- .3 Force grout into joints in accordance with grout manufacturer's directions to produce watertight, filled joints without voids, cracks and excess grout. Finish flush to edge thickness of tile.
- .4 Do not grout internal corner intersections of wall tile.
- .5 Protect grouted work from traffic for minimum forty-eight hours. Epoxy grout will achieve chemical and stain resistance after ten days therefore protect Work against spills until curing period has lapsed.

3.7 SEALANT

- .1 Apply sealant around piping and fittings extending through tiled surfaces.
- .2 Apply sealant in tile control joints and in internal tile to tile joints.
- .3 Tool to a smooth, flush surface, free from air bubbles and contamination. Provide backer rod only where required to control depth of sealant.

3.8 UNCOUPLING MEMBRANE

- .1 Leveling of the subfloor must be done prior to installing uncoupling membrane.
- .2 Install uncoupling membrane to wood subfloor, concrete or vinyl floor in accordance with manufacturer's written instructions.
 - .1 For wood substrates, verify that subfloor panels are properly fastened to framing members
 - .2 For vinyl substrates, ensure that the structure is sound and adequate and well adhered. Remove wax and clean surface. For vinyl over wood structures, nail off floor with ring shank flooring nails every 4" (102 mm) o.c. Fasteners must pass through entire thickness of assembly with minimal penetration into joists.
 - .3 For concrete substrates, mechanically remove any waxy or oily films and curing compounds if present.
- .3 Install membrane in full bedding of thin set mortar. Roll membrane to ensure full and continuous adhesion to structure.
- .4 Movement Joints: construct expansion joints and control joints in accordance with TTMAC Detail 301MJ.

3.9 CLEANING

- .1 Clean off excess grout with soft burlap or sponge moistened with clean water.
- .2 After grouting has cured, clean and polish floor and wall tile. Clean in accordance with TTMAC recommendations for treating new work as specified in its "Maintenance Guide". Do not use acid for cleaning.
- .3 Apply two coats of sealer to unglazed ceramic floor in accordance with sealer manufacturer's printed directions.
- .4 Re-point joints after cleaning as required to eliminate imperfections. Avoid scratching tile surfaces.

3.10 PROTECTION ON COMPLETION

- .1 After completion, close tiled areas to traffic for a minimum period of seventy-two hours.
- .2 Cover Work temporarily with building paper properly lapped and taped at joints, or other protection, until the Work is accepted by Consultant.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- .2 This section specifies testing of concrete floor slabs to guarantee a suitable substrate to receive the floor finishes specified in Division 9. Perform and pay for the following:
 - .1 Moisture tests using calcium chloride quantitative test method
 - .2 Humidity tests
 - .3 Dew point tests
 - .4 pH tests
 - .5 Verify 28-day curing of concrete
 - .6 Coordinate HVAC requirements for testing purposes
 - .7 Notify all parties of test results

1.1 **REFERENCE**

- .1 Conform to the latest edition of the following:
 - .1 AODA - Accessibility for Ontarians with Disabilities Act

1.2 **QUALITY ASSURANCE**

- .1 Technicians: Individuals from a company engaged in the business of performing construction testing and inspection services of the type required by this section, for a minimum of two years within the past five years. Tasks involved include the following:
 - .1 Testing in accordance with specified ASTM testing standards.
 - .2 Keeping a record of testing inspection details.
 - .3 Coordination with floor finishes trades.
 - .4 Electronic reporting of test results to Consultant.

1.3 **APPLICABLE TESTING STANDARDS**

- .1 Perform tests in accordance with the latest edition of the following standards:
 - .1 ACI 302.2R-06 - Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials
 - .2 ASTM D4262 - Standard Test Method for pH of Chemically Cleaned or Etched Concrete
 - .3 ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by Plastic Sheet Method

- | | | |
|----|--------------------------|---|
| .4 | ASTM F710 | - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring |
| .5 | ASTM F1869 | - Standard Test Method for Measuring Moisture Vapour Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride |
| .6 | ASTM F2170 | - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes |
| .7 | ASTM F2420 | - Standard Test Method for Determining Relative Humidity on the Surface of Concrete Floor Slabs Using Relative Humidity Probe Measurements and Insulated Hood |
| .8 | CSA A23.1/A23.2 | - Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete |
| .9 | ICRI Guideline No. 03732 | - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays |

1.4 **SUBMITTALS**

- .1 Technicians' qualifications: Submit the following in accordance with Section 01 33 00:
 - .1 Confirmation of technicians' qualifications as specified.
 - .2 Confirmation of test method to be used.
- .2 Test Reports
 - .1 Submit to the Consultant, summary of tests leading to satisfactory results, prior to floor finish installation. Report to follow specified contents and format. No floor finish installation shall proceed without satisfactory test results reported to, and acknowledged by, the Consultant.

2 **Products**

2.1 **MATERIALS**

- .1 Not applicable

3 **Execution**

3.1 **FLOOR FINISHES SCHEDULE COORDINATION**

- .1 Coordinate testing with the schedule of floor finishes operations. Installation of finishes is predicated upon a concrete substrate that is suitable for installation of finishes as proven by satisfactory test results.

3.2 **SITE MEETING**

- .1 Prior to start of Work, attend a site meeting with the Construction Manager and Consultant, Contractor and Floor Finishes Subcontractors. Purpose of the meeting is to ensure familiarity with the requirements of the Work, common understandings reached, methodologies, relationships and protection of work criteria are understood.

3.3 TESTING

- .1 An appropriate environment is required during testing. Coordinate provision of HVAC during test periods.
- .2 Remove curing compound and/or sealer at test locations using hand-held grinders.
- .3 Perform moisture testing in accordance with ASTM F1869 methods. No alternative test methods accepted.
- .4 Follow ASTM standards for number and frequency of tests. At any rate, satisfactory test results must be representative of the total floor.
- .5 Perform relative humidity tests in accordance with ASTM F2170.
- .6 Perform pH testing in accordance with ASTM D4262 and ASTM F710.

3.4 REPORTING

- .1 All reports shall be prepared by the technician conducting the test, who shall affix his/her signature to the reports. The reports shall confirm compliance of the Work with the Contract Documents and be signed by the technician.
- .2 Report format shall be columnar, containing the information listed below, and, where applicable, contain notations of the specified standard or other reference covering the items to be tested.
- .3 Information required in the reports:
 - .1 Test location.
 - .2 Test method used (indicate passing result).
 - .3 Confirm surface for testing has been prepared.
 - .4 Start time and date of placing calcium chloride test.
 - .5 Relative humidity (RH) at start time.
 - .6 Ambient temperature (AT) at start time.
 - .7 Results after test period.
 - .8 Relative humidity (RH) at end of test.
 - .9 Ambient temperature (AT) at end of test.
 - .10 Satisfactory or unsatisfactory results. Repeat tests if results not satisfactory. Coordinate results with floor finishes trades.
 - .11 Observations or comments.
 - .12 Name and signature of technician; date report sent to Consultant.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **SUBMITTALS**

.1 Submit in accordance with Section 01 33 00.

.2 Product data: Submit manufacturer's Product data and confirmation of compliance to requirements specified herein.

.3 Samples

- .1 Submit two 300 mm x 300 mm sample plates of flooring system applied on smooth cement board.

- .2 Identify samples with Project name, date of submission, colour, manufacturer's name and Subcontractor's name.

1.4 **DELIVERY, STORAGE AND PROTECTION**

.1 Deliver materials to Site in manufacturer's sealed, labelled containers in sequence to meet building schedule. Carefully unload material and deliver clean and undamaged.

.2 Remove defective or damaged materials from the site and replace at no additional cost to Owner.

.3 Avoid damage to this Work by other trades during application and curing period, as Work proceeds and on completion of each area, install barricades and provide signage at all entrances. Barricades shall remain in place during the curing process.

.4 Store containers of components and other volatile materials in well ventilated places where they will not be exposed to excessive heat or direct sun rays. Keep tightly closed when not in actual use. Remove used cloths from building at the end of every working shift and when not in use, take precautions against spontaneous combustion by drenching with water or placing in air-tight covered metal containers in a cool place.

.5 Be responsible for prevention of fire or explosion caused by improper storage of materials, rags, emptied containers, etc. Vapours may be heavier than air and travel along floor and be ignited at locations distant from handling site and flash back. Post "No Smoking" signs in areas of storage and mixing and strictly enforce this requirement. Provide and maintain CO₂ or appropriate fire extinguishers of minimum 9 kg capacity. Repair damage to storage area or surrounding area at no cost to Owner.

.6 Place covers over adjacent work before surface preparation and coating commence and keep in place until Work is complete.

.7 Provide continuous ventilation and exhausting to exterior to convey fumes and vapours from Work area during coating application.

- .8 Read and be familiar with manufacturer's literature and MSD Sheets and comply with precautions, handling procedures and equipment requirements.
- .9 Use protective clothing and equipment as necessary to protect applicators during preparation and application.
- .10 Remove and dispose of waste material in accordance with federal, provincial and local safety codes.

1.5 **QUALIFICATION OF APPLICATOR**

- .1 This Work shall be done only by a Subcontractor trained, licensed and approved by the material manufacturer, or by tradesmen in direct employ of material manufacturer.

1.6 **WARRANTY**

- .1 Warrant Work of this section against defects and deficiencies for a period of five years from date Work is certified as substantially performed in accordance with the general conditions of the Contract.
- .2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective Work satisfactory to the Consultant and at no expense to the Owner.
- .3 Defects shall include but not limited to flooring showing loss of bond, cracking, deterioration or wear.

2 **Products**

2.1 **MANUFACTURERS**

- .1 Resinous Flooring System: solid colour, resin-rich, self-levelling, broadcast, Polyurethane / Cement floor screed system basis of Design:
 - .1 Sika Canada
 - .2 Products from the following manufacturers may be acceptable if they meet the requirements of this specification:
 - .1 Mapei
 - .2 Neogard

2.2 **MATERIALSS**

- .1 Screed Mortar: three components, solid colour, low odour, low VOC, matte finish polyurethane/cement screed.
 - .1 Applied Thickness: minimum 6 mm (1/4 in).
 - .2 Compressive Strength: 39 MPa (5,657 psi) at 28 days in accordance with ASTM C579.
 - .3 Tensile Strength: 6.51 MPa (944 psi) at 28 days in accordance with ASTM C307.
 - .4 Flexural Strength: 11 MPa (1,595 psi) at 28 days in accordance with ASTM C580
 - .5 Thermal Compatibility: Passes in accordance with ASTM C884.
 - .6 Indentation: ~0% in accordance with MIL-PRF-24613.

- .7 Abrasion Resistance: 0.10 g in accordance with ASTM D4060. (CS17/1000cycles/1000g).
- .8 Coefficient of Thermal Expansion: 4.32×10^{-5} mm/mm/°C (2.40×10^{-5} in/in/°F) in accordance with ASTM D696.
- .9 Bond Strength: 3.73 MPa (541 psi) with substrate failure in accordance with ASTM D4541.
- .10 Resistance to Fungi Growth: Rated 0 in accordance with ASTM G21.
- .11 Resistance to Mold Growth: Rated 10 in accordance with ASTM D3273
- .12 VOC Content: 5 g/L in accordance with ASTM D2369.
- .13 Basis-of-Design Product: Sika Canada Inc., Sikafloor® 22NA PurCem®; for sloped areas use PureCem20NA
- .2 Silica Broadcast Aggregates: Medium texture #32 (spherical) 0.3 – 0.85 mm
 - .1 Basis-of-Design Product: Bell & MacKenzie Co. Ltd.
- .3 Top Coat: three components, solid colour, high solids, low odour, low VOC, matte finish polyurethane /cement top coat:
 - .1 Applied Thickness: 254 µm (10 mils) w.f.t.
 - .2 Tensile Strength: 15.38 MPa (2,231 psi) in accordance with ASTM C307.
 - .3 Bond Strength: 4.55 MPa (660 psi) with substrate failure in accordance with ASTM D4541.
 - .4 Hardness: 81 Shore D in accordance with ASTM D2240.
 - .5 VOC Content: 5 g/L in accordance with ASTM D2369.
 - .6 Indentation: ~0% in accordance with MIL-PRF-24613.
 - .7 Abrasion Resistance: 0.08 g loss in accordance with ASTM D4060 (CS17/1000cycles/1000g).
 - .8 Basis-of-Design Product: Sika Canada Inc., Sikafloor® 31NA PurCem®.
- .4 Polyurethane/Cement Cove Mortar: three-component, solid colour, low odour, low VOC, vertical grade coving and detailing mortar with primer.
 - .1 Applied Thickness: minimum 6mm (1/4 in).
 - .2 Compressive Strength: 35 MPa (5,076 psi) at 28 days in accordance with ASTM C579.
 - .3 Tensile Strength: 3.89 MPa (564 psi) at 28 days in accordance with ASTM C307.
 - .4 Hardness: 85 Shore D in accordance with ASTM D2240.
 - .5 VOC Content: 5 g/L in accordance with ASTM D2369.
 - .6 Bond Strength: 3.0 MPa (435 psi) with substrate failure in accordance with ASTM D4541.

- .7 Resistance to Fungi Growth: Rated 0 in accordance with ASTM G21.
- .8 Resistance to Mold Growth: Rated 10 in accordance with ASTM D3273
- .9 Basis-of-Design Product: Sika Canada Inc., Sikafloor® 29NA PurCem® Coving and Detailing Mortar.
- .5 Provide all cleaning agents, cleaning cloths, sanding materials, and clean-up materials required per manufacturer's specifications.

3 Execution

3.1 **SURFACE PREPARATION**

- .1 Confirm presence of vapour retarder under the floor slab.
- .2 Comply with Section 09 60 10 - General Requirements for Floor Finishes. Be responsible for full compliance with such requirements and install flooring to stay in place without failure.
- .3 Mask all adjacent surfaces which could become marred or otherwise damaged.
- .4 Refer to the manufacturer's data sheet for preparing the surface for the specified system in Part 2.
- .5 Equip dry blasting equipment with a self contained vacuum to eliminate airborne dusting. Use portable blast cleaning equipment of a type similar to a wheelabrator "Blastrac" system.
- .6 Complete removal of dust and debris as soon as blast cleaning is completed by vacuum cleaning and magnetically brooming.
- .7 Concrete repairs: Repair deficiencies that have shown up in concrete surfaces after surface preparation has been completed. Remove any protruding steel reinforcing fibres which may interfere with or show through finished resinous floor.
- .8 At door openings provide sawcut across such openings. Remove concrete on surfacing side of sawcut by grinding, to provide smooth transition to adjacent floor elevation and provide full surfacing thickness through transition.
- .9 Where floor drains or other works penetrate through concrete sub-floor, carefully grind or chip out concrete around perimeter of such objects approximately 50 mm and sloping towards same objects to a depth of 13 mm. Overall slope established in sub-floor by concrete trade for drainage shall remain.
- .10 Prior to applying surfacing, mark locations of sawcut control joints required by system manufacturer. Apply surfacing then recut for sawcut control joints. Fill with grout or caulking flush with surface and as recommended by manufacturer.
- .11 Patching: Patch cracks, holes, joints and rough areas resinous patching materials. Patching material shall consist of 100% solids resinous mixed with a fumed silica to a paste consistency. Place patching materials as required using hand trowels or putty knives as recommended by manufacturer.

3.2 **MIXING**

- .1 Mix and prepare materials in compliance with manufacturer's standards for the particular material to be applied.

- .2 Clean containers used for storage, mixing and application of materials free of foreign materials and residue.

3.3 **PRIMER APPLICATION**

- .1 After preparation of concrete, mix and spread primer in accordance with manufacturer's instructions. Ensure areas show a continuous film of primer. Recoat sections of concrete which show complete absorption due to porosity.

3.4 **APPLICATION**

- .1 Prior to installation of flooring system, verify moisture content by non-destructive method.
- .2 Provide a uniform temperature of not less than 13°C (55°F) ambient during installation and for forty-eight hours following completion of the Work.
- .3 Apply flooring to 6 mm minimum thicknesses. Span wall to wall. Apply to a tightly compacted condition, and free from surface holes, depressions, trowel marks, ridges and swirls. At floor drain, place resinous flooring flush to top of drain and in chase provided, maintaining full surface thickness.
- .4 Install base 100 mm in height, thick. Cove internal corners; bullnose external corners to a minimum radius recommended by manufacturer, with the exception of the following.
- .5 Extend resinous floor coating up and on top of building perimeter curbs and up and on top of floor opening curbs.
- .6 Apply top coat and finish coats as recommended by the manufacturer.
- .7 Provide aluminum divider strips as required where resinous flooring butts to a flooring of different material. Install strips with adhesive recommended by divider strip manufacturer.
- .8 Overall finishes shall be non-slip but suitable for easy and thorough cleaning.

3.5 **SURFACE PROTECTION**

- .1 Protect Work of other trades in progress or completed against contamination and make good at own expense any such damage. Provide adequate covering by drop cloths, masking or tarpaulins to adjacent surfaces which are to be left as is or which are to receive a different flooring system.

End of Section

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1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

.2 Work of this section includes but is not necessarily limited to, the following:

.1 Exterior Painting

- .1 Heat and smoke vents
- .2 Fresh air and exhaust air hoods on roof
- .3 Hollow metal doors, transom panels and frames
- .4 Steel stairs, handrails, supports, ladders and cage
- .5 Pipe bumpers
- .6 Guard posts around PIV's
- .7 Steel window sash, sub-frames, mountings, rod bars
- .8 Sprayed masonry coating
- .9 Concrete block walls

.2 Interior Painting

- .1 Exposed building surfaces as indicated on Room Finish Schedule(s)
- .2 Overhead door frames, tracks, brackets, fenders and supplementary steel supports
- .3 Hollow metal doors, frames and transom panels
- .4 Fire doors and frames
- .5 Borrowed light frames
- .6 Glazed screen frames, mullions and closures
- .7 Exposed steel items for the work of all trades
- .8 Steel stairs, landings and railings
- .9 Pipe bumpers
- .10 Screens
- .11 Steel supports for wood benches
- .12 Wood fitments unless plastic laminated as noted
- .13 Natural gas piping
- .14 Finish painting of prime painted diffusers, registers and grilles
- .15 Conduit, piping, ductwork, lighting panels, etc. exposed to view in areas listed on the Room Finish Schedule

- .3 The following surfaces are not to be painted:
 - .1 Exterior concrete surfaces
 - .2 Concealed ceiling spaces and walls above gypsum wallboard ceilings and acoustic tile ceilings
 - .3 Surfaces scheduled as having "No Finish" in room finish schedules
 - .4 Exposed concrete floors
 - .5 Plywood backing panels in electrical, telephone and communication equipment rooms
 - .6 Stainless steel piping

1.2 REFERENCES

- .1 Department of Justice Canada
 - .1 Canadian Environmental Protection Act (CEPA).
- .2 Environmental Protection Agency (EPA)
 - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24, (for Surface Coatings).
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Master Painters Institute (MPI)
 - .1 MPI Architectural Painting Specifications Manual.
- .5 National Fire Code of Canada
- .6 Society for Protective Coatings (SSPC)
 - .1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.
- .7 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act (TDGA).
- .8 Accessibility for Ontarians with Disabilities Act (AODA), latest edition

1.3 QUALITY ASSURANCE

- .1 Qualifications
 - .1 Contractor: Minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.
 - .2 Journeymen: Qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.
 - .3 Apprentices: Working under direct supervision of qualified tradesperson in accordance with trade regulations.

- .2 Conform to the standards contained in the Master Painters Institute Architectural Painting Specification Manual, latest edition (hereafter referred to a MPI Painting Specification) for all painting procedures including preparation and application of materials. MPI Painting Specification Manual as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
- .3 All paint manufacturers and Products used shall be as listed under the "Approved Products" section of the MPI Architectural Painting Specification Manual.
- .4 All painting and decorating Work shall be inspected by a paint inspection agency (inspector) acceptable to the specifying authority and the local MPI Accredited Quality Assurance Association. The painting contractors shall notify the paint inspection agency a minimum of one week prior to commencement of Work and provide a copy of the Project painting Specification, plans and elevation drawings (including pertinent details) as well as a finish schedule.
- .5 All surfaces requiring painting shall be inspected by the paint inspection agency who shall notify the Consultant and Contractor in writing of any defects or problems prior to commencing painting Work or after the prime coat shows defects in the substrate.

1.4 **SUBMITTALS**

- .1 Product Data
 - .1 Submit Product data and instructions for each paint and coating Product to be used.
 - .2 Submit Product data for the use and application of paint thinner.
 - .3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS). Indicate VOCs during application and curing.
- .2 Samples
 - .1 Submit 200 x 300 mm draw-downs of each colour indicated on the Finish Schedule before painting is required.
 - .1 Colours shall match those specified in the Finish Schedules as indicated on Drawings and in this section.
 - .2 Submit sample panels/drawdowns of each paint and stain with clear coating with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
 - .1 3 mm plate steel for finishes over metal surfaces.
 - .2 50 mm concrete block for finishes over concrete or concrete masonry surfaces.
 - .3 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.
 - .3 Where colour availability is restricted, submit full range colour sample chips for Consultant selection.
 - .4 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

- .3 MPI Inspection
 - .1 Submit consent of surety with Bid submission as proof of ability to supply a 100% two year maintenance bond, if an MPI Accredited Assurance Association's guarantee option is not used.
 - .2 Submit list of all painting materials to the Consultant and the paint inspection agency for review prior to ordering materials.
 - .3 When requested, submit invoice list of all paint materials ordered for Project Work to paint inspection agency indicating manufacturer, types and quantities for verification and compliance with Specification and design requirements.
- .4 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturer's Instructions
 - .1 Submit manufacturer's installation and application instructions.
- .6 Closeout submittals: Submit maintenance data for incorporation into maintenance manual. Include following:
 - .1 Product name, type and use.
 - .2 Itemized list complete with manufacturer, Product number, paint type and colour coding for all colours used for Owner's later use in maintenance.
 - .3 MPI Environmentally Friendly classification system rating.

1.5 **DELIVERY, STORAGE AND HANDLING**

- .1 Packing, Shipping, Handling and Unloading
 - .1 Pack, ship, handle and unload materials to jobsite with containers and labels intact.
- .2 Acceptance at Site
 - .1 Identify Products and materials with labels indicating:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.
- .3 Remove damaged, opened and rejected materials from site.
- .4 Storage and Protection
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area with temperature range 7°C to 30°C (45°F to 86°F).

- .5 Store temperature sensitive Products above minimum temperature as recommended by manufacturer.
- .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
- .7 Remove paint materials from storage only in quantities required for same day use.
- .8 Fire Safety Requirements
 - .1 Provide one 9 kg fire extinguisher adjacent to storage area.
 - .2 Store oily rags, waste Products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
 - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.
- .9 Waste Management and Disposal
 - .1 Separate waste materials for reuse and recycling.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
 - .4 Separate for reuse and recycling and place in designated containers; steel, metal and plastic waste in accordance with WMP.
 - .5 Place materials defined as hazardous or toxic in designated containers.
 - .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, regional and municipal regulations.
 - .7 Ensure emptied containers are sealed and stored safely.
 - .8 Unused paint and coating materials must be disposed of at legal hazardous material collections site.
 - .9 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous Products and are subject to regulations for disposal. Information on these controls can be obtained from provincial Ministries of Environment and regional levels of government.
 - .10 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
 - .11 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
 - .12 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:
 - .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

- .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
- .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
- .4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.
- .5 Empty paint cans are to be dry prior to disposal or recycling (where available).
- .13 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

1.6

SITE CONDITIONS

.1 Heating, Ventilation and Lighting

- .1 Provide heating facilities to maintain ambient air and substrate temperatures above 10°C (50°F) for twenty-four hours before, during and after paint application until paint has cured sufficiently.
- .2 Provide continuous ventilation for seven days after completion of application of paint.
- .3 Coordinate use of existing ventilation system with Consultant and ensure its operation during and after application of paint as required.
- .4 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
- .5 Provide minimum lighting level of 323 lux on surfaces to be painted.

.2 Temperature, Humidity and Substrate Moisture Content Levels

- .1 Unless pre-approved written approval by Product manufacturer, do not perform painting when:
 - .1 Ambient air and substrate temperatures are below 10°C (50°F).
 - .2 Substrate temperature is above 32°C (90°F) unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
 - .4 The relative humidity is under 85% or when the dew point is more than 3°C (38°F) variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3°C (38°F) below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint Work.
 - .5 Rain or snow is forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

- .6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand "normal" adverse environmental factors.
- .2 Perform painting Work when maximum moisture content of the substrate is below:
 - .1 Allow new concrete and masonry to cure minimum of twenty-eight days.
 - .2 15% for wood.
 - .3 12% for gypsum board.
- .3 Test for moisture using calibrated electronic moisture meter. Test concrete floors for moisture using "cover patch test".
- .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
 - .3 Apply paint when previous coat of paint is dry or adequately cured.

1.7

GUARANTEE

- .1 Furnish either the local MPI Accredited Assurance Association's two year guarantee, or, alternatively, a 100% two year maintenance bond - both in accordance with MPI Architectural Painting Specification Manual requirements. The maintenance bond shall warrant that all painting Work has been performed in accordance with MPI Architectural Painting Specification Manual requirements.
- .2 All painting and decorating Work shall be in accordance with MPI Architectural Painting Specification Manual requirements and shall be inspected by the local MPI Accredited Quality Assurance Association's Paint Inspection Agency (Inspector), whether using either the MPI Accredited Quality Assurance Association's guarantee, or the maintenance bond option. The cost for such inspections, and for either the local MPI Accredited Quality Assurance Association's Guarantee, or the maintenance bond, shall be included in the Base Bid Price.
- .3 Painting and decorating Subcontractors choosing the maintenance bond option shall provide a maintenance bond consent from a reputable surety company licensed to do business in Canada. Cash or certified cheque are not acceptable in lieu of surety consent.

2

Products

2.1

MATERIALS

- .1 Refer to the Material and Finishes Schedule in the Drawings. It must be noted that the schedule is for the purpose of establishing minimum standards for material types and/or colours for this Project. Except where specified otherwise, other Products are acceptable provided that the quality and/or colour represented in the schedule are fully matched to the acceptance of the Consultant.

- .2 Paint materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.): As listed in the MPI Approved Products List (APL) are acceptable for use on this Project.
 - .1 Painting shall be premium grade.
 - .2 Provide paint materials for paint systems from one manufacturer.
- .3 Only qualified Products with E2 or E3 "Environmentally Friendly" rating are acceptable for use on this Project.
- .4 Conform to latest MPI requirements for exterior and interior painting Work including preparation and priming.
- .5 Shellac and turpentine: Highest quality Product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.
- .6 Provide paint Products meeting MPI "Environmentally Friendly" ratings based on VOC (EPA Method 24) content levels.
- .7 Use MPI listed materials having minimum E2 or E3 rating where indoor air quality (odour) requirements exist.
- .8 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:
 - .1 Water-based for concrete, concrete block and gypsum board
 - .2 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
 - .3 Manufactured without compounds which contribute to smog in the lower atmosphere.
- .9 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .10 All materials and paints shall be lead and mercury free and shall have low VOC content where possible.
- .11 All paint materials shall have good flowing and brushing properties and shall dry or cure free of blemishes or sags.
- .12 Where required, paints and coatings shall meet flame spread and smoke developed ratings designated by local code requirements and/or authorities having jurisdiction.

2.2 **COLOURS**

- .1 General: Colours for some elements to be painted are based on certain Product brands as indicated on the Drawings. Other Products may be used on the condition that colours selected by the Consultant must be matched at no extra cost even if it requires custom matching.

2.3 **PAINT MIXES**

- .1 Perform colour tinting operations prior to delivery of paint to site.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

- .3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .4 Thin paint for spraying in accordance with paint manufacturer's instructions.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 **GLOSS/SHEEN RATINGS**

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

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

2.5 **EXTERIOR PAINTING SYSTEMS**

- .1 Concrete, Concrete Block
 - .1 EXT 3.1A - Latex gloss finish
- .2 Structural Steel and Metal Fabrications: Exposed steel, pipe bollards
 - .1 EXT 5.1D - Alkyd semi-gloss finish.
- .3 Galvanized metal (not chrome passivated): Exterior miscellaneous metal, hollow metal doors and pressed steel frames, rooftop ducts, vents, and piping, as indicated and as specified.
 - .1 EXT. 5.3B - Alkyd semi-gloss finish
 - .2 For hot-dip galvanized surfaces, apply polyamine epoxy tie-coat in lieu of cementitious primer and apply alkyd topcoat.
- .4 Natural Gas Piping
 - .1 Paint surface of exterior natural gas piping
 - .2 EXT 5.1D - Alkyd, semi-gloss finish, yellow colour

2.6 **INTERIOR PAINTING SYSTEMS**

- .1 Concrete Vertical Surfaces
 - .1 INT 3.1C - Latex, semi-gloss finish.
- .2 Concrete masonry units: Concrete block:
 - .1 INT 4.2D - High performance architectural latex, semi-gloss finish.
- .3 Structural steel and metal fabrications: Exposed structural and miscellaneous metals
 - .1 INT 5.1C-DD - dry fall, water based acrylic, semi-gloss finish.

- .4 Galvanized metal (not chrome passivated): Doors, frames, ferrous metal pickets/railings, miscellaneous steel, pipes, exposed decking underside, and ducts
 - .1 INT 5.3K - water based acrylic, semi-gloss finish (over water based primer).
 - .2 For hot-dip galvanized surfaces, apply polyamine epoxy tie-coat in lieu of cementitious primer and apply alkyd topcoat.
- .5 Galvanized metal (not chrome passivated): Exposed decking underside, and ducts
 - .1 INT 5.3H- dry fall, water based acrylic, flat finish.
- .6 Gypsum board: Gypsum wallboard:
 - .1 INT 9.2B - High performance architectural latex, flat for ceilings; semi-gloss for walls.
- .7 Canvas and Cotton Coverings
 - .1 INT 10.1A - Latex, flat finish.
- .8 Interior of all Pipe Spaces and Ducts Visible Through Grilles, and all Surfaces Visible Through Louvres Occurring in Ceilings
 - .1 INT 10.1A - Latex, flat finish, black colour unless indicated otherwise.

Note: Prepare surfaces as required by applying proper primers on the surface to which paint is applied. For surfaces above ceilings, paint surfaces after all services have been installed and prior to ceiling installation.
- .9 Piping and Conduit (except gas piping)
 - .1 INT 5.1C-G5 - dry fall, water based acrylic, semi-gloss finish.
- .10 Natural Gas Piping
 - .1 INT 5.1C-G5 - INT 5.1C-G5 - dry fall, water based acrylic, semi-gloss finish, yellow colour
- .11 Fire Protection Piping
 - .1 INT 5.1C-G5 - dry fall, water based acrylic, semi-gloss finish, red colour.
- 3 Execution
 - 3.1 **MANUFACTURER'S INSTRUCTIONS**
 - .1 Compliance: Comply with manufacturer's written recommendations or specifications, including Product technical bulletins, handling, storage and installation instructions, and data sheet.
 - 3.2 **GENERAL**
 - .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
 - .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

- .1 Examine substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Consultant damages, defects, and unsatisfactory or unfavourable conditions before proceeding with Work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with Work until conditions fall within acceptable range as recommended by manufacturer.

3.4 PREPARATION

- .1 Protection
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed Consultant
 - .2 Protect items that are permanently attached such as fire labels on doors and frames.
 - .3 Protect factory finished Products and equipment.
- .2 Surface Preparation
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Consultant.
- .3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
 - .1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air, as appropriate for the given condition.
 - .2 Wash surfaces with a biodegradable detergent and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
 - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
 - .4 Allow surfaces to drain completely and allow to dry thoroughly.
 - .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
 - .6 Use trigger operated spray nozzles for water hoses.
 - .7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.

- .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.
- .6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1 m.
- .7 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast Products from surfaces, pockets and corners to be painted by brushing with clean brushes or other suitable means.
- .8 Touch up of shop primers with primer as specified.

3.5 **APPLICATION**

- .1 Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application
 - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray Application
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
 - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
 - .3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.
 - .4 Brush out immediately all runs and sags.
 - .5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.

- .4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish closets and alcoves as specified for adjoining rooms.
- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 **MECHANICAL/ELECTRICAL EQUIPMENT**

- .1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- .2 Boiler room, mechanical and electrical rooms: Paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 Other unfinished areas: Leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .5 Do not paint over nameplates.
- .6 Keep sprinkler heads free of paint.
- .7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .8 Paint fire protection piping red.
- .9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .10 Paint natural gas piping yellow.
- .11 Do not paint interior transformers and substation equipment.

3.7 **SITE TOLERANCES**

- .1 Walls: No defects visible from a distance of 1 m at ninety degrees to surface.
- .2 Ceilings: No defects visible from floor at forty-five degrees to surface when viewed using final lighting source.
- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.8 **RESTORATION**

- .1 Clean and re-install hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.

- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant.

3.9 **FIELD QUALITY CONTROL**

- .1 All surfaces, preparation and paint application shall be inspected by the paint inspection agency.
- .2 Painted surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the painting inspection agency inspector.
 - .1 Runs, sags, hiding or shadowing by inefficient application methods.
 - .2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
 - .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 wind-blown contaminants (dust, sand blast materials, salt spray, etc.).
- .3 Painted surfaces rejected by the inspector shall be made good at the expense of the Contractor. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 AODA - Accessibility for Ontarians with Disabilities Act
.2 TADG - Toronto Accessibility Design Guidelines

1.3 **SUBMITTALS**

- .1 Shop Drawings shall contain detailed description, and bear item numbers, marked to show quantity, colour, model numbers, fabrication details, and installation instructions. Submit in bound volumes.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver packaged materials in original, undamaged containers with manufacturer's labels and seals intact. Handle and store materials in accordance with manufacturer's and Supplier's recommendations to prevent damage thereto.

1.5 **PROTECTION**

- .1 Protect the 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.

2 Products

2.1 **ACCESSIBLE PUSH BUTTON MOUNTING POST/ BOLLARD (PEDESTAL)**

- .1 Push plate switch mounting post (bollards), 6" square post, 1/8" thick walls, molded ABS flame and impact resistant peaked cap, steel surface mounting base and heavy-duty anchor fasteners to secure to existing concrete. Provide in-ground concrete mounting base for new concrete. Posts shall be 42", 48" or 54" in height to accommodate standard push plate switch. Refer to hardware schedule.

.1 Surface Mounted, stainless steel or aluminum,

- .1 Model No. "CM-42" or CM-48" by Camden
.2 Model No. "BPS6" (42") by SDC
.3 Or accepted equal

.2 In-Ground Mounted, stainless steel or aluminum

- .1 Model No. "CM-42-IG" by Camden
.2 Model No. "BPG6" in-ground mount (54") by SDC, Security with Black HDPE mortise removable cap with secure transmitter mount.

- .3 Or accepted equal
 - .2 Mounting Post / Pedestal with 2 Preps: Surface mounted, concealed base with standard mounting bolts and welded angled top.
 - .1 Model No. B-4X6-AT-PCCLR-BP-2P (RT13) by Wikk or accepted equal
 - .2 Finish: Mill Aluminum Type 6063 T-5, Powder Coated Tiger Drylac, Anodized Silver or Jet Black.
 - .3 Size of pedestal: 102 mm x 152 mm x 1170 mm high. 3 mm thick wall.
 - .4 2 preps:
 - .1 1- Round Push Plate mounted at 900 mm AFF.
 - .2 1- Card reader or doorbell mounted at 1050 mm AFF.
 - .3 Mounting Post / Pedestal with 3 Preps to accommodate card reader, push button, and doorbell: Surface mounted, aluminum, concealed base with standard mounting bolts and welded angled top.
 - .1 Model B-4X6-AT-PCCLR-BP-3P (RT13) by Wikk or accepted equal
 - .2 Finish: Mill Aluminum Type 6063 T-5, Powder Coated Tiger Drylac, Anodized Silver or Jet Black.
 - .3 Size of pedestal: 102 mm x 152 mm x 1170 mm high. 3 mm thick wall
 - .4 3 preps:
 - .1 1-Round Push Plate mounted at 900 mm AFF, mounted on front of pedestal.
 - .2 1-Card reader at 1050 mm AFF, mounted on front of pedestal.
 - .3 1-Door Bell at 1050 mm AFF, mounted on pedestal side.
 - .4 Touch Panel Column Surface or Bollard Mounted
 - .1 Sturdy 1/8" extrusion with architectural finish, 628 aluminum (standard), 9"x6", 36"x6", Ingress-R.E.X Touch Panel Column, fully active
 - .1 Model No. 482AA9, 482AA36, blue infill, SPDT by SDC Security
 - .2 Or accepted equal
- 2.2 **PUSH PLATE SWITCH**
- .1 Narrow Push Plate Switch
 - .1 Heavy duty, surface or flush mount, all active switch, 18-gauge stainless steel or aluminum, concealed mounting screws. Refer to hardware schedule.
 - .1 "CM-25", CM-26" or CM-35 by Camden
 - .2 Square Push Plate Switch
 - .1 Heavy duty, surface or flush mount, all active switch, 4 1/2" faceplate, stainless steel or aluminum, tamperproof screws. Refer to hardware schedule
 - .1 "CM-45" or "CM-46" by Camden

.3 Round Push Plate Switch

.1 Heavy duty, surface or flush mount, all active switch, 18-gauge stainless steel faceplate. Stainless steel or aluminum, tamperproof screws. Refer to hardware schedule.

.1 "CM-60" by Camden.

2.3 **TOUCHLESS SWITCH**

.1 Wave Button: surface mounted, wired touchless / hands-free switch, built-in controls, stainless steel face plate, adjustable operating range, motion sensor for indoor and outdoor use. Refer to hardware schedule.

.1 "CM-331" by Camden

.2 Touchless Switch Restroom Kit: Surewave Touchless Restroom Control System. Refer to hardware schedule.

.1 "CX-WC16" by Camden

2.4 **TAPE SWITCH**

.1 Surface mounted, momentary contact, press at any point linear switch, clear encase impact-resistant and vandal resistant Lexan housing, actuation force of 5 lbs. Colour, text and graphics as indicated on the Drawings.

.1 "NexGen Tamper Resistant Switches" by Tapeswitch

.2 Or accepted equal

2.5 **EMERGENCY CALL SYSTEM**

.1 Emergency call kit for universal washroom, complete equipment package, audible and visual annunciation, push/pull mushroom button, instructional signage. Refer to hardware schedule.

.1 "CX-WEC10K2" by Camden

3 Execution

3.1 **INSTALLATION**

.1 Install miscellaneous specialties perfectly rigid in accordance with manufacturers' printed directions.

.2 After installation, test-operate and adjust operable parts as required for ease of operation.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- .2 Work includes, but is not necessarily limited to, the following:
 - .1 Sign graphics
 - .2 Cut-out letters
 - .3 Wall plates
 - .4 Door plates
 - .5 Number plates
 - .6 Barrier-free signage plates
 - .7 Signage at magnetic locked doors
 - .8 Project Information signage for public buildings

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- .2 ASTM B32 - Standard Specification for Solder Metal
- .3 ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
- .4 - Aluminum Association Designation System for Aluminum Finishes
- .5 CAN/CSA-G164 - Hot Dip Galvanizing of Irregularly Shaped Articles
- .6 CSA W47.2 - Certification of Companies for Fusion Welding of Aluminum
- .7 CSA W59-M - Welded Steel Construction (Metal Arc Welding)
- .8 CAN/CGSB-1.108 - Bituminous Solvent Type Paint
- .9 CGSB 41-GP-6M - Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced
- .10 CSA - Canadian Standards Association
- .11 CNIB - Canadian National Institute for the Blind
- .12 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **SUBMITTALS**

.1 Shop Drawings

- .1 Submit Shop Drawings in accordance with Section 01 33 00.
- .2 Submit Shop Drawings and catalogue sheets.
- .3 Indicate materials, thicknesses, sizes, finishes, colours, construction details, removable and interchangeable components, mounting methods, schedule of signs.
- .4 Submit full size templates drawn-to-scale details for individually fabricated (or incised) lettering indicating word and letter spacing.

.2 Samples

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit sample of each type sign, sign image and mounting method.

1.4 **QUALIFICATIONS**

- .1 Manufacturer of signs shall be specialist in this field having minimum five years proven experience in sign manufacturing and installation of each type of signs specified.

2 Products

2.1 **MATERIALS**

.1 Acceptable manufacturers:

- .1 Forward Signs Inc.
- .2 or accepted equal

.2 Source sign fabrication made by one manufacturer from one of the following:

- .1 Spectra Advertising
- .2 WSI Signage
- .3 Neon Products Ltd.
- .4 Steel Art Signs Ltd.
- .5 Imperial Sign Ltd.

.3 Aluminum extrusions: Aluminum Association alloy AA 6063-T5, minimum 2 mm thick, free from scratches and surface blemishes.

.4 Sheet aluminum: Aluminum alloy AA6063-T5, minimum 0.75 mm thick for exposed work requiring finish to match extruded Sections.

.5 Prefinished sheet aluminum: Plain sheet with manufacturer applied baked enamel finish to Aluminum Association designation AA-M22-C22-A41 (clear) or AA-M22-C22-A42 (black) 0.25 mm thick on face and 0.0076 mm thick on back.

- .6 Prefinished sheet steel: Conforming to Canadian Steel Sheet Building Institute Bulletin finished with Z275 zinc coating in accordance with CSSBI Standards and prepainted as follows:
 - .1 Finish: Coil coated, baked-on, 70% Kynar 500 or Hylar 5000 based fluoropolymer enamel, 10000 Series by Stelco Inc., or Dofasco Inc. on exposed surfaces as applied by Baycoat. Coil coated surfaces pretreated and primed prior to application of coating. Paint colour: As selected by Consultant.
- .7 Galvanized steel sheet: Commercial quality to ASTM A653/A653M, GRADE A, with zinc coating designation.
- .8 Acrylic sheet: Polymethylmethacrylate (PMMA) cast sheet suitable for intended use in sign fabrication, colours as indicated.
- .9 Engraving sheet: Lamicoid 3.2 mm thick plastic sheet, black or white core.
- .10 Welding materials: To CSA W59.
- .11 Solder: To ASTM B32.
- .12 Self-stick foam tape: Minimum 1.6 mm thick, 352.4 kg/m³ density polyurethane open-cell foam tape for sign purposes, with synthetic self-stick adhesive on both sides. Width to suit sign sizes.
- .13 Adhesives, paints, sealants and solvents for acrylic.: Type recommended by sheet manufacturer for applicable condition.
- .14 Acrylic topcoat: Clear, non-yellowing, exterior grade, satin finish, acrylic polyester resin protective coating, compatible with acrylic or metal surface of type recommended by sheet manufacturer.
- .15 Bituminous paint: To CAN/CGSB-1.108, Type 2.

2.2 **FINISHES**

- .1 Anodized Aluminum
 - .1 Clear finish: Conform to Aluminum Association designation AA-M22-C22-A41 in uncoloured anodized finish with film thickness of 0.25 mm.
 - .2 Colour finish: Conform to Aluminum Association designation AA-M22-C22-A42 to match sample.
- .2 Galvanized finish: On irregular shaped articles, 600 g/m² zinc coating to CAN/CSA G164.
- .3 Chrome and nickel plating: To ASTM B456, satin finish.
- .4 Prefinished metals: As specified herein.

2.3 **GENERAL FABRICATION REQUIREMENTS**

- .1 Fabricate signs in accordance with details on Drawings, Specifications and Shop Drawings to present a safe and rigid installation.
- .2 Build units square, true, accurate to size, free from visual or performance defects.
- .3 Accurately fit and securely join sections to obtain tight, closed joints.
- .4 Allow for thermal movement without distortion of components.

- .5 Do not use exposed fasteners unless indicated otherwise on Drawings, and shall be inconspicuous and same finish and colour as base metal on which they occur.
- .6 Polish exposed edges of plastic and metal to smooth, slightly convex profile.
- .7 Do steel welding to CSA W59 aluminum welding to CSA W47.2 Finish exposed welds flush and smooth.
- .8 Brush-apply bituminous paint to aluminum in contact with dissimilar metals, concrete or masonry.
- .9 Do not locate manufacturer's nameplates on sign surfaces visible in completed work.
- .10 Letters shall be as indicated otherwise on Drawings, and be clear cut and free from ragged or indistinct edges.

2.4 **SIGN GRAPHICS**

- .1 Sign graphics to be well defined, arranged for balanced appearance, and properly word- and letter-spaced. Acceptable manufacturers for computer cut graphics:
 - .1 System Graphics
 - .2 Alpine Graphics Productions
 - .3 Autograph Trim
 - .4 Canada Decal Inc.
- .2 Silk screen process: Apply colour photographic produced silk screen printed images to face of sign.
- .3 Self-stick vinyl film: Individual letters, numerals and symbols cut from 0.1 mm thick matte finish, exterior grade PVC film, with self-stick adhesive backing. Colour selected by Consultant from manufacturer's standard range.
- .4 Decals: Silk screened or printed images on minimum 0.025 mm, clear matte finish, PVC film, with self-stick adhesive backing. Protect image subject to abuse with laminated film overlay of same material as decal base.

2.5 **WALL PLATES**

- .1 Plastic Wall Plates
 - .1 Fabricate from (clear) (colour) (acrylic sheet) (fibreglass) minimum 3.2 mm thick. Sizes as indicated.
 - .2 Sign graphics: Apply by silk screen or self-stick vinyl film letters.
- .2 Metal Wall Plates
 - .1 Fabricate from (aluminum sign plates, minimum 3.2 mm thick, with clear finish. Sizes as indicated.
 - .2 Sign graphics: Apply by silk screen or self-stick vinyl letters.
- .3 Interchangeable mounting: Supply wall plates with semi-concealed, retaining holders that permit quick but vandal-resistant interchange of sign face. No exposed fasteners permitted. Exposed portions to match sign face.

- .4 Fixed mounting: Prepare wall plates for fixing by self-stick foam tape. Include back-up plates for fixing to uneven surfaces where required.
- .5 Bracket mounting: Fabricate brackets for wall projecting or as detailed.

2.6 **DOOR PLATES**

- .1 Fabricate sign faces of acrylic sheet. Sizes and thickness as indicated on Drawings.
- .2 Sign graphics: Apply by silk screen or self-stick vinyl letters.
- .3 Interchangeable mounting: Supply door plates with semi-concealed, retaining holders that permit quick but vandal-resistant interchange of sign face. No exposed fasteners permitted. Exposed portions to match sign face.
- .4 Fixed mounting: Use self-stick foam tape.
- .5 Mounting on transparent surfaces: Use self-stick foam tape. Include blank back-up plate for opposite side.
- .6 Washroom pictographs: Cut-out figures without backgrounds

2.7 **BARRIER-FREE SIGNAGE PLATES**

- .1 3D-graphics signs for the visually impaired, the Barrier-Free Act, building codes and CNIB and CSA recommendations. Minimum description:
 - .1 Raised letters, Grade 1, Braille and graphics system on injection moulded acrylic, styrene or polycarbonate substrate and protected with a non-glare, matt finish.
 - .2 Double sided tape mounting.
 - .3 Colours as selected by the Consultant.
- .2 Washroom Door
 - .1 Tactile type universal male or female symbol and a universal barrier-free symbol on a dark coloured high square. Size and colour as indicated on Drawings.
 - .2 Braille signs under the universal symbols, within the square.
 - .3 Tactile type bilingual text (Men-Hommes) or (Women-Femmes).
- .3 Stair Shaft
 - .1 The sign is to be multi-layer process consisting of substrate, laminating adhesive, background film, profile film, test film and top film.
 - .2 Location: Mounted on wall on the latch side of doors leading to stair shafts.
- .4 Handrails
 - .1 150 mm long high contrast handrail wayfinding sign with Braille and 25 mm wide hazard strip on either side of the sign to be 200 mm in total length indicating the stair number and floor/level number.
 - .2 Location: On centre within the extension piece of the handrail.
 - .3 Colour: as indicated on Drawings.

- .4 Acceptable Manufacturer:
 - .1 Atec Signs Inc.
 - .2 or accepted equal.

2.8 **SIGNAGE AT MAGNETIC LOCKED DOORS**

- .1 Aluminum plate with the following text engraved in Helvetica typeface, 25 mm high: "EMERGENCY EXIT, UNLOCKED BY FIRE ALARM".
- .2 Paint plate with one colour. Paint engraved text with a contrasting colour. Paint to be baked enamel finished.
- .3 Colours as selected by Consultant.

2.9 **PROJECT INFORMATION SIGNAGE FOR PUBLIC**

- .1 Refer to Section 10 14 00.01 City of Toronto Construction-Improvement Signs for information on the standard template to be used for projects accessible to the public.

3 Execution

3.1 **INSTALLATION**

- .1 Erect and secure signs plumb and level at elevations.
- .2 Comply with sign manufacturer's installation instructions and approved Shop Drawings.
- .3 Mechanical Attachment
 - .1 Apply signage to concrete or solid masonry with lag screws and expansion bolts or screws.
 - .2 Apply to hollow masonry with toggle bolts or equivalent.
 - .3 Secure behind stud walls or above ceilings into framing members.
 - .4 Mechanical fasteners shall be non-staining, non-ferrous type.
 - .5 Fabricate special fasteners as required for installation conditions.
- .4 Adhesive attachment: Use self-stick adhesive foam tape to manufacturer's instructions to adequately fix sign and prevent "rocking". Keep tape maximum 1.6 mm from edges.

3.2 **CLEANING**

- .1 Leave signs clean and polish all exposed surfaces.
- .2 Touch up any damaged finishes.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- .2 Work includes, but is not necessarily limited to, the following:
 - .1 Field-verify dimensions and site conditions at sign locations; engineer signs and sign foundations; provide electrical hook-up to illuminated signs where needed; and provide fastenings for attachment and installation of all signs where needed.
 - .2 Coordinate with Owner and other trades as required for completing the Work.
 - .3 Installation shall include unloading, receiving and handling, storing, relocating, uncrating, inspecting, cleaning and assembly, testing and adjusting sign units into final locations.
 - .4 Installation of all work shall be completed according to deadlines determined by Owner's Representative.

1.2 **REFERENCES**

- .1 Conform to the latest edition of the following:
 - .1 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **GENERAL REQUIREMENTS**

- .1 Provide all materials, labour, equipment, and services to furnish and install the complete sign package.
- .2 The new signs shall have internally illuminated logo and letters electrically controlled by a photocell, in the case of primary and secondary Identification signs, or applied vinyl in the case of other identification signs and guide, information, orientation and regulation signage.
- .3 The Owner's logo shall be done using the colour of Akzo/Nobel Blue ATO-208 and the colour shall match the Owner's previously selected colour shades and utilize the Owner's standard fonts and text as specified in the Design Intent Drawings.
- .4 All signs shall meet the local governing sign ordinances, including those addressing content, anchorage and weather durability.
- .5 Extent of the signage and graphics is shown on the Drawings and in the appendix. Quantities of required signs shall be per scheduled in message schedule unless revised by Owner.
- .6 Symbols shall be as specified by the United States Department of Transportation (DOT) and the American with Disabilities Act (ADA).
- .7 Forms of signage shall include site identification, directional and regulatory, and parking area/space identification.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver signs and mounting hardware to Site packaged to prevent damage and marked for easy identification.
- .2 Store materials in clean, dry location protected from damage and stored horizontal and flat to prevent warping. Replace damaged materials at no added cost to the Owner.

1.5 QUALITY ASSURANCE

- .1 Materials and workmanship shall be new and of the best grades of their kind for their specified purpose.
- .2 The term "or as approved" shall mean a material and/or method approved by the Architect-Engineer as equal to those named in Specifications.
- .3 Contractors who wish to bid on a material or method assumed "equal" to those specified must submit a written request including supporting technical data with their bid.
- .4 Sign units shall be engineered to be rigid, without buckling of any member, failure of any points, distortion, or other damage. Joints shall be weathertight and vandal proof.
- .5 Joints in members shall be internally aligned and shall provide for thermal expansion and contraction. Exposed corners of frames shall be mitered and welded, with sharp ninety degree corners, unless otherwise specified. Joints and seams shall be filled and ground smooth so as not to be visible on the finished sign.
- .6 Welding shall conform to applicable AWS standard and shall be free of defects. Welding shall be done prior to finishing. Aluminum-to-aluminum joints on the exterior of a sign shall be continuous heli-arc welded and finished smooth.
- .7 Exterior signs shall be engineered to be rigid and withstand movement, shear and torsion loads. Exposed areas of sign shall not oilcan. Sign shall withstand wind load of 30 pounds per square foot (psf) without permanent malformation or damage, or a higher wind load as specified by applicable local ordinances.
- .8 Use only personnel thoroughly skilled and experienced with the Products and method for fabrication and installation of signage specified. Work done and materials furnished shall be first class in every respect and, unless otherwise specified, materials and equipment shall be new and of the latest design.

1.6 ELECTRICAL WORK

- .1 Electrical Work shall bear the label of Underwriters Laboratories, Inc. (UL) approval.
- .2 Electrical fixtures and assemblies shall meet UL requirements and be installed in accordance with National Electrical Code (NEC) standards.
- .3 The Owner will be responsible for providing a power source to the base of each sign requiring power. The Owner will identify main trunk lines from which electrical power may be pulled. Power to be 120/240 volts at 60 cycles unless otherwise noted in the documents.
- .4 It is the responsibility of the Sign Contractor to provide required illumination and electrical connections, manipulate the existing conduit to its proper location, install an external disconnect, extend the conduit through the concrete base to align with the point of hookup, run the power supply through it and hook up the sign. Conduit running from the disconnect switch to the sign shall travel within the concrete base, not on its surface.
- .5 The Contractor shall coordinate with Division 26 Specification sections and Drawings.

1.7 **FIELD MEASUREMENTS**

- .1 Take field measurements where required to verify or supplement dimensions indicated and be responsible for accurate fit of the work.

1.8 **UTILITIES AND SERVICES**

- .1 Protect existing utilities and services within and adjacent to area of Work, from damage while performing the Work.
- .2 If utilities or services are uncovered that are not indicated on the Drawings, advise Owner and do not work in the immediate area until instructed by the Owner.

1.9 **EARTHWORK**

- .1 Backfill excavations as promptly as work permits.
- .2 Repair and re-establish grades where damaged during demolition and installation.

1.10 **SUBMITTALS**

- .1 Drawings: Submit Shop Drawings for fabrication and installation of the signs. Include plans, elevations, and typical large-scale details of construction, sign working and lettering layout. Show anchorages and accessory items. Furnish location template Drawings for items supported or anchored to permanent construction.
- .2 Samples: Submit samples/prototypes for verification of the following:
 - .1 Two samples of each specified sign colour, paint and vinyl, for colour verification, 100 mm x 100 mm minimum size.
 - .2 Two samples of Casocryl Black'n White acrylic sheet, 100 mm x 100 mm minimum size.
 - .3 Two samples of ACM Alucobond with silver metallic A 3001-DXLE finish.
- .3 Submit within ten days following approvals, a final schedule of fabrication and installation and total completion.
- .4 Submit two copies of maintenance and instructional information for use by the Owner. Information shall describe proper maintenance such as cleaning and touch-up, and shall include guarantees, special warranties and replacement data. Manufacturer brochures describing the material used in the Work shall also be furnished. This shall include finish paint formula and manufacturer's numbers, etc.
- .5 All submittals shall be sent to the Architect-Engineer through the Owner's Representative per Division 1 requirements.
- .6 Submit Product data for lamping/lighting fixtures.

1.11 **WARRANTY**

- .1 Provide a written five year full replacement warranty to the Owner that all signage will be free of defects due to workmanship or materials including but not limited to fading, peeling, de-lamination, and installation.
- .2 During the Warranty Period, the Contractor agrees to restore defective Work to the standard of the Contract Documents without cost to the Owner, including materials and labour.

- .3 Lamps and light fixtures shall be warranted a minimum of one year from final approval against failure of operation. If a unit becomes defective within this time period it shall be replaced at no cost to Owner.
- .4 Joints in acrylic plastic construction shall be warranted for five years against failure or delamination. If unit becomes defective within this time period it shall be replaced at no cost to the Owner.
- .5 Vinyl die-cut letters shall be warranted for five years against delamination from substrate.
- .6 All warranties shall begin on the date of the Owner's final acceptance of the Work.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Forward Signs Inc.
- .2 Approved alternative

2.2 **ADHESIVE VERY HIGH BOND TAPE**

- .1 Double-coated high bond acrylic tape for joining of sign units, of thickness needed to achieve maximum adhesion with minimum visibility.
- .2 Acceptable manufacturers:
 - .1 Graphtec Industries
 - .2 3M Co.

2.3 **ALUMINUM**

- .1 Aluminum sheet: Provide aluminum sheet of alloy and temper recommended by the aluminum producer or finisher for the type of use and finish indicated, and with not less than the strength and durability properties specified in ASTM B 209 for 5005-H-15.
- .2 Aluminum extrusions: Provide aluminum extrusions of alloy and temper recommended by the aluminum producer or finisher for the type of use and finish indicated, and with not less than the strength and durability properties specified in ASTM B 221 for 6063-T5.
- .3 Filler metal for welding aluminum shall be the alloy recommended for each application by the manufacturer of aluminum alloy.
- .4 Aluminum shall be separated from direct contact with concrete and metals other than stainless steel, zinc, cadmium or nickel bronze, by painting contact surfaces with zinc chromate primer and aluminum paint or with a coat of heavy-bodied bituminous paint or by non-absorptive tape or gasket.

2.4 **ANCHORS AND INSERTS**

- .1 Use non-ferrous metal inserts for interior installations. Furnish inserts, as required, to be set into masonry Work.

2.5 **FASTENERS**

- .1 Unless otherwise indicated, use concealed fasteners fabricated from metals that are non-corrosive to either the sign material or the mounting surface.

2.6 **CEILING SUSPENSION CABLING**

- .1 Follow manufacturer recommendation.

2.7 **PLASTICS**

- .1 Cast acrylic sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thickness indicated, with a minimum allowable continuous service temperature of 80°C (176°F), and of the following types.
- .2 Transparent sheet: Where sheet material is indicated as “clear” provide colourless sheet in matte finish, with light transmittance of 92%, when tested in accordance with the requirements of ASTM D 1003.
- .3 Acceptable Manufacturer (Transparent Sheets)
 - .1 Plexiglass (Rohm and Haas Co.)
 - .2 Lexan (General Electric Co.)
- .4 Opaque plastic sheet: ABS sheet, in thickness indicated, with lightly textured surface. Polyvinylchloride (PVC) sheet, expanded low-density closed cell material with smooth flat surfaces.
- .5 Acceptable Manufacturer (Opaque Sheet)
 - .1 Alucobond Technologies Inc.
 - .2 Architect-Engineer approved equivalent.

2.8 **VINYL FILM**

- .1 Provide opaque non-reflective, vinyl film, 2 mil minimum thickness, with pressure sensitive adhesive backing, suitable for interior applications.
- .2 Legends shall securely adhere when subjected to any temperature within the range of -34°C to +93°C (-30°F to +200°F) and shall not crack, chip or peel voluntarily.
- .3 Shrinkage of letters shall not exceed 0.4 mm in any direction.
- .4 Acceptable Products are:
 - .1 3M's Scotchcal
 - .2 Avery Dennison's "Fasson 1000 series Premium Vinyl

2.9 **CONCRETE**

- .1 Concrete Work shall conform to applicable ACI codes and standards in conformance with the requirements of Section 03 30 00.
- .2 Concrete Work for sign foundations shall be 3000 psi mix, air entrained in conformance with the requirements of Section 03 30 00. Concrete shall be vibrated during the pour to adequately distribute aggregate and eliminate air pockets or other surface imperfections. Exposed concrete shall be smooth finish, without form marks or discolouration. Exposed edges shall be even.
- .3 Metal reinforcement shall be steel bars or wire as engineered by the sign fabricator and as shown on the Shop Drawings.

- .4 Install inserts as required for anchorage of sign units and cast in conduit as indicated, in conformance with the requirements of Section 03 30 00.

2.10 **ALUCOBOND**

- .1 Provide Alucobond signs or Owner-approved equivalent Aluminum Composite Material (ACM) of specified thicknesses and finishes where specified or shown on Drawings.
- .2 Alucobond material manufactured by Alcan Composites USA, Inc. 208 West 5th Street Benton, KY 42025 (800 626-3365 270 527-4200). Items of the same function and performance, which have received prior approval from the Owner, shall be allowed for this Project. Approval shall be based on documentation submitted showing adequacy of the material.
- .3 Thickness 3 mm sheet. All cut ACM edges to be covered and smooth. All surfaces are to be smooth. All joints to be uniformed.
- .4 Finish to be silver metallic, #A3001-DXLE with a ten (10) year coating warranty for outdoor weather exposure at forty-five degree angle facing south Florida exposure. Maximum colour change of 5 Delta E units as calculated in accordance with ASTM D 2244. Maximum chalk rating of eight in accordance with ASTM D 4214. No checking, crazing, adhesion loss.
- .5 Plans, elevations, details, characteristics, and other requirements indicated are based upon standards by one manufacturer. It is intended that other manufactures, receiving prior approval, may be acceptable, provided their details and characteristics comply with size and profile requirements, and material/performance standards.
- .6 Fasteners (concealed/non-corrosive): Fasteners as recommended by panel manufacturer. Do not expose fasteners.
- .7 Install panels plumb, level and true. Anchor panels securely per engineering recommendations and in accordance with approved Shop Drawings to allow for necessary thermal movement and structural support. Do not install component parts that are observed to be defective, including warped, bowed, dented, abraded, or broken members. Do not cut, trim, weld, or braze component parts during erection in a manner which would damage finish, decrease strength, or result in visual imperfection or a failure in performance. Return component parts that require alteration to shop for re-fabrication, if possible, or for replacement with new parts. Separate dissimilar metals and use fasteners with gaskets where needed to eliminate the possibility of corrosive or electrolytic action between metals.
- .8 Remove masking (if used) as soon as possible after installation. Masking intentionally left in place after panel installation shall become the responsibility of the Owner. Make sure weep holes and drainage channels are unobstructed and free of dirt and sealants.

2.11 **ICETRON**

- .1 ICETRON manufactured by Osram Sylvania, 18725 N. Union Street, Westfield, IN 46074 (Phone 800 762-7191, Canada 800 265-2852) Items of the same function and performances, which have received prior approval from the Owner shall be allowed for this Project. Approval shall be based on documentation submitted showing adequacy of the Product.
- .2 System shall be 150W ICETRON inductively coupled electrodeless lamp and ballast system (or Owner-approved equivalents) having 12,000 rated lumens. System shall have an average rated life of 100,000 hours.

- .3 System and components shall be covered for up to sixty months (five years) with a comprehensive system warranty on ICETRON lamp and QUICKTRONIC ballast systems (or Owner-approved equivalents). The warranty is valid for lamp operation cycles up to, and including, continuous operation.

- .4 Hardware

- .1 Hardware shall be as required by manufacturer. Use stainless steel and aluminum tamper-proof nuts, bolts and screws. Mountings shall be of such a material as to prevent anodic/cathodic corrosion. Where different metals would otherwise meet (i.e. steel and aluminum), the surface of one metal must be primed and painted to prevent direct contact with the other.

2.12 **ACCEPTABLE MANUFACTURERS**

- .1 Acceptable manufacturers are:

- .1 A. S. I. Sign Systems
 - .2 APCO Company
 - .3 Andco Industries, Inc.
 - .4 System 2/90
 - .5 Visual Entities
 - .6 Howard Industries

2.13 **FABRICATION**

- .1 The work shall be shop fabricated.
- .2 Sign content, including messaging, must be provided to the Owner and approved by the Owner before signage is fabricated.
- .3 Fastenings shall be concealed where possible. Exposed fastenings shall occur only where concealed fastenings are not specified and shall be finished to match the surrounding surface.
- .4 Touch-up of artwork for photographic enlargement, and quality of artwork for finished signage shall be the responsibility of the Contractor. The Owner reserves the right to reject artwork if it fails to meet the standards of quality established.
- .5 Edges and corners of finished letter forms and symbols shall be photographically precise, crisp, clean; tick marks, rounded corners, discontinuous curves, line wave, cut or ragged edges, edge build-up, bleeding, surface pinholes or other imperfections will not be accepted.
- .6 Letterforms and symbols shall be aligned to maintain a base line parallel to the sign format. Letterforms and symbols shall conform to the prescribed letter from proportions.
- .7 Message copy, unless otherwise specified, shall be GM sans regular and bold as indicated. Alternate letterforms shall not be accepted. Message copy colours shall be as indicated on the Drawings.
- .8 Message copy on Drawings is for layout purposes. Actual copy for signs shall be as scheduled.

- .9 Fabrication of acrylic plastic sheet shall be in accordance with approved Shop Drawings and with techniques and recommendations of the manufacturer.
- .10 Remove protective paper from acrylic sheet only as required during fabrication. Exercise care in handling and fabrication to avoid scratching, chipping or crazing of the acrylic plastic sheet.
- .11 Panel signs: Fabricate panel signs to comply with the requirements indicated for materials, thickness, finishes, colours, designs, shapes, sizes and details of construction. Produce smooth, even, level sign panel surfaces, constructed to remain curved or flat (as specified in the Design Intent Drawings) under installed conditions within a tolerance of plus or minus 1.5 mm measured diagonally.
- .12 Brackets: Fabricate brackets and fittings for bracket-mounted signs from flat aluminum to suit sign panel construction and mounting conditions indicated.
- .13 Graphic image process: Provide sign copy to comply with the requirements indicated for sizes, styles, spacing, content, positions, materials, finishes and colours of letters, numbers, symbols and other graphic devices.
- .14 Graphics shall be executed in such manner that edges and corners are true, clean and photographically precise. Graphics with rounded corners, cut or ragged edges or edge build-up will not be accepted.
- .15 Apply pressure-sensitive vinyl graphics to clean surface; surface and air temperature shall be 16°C (60°F) minimum.
- .16 Substrates shall be considered dirty and shall be wiped with a solvent recommended by the acrylic manufacturers prior to the application of vinyl film or sheeting. Dry the surface with a lint-free cloth before the solvent evaporates from the surface.
- .17 ACM Alucobond curved sign panels; approximate size and proportions as shown on the Design Intent Drawings. All signs of same size shall be totally uniform in size, proportions, and colour.
- .18 Fabricate signs with adequately sized stiffener channels and mounting brackets: Front of structure - recessed, rear of structure - surface mounted.
- .19 Field verify dimensions of surface before preparing signs. Coordinate with masonry or wall Contractor for correctly sized sleeves and recessed boxes.
- .20 Coordinate necessary adjustments in signs with the Owner's Representative.
- .21 Contractor shall review the Design Intent Drawings and their relevant graphics, fonts, format, colours and shades in preparing his/her Bid.

2.14 **FINISHES**

- .1 Metal finishes: Comply with NAAMM (National Association of Architectural Metal Manufacturers) "Metal Finishes Manual" for finish designations and applications recommendations.
- .2 Aluminum finishes: Aluminum shall be pretreated as recommended by the paint manufacturer. Prime surfaces to be painted with paint manufacturer's recommended primer.

- .3 Paints and inks shall be made of other surface material on which they are to be applied and as recommended by the manufacturer of the paint or ink. Identification of paint or ink shall be noted on Shop Drawings with method of application. Prime coats or other surface pre-treatments, where recommended, shall be included in the Work. Coating shall be even over entire surface to be painted, without voids, runs, sags, brush or roller marks.
- .4 In general, paint application shall be by brush or airless spray. Paint applied by brush shall be free of objectionable brush marks and meet the approval of the Owner.
- .5 Interior paint finishes shall be acrylic polyurethane, semi-gloss on aluminum substrates, matte finish on plastic substrates.
- .6 Acrylic polyurethane finish shall be applied at the rate of 2.5 mils per coat by air or airless spray.
- .7 Acceptable manufacturers include:
 - .1 Matthews Paint Co.
 - .2 Akzo Coatings Inc.
- .8 Sign colours shall match approved samples and shall be exactly as specified. Sign colours shall be consistent in chroma and in value, shall maintain even opacity and be free of any imperfections.

2.15 **SIGN GRAPHICS AND COMPONENTS**

- .1 Paint colour for exterior sign types is identified as silver/metallic on Design Intent Drawings. Colour to match Alucobond exterior signage panels.
- .2 Identity Signs (Series 100-1400):
 - .1 Aluminum framing with ACM Alucobond sign panels, painted, constructed to create frameless box with curved sign faces as specified. Sign type is internally illuminated, with routed out graphics with Day/Night Casocryl acrylic back up.
 - .2 Provide Icetron lamps, 120/240 volts, for even illumination with no halation. Provide electrical shut-off switch inside sign box.
- .3 Guide Signs (Series 1600-2100):
 - .1 Aluminum framing and faces, painted, constructed to create an exposed frame with curved sign faces as specified.
 - .2 Sign type is non-illuminated, with applied vinyl graphics.
 - .3 Aluminum plate of various thicknesses with removable panels, painted. Aluminum extruded square profile posts, various thicknesses, painted, with aluminum caps, designed to accept curved sign panels on a custom bracket.
 - .4 Sign type is non-illuminated, with surface applied vinyl graphics.
- .4 Orientation Signs (Series 2200-2400):
 - .1 Aluminum fabricated cabinets and brackets, various thicknesses, painted. Single aluminum post, square with diamond profile, custom brackets to accept directory cabinet, various thicknesses, painted, with custom aluminum caps.
 - .2 Sign type is non-illuminated, with surface applied vinyl graphics.

.5 Regulatory Signs (Series 2700-4100):

- .1 Aluminum sign panels, .090 minimum thickness, painted. Single aluminum post, square profile, with sign panel centered on post, fastened mechanically through sign panel, various thicknesses, painted, with extruded aluminum caps.
- .2 Sign type is non-illuminated, with surface applied vinyl graphics. Stop symbol signs have reflective graphics.

3 Execution

3.1 **INSPECTION**

- .1 Before installation of signs, examine site conditions and Work of others in so far as it affects Work of this section and report immediately in writing to Owner's Representative all conditions which interfere with installation and its electrical service.
- .2 Begin installing signs only after deficiencies have been corrected in an acceptable manner.
- .3 Commencement of installation implies acceptance of related Work performed by others.

3.2 **PREPARATION**

- .1 Verify sleeves and recess sizing for proper alignment and service to an acceptable sign installation.
- .2 Protect surrounding areas from Work of this section.

3.3 **DEMOLITION**

- .1 The Contractor is responsible for the removal and disposal of certain existing freestanding signs and sign elements as identified in the sign Drawings. Existing sign demolition and/or renovation is not to commence until new signage is fabricated and ready for immediate installation.
- .2 The Contractor shall at all times keep the Owner's premises and the adjoining premises, driveways and streets clean of rubbish caused by the demolition operations, and the job site shall be left safe, neat and clean at the completion of each day's operation. All rubbish and debris shall be deposited off the Owner's property in an approved sanitary landfill site.
- .3 At the completion of the Work, the Contractor shall remove all the rubbish, tools, equipment, temporary work and surplus materials, from and about the premises, and shall leave the Site graded level with new sod. Again, all rubbish and debris shall be disposed of off the Owner's property in an approved sanitary landfill site.

3.4 **INSTALLATION**

- .1 Install sign units level, plumb and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
- .2 Use of power-propelled fasteners to install signs is prohibited unless the Contractor receives written permission from the Owner.
- .3 Locate sign units and accessories where shown or scheduled, using mounting methods of the type described and in compliance with the manufacturer's instructions. Exact position of exterior directional signs shall be field located.

3.5 **CLEANING AND PROTECTION**

- .1 Keep the premises free of rubbish and debris caused by this Work, and upon completion of the Work leave the area included in the Contract broom clean. Remove waste materials and debris from the site and dispose of at legal disposal area away from the site.
- .2 Provide adequate protection for sign units from damage to materials or finish due to handling, storage, assembly and installation, until acceptance from Owner.
- .3 In the event of damage, be responsible to immediately make repairs and replacements to the approval of the Owner, at no cost to the Owner.
- .4 Use only those cleaning materials and methods recommended by manufacturers of surface materials to be cleaned.
- .5 At completion of installation, clean soiled sign surfaces in accordance with material manufacturer's instructions.
- .6 All installed sign units shall be free of tape, dirt, smudges and other foreign material.

End of Section

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- 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 Refer to Drawings, and examine the nature and extent of structural steel, siding, and Work of other trades which are related to the sign and swing stage construction and which cause interference on the roof.
- 1.3 **REFERENCES**
 - .1 Conform to the latest edition of the following:
 - .1 AODA - Accessibility for Ontarians with Disabilities Act
- 1.4 **INTERFERENCE**
 - .1 Investigate and ascertain the nature and extent of work of other trades on the roof that will cause interference with sign Work and swing stage construction and operation.
 - .2 A continuous running track to support sign maintenance and erection swing stage is not suitable or practical due to interference caused by obstruction lights and photo cell, etc. Make necessary arrangements, design the Work and execute installation to suit existing and designed work of other trades.
- 1.5 **SHOP DRAWINGS**
 - .1 Submit in accordance with Section 01 33 00.
 - .2 Describe all items, dimensions, erection details, anchors, fastenings and electrical components and connections on Drawings.
 - .3 Indicate on Shop Drawings and/or brochures, the materials and/or equipment being supplied, all details of construction, finish, accurate dimensions, capacities and performance.
 - .4 Indicate swing stage design and details.
- 1.6 **CODES, PERMITS AND INSPECTION**
 - .1 Obtain and pay for all licenses, permits, fees and inspections required for construction and installation of the signs and related Work of this section.
 - .2 The equipment and installation shall comply with all local and provincial laws, and with the requirements of the Canadian Standards Association when mandatory. Be responsible for compliance of the installation with all such laws and regulations, and all changes or alterations required by the authorized inspector of the authority having jurisdiction shall be made without increase in Contract Price.
 - .3 Supply and install all warning signs and nameplates as required by the inspection authority.
 - .4 Unless specifically directed otherwise, submit all required documents and Shop Drawings to the authorities having jurisdiction in order to obtain approval for the Work.

- .5 After completion of the Work, furnish to the Consultant a Certificate of Final Inspection Approval from the inspection authorities having jurisdiction.

1.7 **EXAMINATION**

- .1 Visit the Site and take all necessary measurements required for this Work. Examine existing work of other trades upon which work of this section is dependent. Examine existing conditions which must be accepted for completion of the Work. Notify the Consultant in writing of all conditions which may prejudice the proper installation of this Work.

1.8 **COOPERATION**

- .1 Cooperate with other trades. Provide all items to be installed by them in time to prevent delays in their work.

1.9 **DELIVERY, STORAGE AND HANDLING**

- .1 Handle and store metal materials at job site in such a manner to prevent damage to other materials, to existing buildings or to property.
- .2 Handle components to avoid permanent distortion.
- .3 Handle components with care, and provide protection for surfaces against marring or other damage. Ship and store members with cardboard or other resilient spacers between surfaces. Use lifting chokers of material which will not damage surface of members.
- .4 Provide adequate protection for floors and walls and Owner's property during erection. Any damage caused by this trade shall be made good to the satisfaction of the Consultant at no additional cost to the Owner.

1.10 **MAINTENANCE PROGRAM**

- .1 Quote separately with Tender, a separate price for execution of sign maintenance program for a period of five years following expiration of the normal one year Warranty Period for the Work.
- .2 Such program shall include for periodic sign cleaning, electrical checking and maintenance including parts replacement and installation when required, together with written report to the Owner after each inspection.
- .3 Submit detailed maintenance for review.

2 **Products**

2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Forward Signs Inc.
- .2 Approved alternative

2.2 **MATERIALS - GENERAL**

- .1 Structural shapes, plates, bolts, washers, etc.: New material conforming to CSA Standard G40.21M, Grade 300W, general purpose structural steel.
- .2 Sheet metal: 0.76 mm (22 ga) minimum base steel thickness, zinc coated to ZF075(2) (wiped coat) conforming to ASTM specification A653/A653M, Grade A.

- .3 Letters and Logo
 - .1 Open channel style.
 - .2 Letters to have five tubes per stroke width.
 - .3 Logo surround four tubes.
 - .4 Maple leaf to have five continuous rows of tubes.
 - .5 All neon tubing shall be 15 mm size.
 - .6 All neon to be red in colour.
 - .7 Stroke interior, red in colour.
 - .8 Remainder of signage, colour as later selected.
- .4 Coatings (sign steel): International Paints "Interprime" VTA528/VTA529 etch yellow, "Interguard" EPA046/EPA047 primer yellow and "Interthane" PA series finish (red) and in selected colour elsewhere. Equivalent by Sherwin Williams or CPI are acceptable.

2.3 **MATERIALS - ELECTRICAL**

- .1 Raceway Materials
 - .1 Electrical Metallic Tubing (EMT): Galvanized cold rolled steel tubing with fittings meeting the same requirements for finish and materials as EMT. Connectors, couplings, etc., as manufactured by Thomas and Betts Series 5123 and Series 5120 respectively. NOTE: SET SCREW CONNECTORS NOT ACCEPTABLE.
 - .2 Liquid-tight flexible conduit: Use for connection of conduits (or boxes) inside the facility to the exterior sign lights. Conduits shall be complete with extruded polyvinyl covering with watertight connectors. The flexible connection shall be of sufficient length to allow a drip loop in the exterior liquid tight to prevent ingress of water into the installation. Liquid-tite flexible raceway shall also be used for connection of all transformers to conduit stubs, etc. Connectors for liquid-tite flexible conduit shall be as manufactured by Thomas and Betts Ltd., Series 5331 or Crouse-Hinds Series LT38 with nylon insulated throat. Where the fittings are brought into an enclosure with a knockout, Thomas and Betts "Sealing O Rings" Series 5262 or Crouse-Hinds Series SG1 shall also be installed.
 - .3 Anti-seize compound: As manufactured by Thomas and Betts (Kopr-sheld) or Crouse-Hinds STL.
- .2 Wire: Stranded copper.
 - .1 Do not use size smaller than No. 12 AWG for lighting or power circuits. For 120 volt receptacle or lighting circuits, where the TOTAL conduit distance between the panel and the outlet exceeds 50 ft., use No. 10 AWG or larger. Limit voltage drop at any lighting fixture at full load on the circuit to 3% maximum.
 - .2 Do not use sizes smaller than No. 14 AWG for control or signal circuits.
 - .3 For all applications above grade, use Type RW90 (X-Link).
 - .4 All wire and cable insulation shall be rated not less than 600 volts.
 - .1 Compression connectors: Sta-Kon series by Thomas and Betts.

- .2 Colour keyed compression connectors: Series 54000 (for copper conductors) by Thomas and Betts. Tools shall be by same manufacturer.
- .3 Wrap-around type markers: Thomas and Betts E-Z Code Series Brady "Perma-Code" wire markers of solid colours.
- .3 Panelboard
 - .1 Circuit breaker panel (120/208 V, 3 phase, 4 wire): ITE NLAB panelboard complete with all necessary bolt-on breakers, integral 3 phase magnetic contactor all in an EEMAC 4 enclosure.
 - .2 Provide two sets of keys and a typed directory.
- .4 Transformer
 - .1 Dry-type enclosed in an EEMAC 4 enclosure and complete with four 2-1/2% full capacity taps (two below and two above normal). Insulation class shall be "H".
 - .2 Sound level rating shall not exceed decibel rating listed in the EEMAC standards for specific kVA sizes.
 - .3 Transformer shall be manufactured by Westinghouse, GE, Pioneer, Ferranti Packard, Polygon, Marcus, Hammond.
 - .4 Make conduit connections to transformer case using a short length of liquidtight flexible conduit to reduce vibration and noise transmission. Mount transformer on approved vibration eliminators. Connect conduits to transformer case on termination plates provided by the transformer manufacturer.
- .5 Photocell: Powerlite Catalog 5946 complete with mounting bracket.
- .6 Electrical Equipment Identification
 - .1 Nameplates: Lamacoid white with engraved letters to show black. Provide nameplates on ALL pieces of electrical equipment such as, but not limited to, transformers and distribution panelboard.
 - .1 Nameplates to clearly describe the function or use of the particular equipment involved. Nameplates for panelboard shall include the panel designation, voltage and phase of the supply. For example, "Panel 'A', 600 V, 3-phase, 3-wire". Nameplates for transformers shall indicate the transformer designation, primary and secondary voltage. Where, in the opinion of the Consultant, the inscription is inadequate, the Contract shall replace with a newly inscribed nameplate at no increase in Contract Price.
 - .2 Securely fasten nameplates to the equipment with No. 6 Phillips round-head cadmium plated steel self-drilling screws.
 - .2 Colour coding: Use the following colour coding throughout and for all terminations and connections:
 - .1 Red - Phase A
 - .2 Black - Phase B
 - .3 Blue - Phase C
 - .4 Green - Ground

- .5 White - Neutral
- .6 Yellow - Control

2.4 **FABRICATION**

.1 General

- .1 Use only workers skilled in the Work of this section. Do Work to best standard practice.
- .2 Fit and assemble Work in shop where possible. Execute Work in accordance with details and reviewed Shop Drawings. Where shop fabrication is not possible, make trial assembly in shop.
- .3 Workmanship shall be of best grade modern shop and field practice known to recognized manufacturers specializing in this Work. Fit joints and intersecting members accurately. Make Work in true planes with adequate fastenings.
- .4 Conform to CSA S16, Steel Structures for Buildings, latest edition for the design of details and execution of structural Work, except as otherwise shown on the Drawings.
- .5 Carefully make and fit details and take special care so that finished Work presents a neat and workmanlike appearance.
- .6 Perform shop welding to CSA W59. Welding firm to be FULLY certified to CSA W47 for steel and/or aluminum Work. All welders employed in the field shall be qualified as Class "O" as defined in CSA W47.
- .7 All welding operations shall conform to the safety requirements of CSA Standard W117.
- .8 Thoroughly clean welded joints and the cleaned steel exposed for a sufficient space to properly perform the welding operation. Neatly finish all welds. Continuously weld and grind smooth welds which will be exposed to view and finish painted.
- .9 Assemble all members true and without twists or open joints.
- .10 Provide properly sized holes for connecting the Work of other trades. Show such holes on Shop Drawings.
- .11 Do not cut holes in building structural steel without Consultant's approval.
- .12 Provide weathertight removable panels for access to transformers.
- .13 Provide adequate drain holes in letters to prevent moisture build-up.
- .14 Provide necessary safety hoops for installation and maintenance of the Work.
- .15 Fabricate supporting steel for electrical equipment similarly of welded construction where practicable, with bolted joints allowed for field assembly. Use high strength steel bolts. Chip all welds to remove slag and ground smooth.

.2 Cleaning, Shop Painting

- .1 Degrease all sign steel to SSPC No. SP1 Solvent Cleaning. Remove white corrosion Products by hand cleaning. Shop paint steel with one coat of etch - yellow to 0.5 mils dry film thickness, followed by one coat primer - yellow to 2.0

mils dry film thickness, followed by two coats finish - red in tube channels, to 1.5 mils dry film thickness per coat.

- .2 Clean miscellaneous steel for electrical equipment by scraping, wire-brushing or other effective means to remove scale, rust, oil, dirt or other foreign matter to SSPC SP3 and prime with (specify primer used for building steel, plus a finish coat) (specify same primer and finish used for sign steel).
- .3 Apply two coats primer on surfaces which will be inaccessible after erection.
- .4 Paint all items under cover and leave under cover until primer is dry. Follow paint manufacturer's recommendations regarding application methods and equipment and temperature and humidity conditions.

.3 Hot-Dip Galvanizing

- .1 Hot-dip galvanize all angle supports and fasteners and items noted on the Drawings and called for herein as follows.
- .2 Apply zinc hot galvanized coatings in accordance with CSA - G164 with the exception that the mass of the zinc coating of actual surface shall average not less than 687 g/m² and no individual specimen shall show less than 610 g/m².
- .3 Repair damage to any galvanized surface (this also applies to drilled holes) using "Galvicon" manufactured by Galvicon Corporation. Perform surface preparation and application in accordance with Galvicon Corp. printed instructions. Apply two brush coats allowing a minimum of twelve hours drying time between coats. After a minimum of forty-eight hours drying time the second coat shall be wire-brushed to a bright finish. The final regalvanized surface shall present a continuous galvanized appearance with all areas sealed and protected.

3 Execution

3.1 **GENERAL**

- .1 Erect Work plumb, true, square, straight and level free from distortion or defects detrimental to appearance or performance.
- .2 Installation of structural sections shall conform to CSA Standard S16. Provide all temporary bracing and remove on completion. Bolt connections using high tensile strength bolts to ASTM A325.
- .3 Provide necessary washers, rubberized fabric seal type washers and fasteners and neatly fit all Work to the building in a manner to be thoroughly waterproof and weathertight throughout.
- .4 Thoroughly remove all foreign matter from Work on completion of erection.

3.2 **FIELD PAINTING**

- .1 Paint all bolt heads, washers, nuts, field welds, drilled holes and previously unpainted items. Touch up with matching paint system, all shop coatings damaged during transit and installation.

3.3 **ELECTRICAL WORK**

- .1 General: This Work includes but not limited to the following:
 - .1 Provide 600 volt 3 phase service from existing panelboard DP-2 (located near column Ex 69 in Electrical Room, see Drawing EL120) to the catwalk area near

- column G70, see Drawing EL109. The existing panelboard is equipped with spare 60A and 30A 3 pole breakers as required.
- .2 At the catwalk location, provide a 3 phase step-down transformer 600-120/208 volt, a 120/208 volt 3 phase 4 wire circuit breaker panelboard complete with an integral contactor.
 - .3 Provide all branch wiring and raceways to sign lights.
 - .4 Provide photocell to automatically control the sign light.
- .2 Transformers for neon shall be high power factor type, one every 15.24 m of tube length.
- .3 Raceways: In areas where electrical surfaces are mated and also where threaded joints are mated on raceways, use conductive anti-seize compound specified.
- .4 Where raceways pass through exterior walls, provide sleeves flashed through walls. Make joints watertight by using silicone sealant.
- .5 Where they enter panelboard, pull boxes, or outlet boxes secure raceways in place by watertight connector.
- .6 Separation: Maintain a minimum separation of 150 mm between raceways and all surfaces over 37.78°C (100°F).
- .7 Inserts, Hangers, Sleeves and Supports
- .1 Provide all hangers, inserts, sleeves and supports required to hang, support or accommodate the equipment and materials of this section. Do not use high velocity powder activated fastenings in any section of the building. Low velocity powder activated fastenings may be used but only with written approval of the Consultant.
 - .2 SUSPENSION OF ANY ELECTRICAL APPARATUS TO THE ROOF DECK, VENTILATION DUCTS AND PIPING IS ABSOLUTELY PROHIBITED UNLESS SHOWN OTHERWISE ON THE DRAWINGS.
 - .3 Support raceways at intervals as outlined in the C.E.C.
- .8 Outlet boxes: Where conduit is exposed, use cast conduit boxes with electro-galvanized finish and weatherproof gaskets.
- .9 Pullboxes: Furnish and install EEMAC 4 pullboxes, where necessary in the raceway system, to facilitate conductor installation. In general, install a pullbox for conduit runs of more than 30.5 m, or with more than three right-angle bends, at a convenient intermediate location.
- .10 Junction boxes: Where necessary to terminate, tap-off or redirect multiple conduit runs, furnish and install appropriate EEMAC 4 boxes.
- .11 Wiring Methods
- .1 Install all wiring in raceways.
 - .2 Do not install wiring until all Work of any nature that may cause damage to the wire is completed. Do not use mechanical means in pulling in wires No. 8 or smaller. Lubricants shall be approved.
 - .3 Splice conductors No. 10 AWG or smaller with specified compression connectors.

- .4 Terminate and splice conductors No. 8 and larger with specified colour keyed compression connectors.
- .5 Connect all circuit conductors of the same colour to the same ungrounded feeder conductor throughout the installation.
- .6 For No. 6 AWG or smaller, use a colour code to match the insulating covering. Accomplish colour coding of wire larger than No. 6 AWG and other types of wire by means of specified wrap-around type markers.

3.4

CLEANING

- .1 Promptly as Work proceeds and upon completion, clean up and remove from Site on a daily basis, all rubbish and surplus materials resulting from Work under this section.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- | | | | |
|-----|-----------------------|---|--|
| .1 | ASTM A653/A653M | - | Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| .2 | CAN/CSA-G40.20/G40.21 | - | General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels |
| .3 | | - | Aluminum Association Designation System for Aluminum Finishes |
| .4 | CAN/CSA-G164 | - | Hot Dip Galvanizing of Irregularly Shaped Articles |
| .5 | CSA W47.2 | - | Certification of Companies for Fusion Welding of Aluminum |
| .6 | CSA W59-M | - | Welded Steel Construction (Metal Arc Welding) |
| .7 | CAN/CGSB-1.108 | - | Bituminous Solvent Type Paint |
| .8 | CGSB 41-GP-6M | - | Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced |
| .9 | SSPC | - | Steel Structures Painting Council, "Steel Structures Painting Manual, Vol. 2" |
| .10 | AODA | - | Accessibility for Ontarians with Disabilities Act |

1.3 **DESIGN**

- .1 Design signs to withstand wind loading equal to 1.67 kPa without failure of sign faces or connections to structures.

1.4 **SUBMITTALS**

.1 Shop Drawings

- .1 Submit in accordance with Section 01 33 00.
- .2 Show material information, thicknesses, sizes, finishes, colours of materials scheduled to be exposed in finished work, construction details, removable components showing letter typeface, joint quality, and schedule of signs.

.2 Samples

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit sample of each type sign, sign image and mounting method.

1.5 **QUALIFICATIONS**

- .1 Manufacturer of signs shall be specialist in this field having minimum five years proven experience in sign manufacturing and installation of type of signs specified.

1.6 **MAINTENANCE DATA**

- .1 Provide maintenance data for signs for incorporation into manual specified in Section 01 33 00.

2 Products

2.1 **MATERIALS**

- .1 Acceptable Manufacturers
 - .1 Forward Signs Inc.
 - .2 Approved alternative
- .2 Source sign fabrication made by one manufacturer from one of the following:
 - .1 Neon Products Ltd.
 - .2 Steel Art Signs Ltd.
 - .3 Imperial Sign Ltd.
- .3 Aluminum extrusions: Aluminum Association alloy AA 6063-T5, minimum 2 mm thick, free from scratches and surface blemishes.
- .4 Sheet aluminum: Aluminum alloy AA6063-T5, minimum 0.75 mm thick for exposed Work requiring finish to match extruded sections.
- .5 Prefinished sheet aluminum: Plain sheet with manufacturer applied baked enamel finish to Aluminum Association designation AA-M22-C22-A41 (clear) or AA-M22-C22-A42 (black) 0.25 mm thick on face and 0.0076 mm thick on back.
- .6 Prefinished sheet steel: Conforming to Canadian Steel Sheet Building Institute Bulletin finished with Z275 zinc coating in accordance with CSSBI Standards and prepainted as follows:
 - .1 Finish: Coil coated, baked-on, 70% Kynar 500 or Hylar 5000 based fluoropolymer enamel, 10000 Series by Stelco Inc., or Dofasco Inc. on exposed surfaces as applied by Baycoat. Coil coated surfaces pretreated and primed prior to application of coating. Paint colour: As selected by Consultant.
- .7 Galvanized steel sheet: Commercial quality to ASTM A653/A653M, Grade A, with zinc coating designation.
- .8 Acrylic sheet: Polymethylmethacrylate (PMMA) cast sheet suitable for intended use in sign fabrication, (translucent white) (transparent clear) (colours as indicated).
- .9 Fiberglass sheet: To CGSB 41-GP-6M, flat sheet, smooth finish, colours as indicated.
- .10 Welding materials: To CSA W59.
- .11 Solder: To ASTM B32.
- .12 Adhesives, paints, sealants and solvents for acrylic and fiberglass sheet: Type recommended by sheet manufacturer for applicable condition.

- .13 Fasteners: Hardened aluminum or stainless steel or of type that will not permit galvanic action.
- .14 Acrylic topcoat: Clear, non-yellowing, exterior grade, satin finish, acrylic polyester resin protective coating, compatible with (acrylic) (fiberglass) (metal) surface of type recommended by sheet manufacturer.
- .15 Sign poles: 150 mm x 150 mm x 5 mm hollow steel section conforming to CAN/CSA-G40.20-M and CAN/CSA-G40.21-M, to height indicated on Drawings. Pole shall be complete with welded base plate 300 mm x 250 mm x 19 mm thick and drilled four holes for anchor bolts. Cover plate formed of 1.6 mm thick (16 gauge) sheet steel or aluminum with welded corners.
- .16 Bituminous paint: To CAN/CGSB-1.108, Type 2.

2.2 **FINISHES**

- .1 Anodized Aluminum
 - .1 Clear finish: Conform to Aluminum Association designation AA-M22-C22-A41 in uncoloured anodized finish with film thickness of 0.25 mm.
- .2 Galvanized finish: On irregular shaped articles, 600 g/m² zinc coating to CAN/CSA G164.
- .3 Prefinished metals: As specified herein.
- .4 Prepared steel pole surface in accordance with SSPC SP3 and shop prime coated with rust inhibitive alkyd primer, make ready for finish painting by Section 09 91 00.

2.3 **GENERAL FABRICATION REQUIREMENTS**

- .1 Sign Box
 - .1 Fabricate signs in accordance with details on Drawings, Specifications and Shop Drawings to present a safe and rigid installation.
 - .2 Build units square, true, accurate to size, free from visual or performance defects.
 - .3 Accurately fit and securely join sections to obtain tight, closed joints.
 - .4 Make casing continuous without intermediate joints. Mitre corners to close tolerances, with attachments and fixing devices completely concealed.
 - .5 Pole mounted sign boxes to be equipped with sign face both sides.
 - .6 Sign box to be capable of interchanging sign face.
 - .7 Internally reinforce case to maintain maximum horizontal and vertical deflection to 1/360 of clear span under OBC loading requirements. Ensure maximum water resistance of case. (Provide back to wall mounted signs).
 - .8 Design casing to ensure free thermal movement between dissimilar materials.
- .2 Do not use exposed fasteners unless indicated otherwise on Drawings; fasteners shall be inconspicuous and same finish and colour as base metal on which they occur.
- .3 Polish exposed edges of plastic and metal to smooth, slightly convex profile. Ground exposed welds to a smooth invisible joint.

- .4 Do steel welding to CSA W59 aluminum welding to CSA W47.2. Finish exposed welds flush and smooth.
- .5 Apply bituminous paint to aluminum in contact with dissimilar metals, concrete or masonry.
- .6 Do not locate manufacturer's nameplates on sign surface locations visible in completed work.
- .7 Sign Faces
 - .1 Fabricate sign faces in one piece to pole mounted signs.
 - .2 Installed face to present rigid surface with minimal distortion.
 - .3 Make facing to wall mounted signs in two pieces with facing name a separate face.
- .8 Sign graphics: Apply by (silk screen) (cut and spray) (self-sticking vinyl film) (decals) (cut-out acrylic letters).
- .9 Sign back: Minimum 0.80 coated sheet steel.
- .10 Letters shall be "_____ " unless indicated otherwise on Drawings, and shall be clear cut and free from ragged or indistinct edges.

2.4 **SIGN GRAPHICS**

- .1 Sign graphics to be well defined, arranged for balanced appearance, and properly word and letter spaced. Acceptable manufacturers for computer cut graphics:
 - .1 System Graphics
 - .2 Alpine Graphics Productions
 - .3 Autograph Trim
 - .4 Canada Decal Inc.
- .2 Silk screen process: Apply colour photographic produced silk screen printed images to (face) (back) side of transparent sign faces; face side of opaque sign faces.
- .3 Self-stick vinyl film: Individual letters, numerals and symbols cut from 0.1 mm thick matte finish, exterior grade PVC film, with self-stick adhesive backing. Colour selected by Consultant from manufacturer's standard range.
- .4 Decals: Silk screened or printed images on minimum 0.025 mm, clear matte finish, PVC film, with self-stick adhesive backing. Protect image subject to abuse with laminated film overlay of same material as decal base.

2.5 **CUT-OUT LETTERS**

- .1 Cut letters and symbols from (opaque) (translucent) (coloured acrylic) (plain) (embossed) (aluminum sheet).
- .2 (Helvetica) typeface, upper (and lower) case; sizes and thicknesses as indicated. Make corners (cutter radius) (square cut).
- .3 Fabricate aluminum with (clear) (colour) anodizing) (baked enamel) finish.

3 Execution

3.1 **INSTALLATION**

- .1 Build and erect signs plumb true, square, straight level and accurate to sizes detailed on reviewed Shop Drawings, free from distortion or defects detrimental to appearance and performance.
- .2 Comply with sign manufacturer's installation instructions and approved Shop Drawings.
- .3 Install wall mounted sign(s) in the locations indicated on Drawings. Bolt through sign framing to hollow masonry Work or other structure using lag bolts with lead sleeves.
- .4 Install pole mounted sign on prepared foundation using stainless steel anchor bolts, washers and shims. Pole shall be plumb and sign box shall be mounted with face plane on same axis as pole. Install cover plate over anchor bolts.

3.2 **CLEANING**

- .1 Leave signs clean and polish all exposed surfaces.
- .2 Touch up any damaged finishes.

End of Section

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- 1 General
 - 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
 - 1.2 **REFERENCES**
 - .1 Conform to the latest edition of the following:
 - .1 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 CAN/CSA-G40.20/G40.21 - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
 - Aluminum Association Designation System for Aluminum Finishes
 - .3 CAN/CSA-G164 - Hot Dip Galvanizing of Irregularly Shaped Articles
 - .4 CSA W47.2 - Certification of Companies for Fusion Welding of Aluminum
 - .5 CSA W59-M - Welded Steel Construction (Metal Arc Welding)
 - .6 CAN/CGSB-1.108 - Bituminous Solvent Type Paint
 - .7 AODA - Accessibility for Ontarians with Disabilities Act
 - 1.3 **DESIGN**
 - .1 Design signs to withstand wind loading equal to 1.67 kPa without failure of sign faces, posts or connections.
 - 1.4 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Submit in accordance with Section 01 33 00.
 - .2 Show material information, thicknesses, sizes, finishes, colours of materials, construction details, letter typeface, posts and concrete bases.
 - .2 Samples
 - .1 Submit samples in accordance with Section 01 33 00.
 - .2 If requested, submit sample of each type sign, sign image and mounting method.
 - 1.5 **QUALIFICATIONS**
 - .1 Manufacturer of signs shall be specialist in this field having minimum five years proven experience in sign manufacturing and installation of type of signs specified.
- 2 Products

2.1 MATERIALS

- .1 Acceptable Manufacturers
 - .1 Forward Signs Inc.
 - .2 or accepted equal
- .2 Sign blanks: Steel sign blanks fabricated from galvanized/galvalume steel made from sheets. Galvanized steel shall conform to ASTM A653/A653M, regular type, coating designation Z-275.
 - .1 Galvalume steel shall conform to ASTM A 792, coating designation AZ-150.
 - .2 The coated steel shall be minimum 1.5 mm thick.
- .3 Fasteners: Hardened aluminum or stainless steel or of type that will not permit galvanic action.
- .4 Sign posts: Breakaway installed, 50 mm square posts fabricated from 14 ga galvanized steel tube with pre-punched holes on 25 mm centers on all four sides. Posts, spacers, bolts, nuts and lock washers shall be galvanized after fabrication conforming to ASTM A-123.
 - .1 All holes shall be punched or drilled cleanly prior to galvanizing and shall be freed of excess deposits of zinc.
 - .2 Design posts to allow removal and replacement without breaking out concrete.
- .5 Sign anchors: Direct buried minimum 609.6 mm and 50-75 mm above finish grade. Hammered down anchor for concrete and asphalt complete with non-shrink grout. Hammered down omni-directional anchor for soil.
- .6 Sign graphics: Self-sticking UV resistant, premium quality vinyl film by 3M.
- .7 Bituminous paint: Henry 410-02.
- .8 Concrete bases: Air entrained 20 MPa concrete at 28 days, conforming to Section 03 30 00.
- .9 Concrete base forms: "Sonotube".

2.2 PROJECT INFORMATION SIGNAGE FOR PUBLIC

- .1 Refer to Section 10 14 00.01 City of Toronto Construction-Improvement Signs for information on the standard template to be used for projects accessible to the public.

2.3 SIGN SCHEDULE

- .1 Refer to accompanying sheet following this section.

2.4 GENERAL FABRICATION REQUIREMENTS

- .1 Fabricate signs in accordance with details on Drawings, Specifications and Shop Drawings to present a safe and rigid installation.
- .2 Build units square, true, accurate to size, and free from visual or performance defects.
- .3 Accurately fit and securely join sections to obtain tight, closed joints.

- .4 Do steel welding to CSA W59 and aluminum welding to CSA W47.2 Finish exposed welds flush and smooth.
- .5 Apply bituminous paint to aluminum in contact with dissimilar metals, concrete or masonry.
- .6 Sign Faces
 - .1 Fabricate sign faces in one piece.
 - .2 Installed face to present rigid surface with minimal distortion.
 - .3 Degrease sign blanks before applying vinyl.

3 Execution

3.1 **EXCAVATION AND CONCRETE WORK**

- .1 Excavate post holes to suit depth of concrete bases, cleanly cut to diameters as specified, ready to receive posts set in concrete fill. Remove excavated earth from the site.
- .2 Form the top 200 mm of the concrete bases with specified form.
- .3 Mix concrete with a minimum amount of water and ram solidly into the excavations and around posts.
- .4 Unless Drawings show otherwise, concrete bases shall be of diameter as specified below and approximately 50 mm above grade with tops pitching away from posts and finished smooth and even.
 - .1 For all posts: 300 mm diameter, 1200 mm deep

3.2 **INSTALLATION**

- .1 Build and erect signs plumb true, square, straight level and accurate to sizes detailed on reviewed Shop Drawings, free from distortion of defects detrimental to appearance and performance.
- .2 Comply with sign manufacturer's installation instructions and approved Shop Drawings.
- .3 Install poles in concrete foundation. Refer to and comply with Section 03 30 00 for concrete requirements.

3.3 **CLEANING**

- .1 Leave signs clean and polish all exposed surfaces.
- .2 Touch up any damaged finishes.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 AODA - Accessibility for Ontarians with Disabilities Act
.2 TADG - Toronto Accessibility Design Guidelines

1.3 **SUBMITTALS**

- .1 Submit manufacturer's specifications and technical data, installation instructions, as required, and catalogue cuts and templates where required to explain the construction and incorporate it into the project.
.2 Submit shop drawings showing complete fabrication details, fastener and anchor location, plans of plate placement including joints, and material to be used as well as outlining installation materials and procedure.
.3 Samples: Submit sample illustrating colour and finish.

1.4 **QUALIFICATIONS**

- .1 Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of the Products, systems and assemblies specified and with approval and training of the Product manufacturers.
.1 Installers shall have received training from the manufacturer for the installation of the specified tactile warning systems.

1.5 **MANUFACTURER'S INSPECTION**

- .1 Manufacturer's representative shall visit Site during this Work and verify in writing, that application is in accordance with this Specification and manufacturer's recommendations.
.2 Upon completion of this Work, manufacturer's representative shall verify, in writing, that the application has been completed in accordance with this Specification and manufacturer's recommendation.

1.6 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver packaged materials in original, undamaged containers with manufacturer's labels and seals intact. Handle and store materials in accordance with manufacturer's and Supplier's recommendations to prevent damage thereto.

1.7 **WARRANTY**

- .1 Warrant Work of this section against defects and deficiencies for a period of five years from date Work is certified as substantially performed in accordance with the conditions of the Contract.

- .2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective Work satisfactory to the Consultant and at no expense to the Owner.
- .3 Defects shall include, but not be limited to, loss of bond, breakage, deformation, fading and loosening of tiles.

1.8 PROTECTION

- .1 Protect the 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.

2 Products

2.1 TACTILE WALKING SURFACE INDICATORS

- .1 Surface Applied Composite Polymer Tile (TA-1a)
 - .1 Engineered polymers truncated dome tile with beveled edges, surface mounted and secured with adhesive and fasteners matching the colour of the tile.
 - .1 Application: Interior and existing exterior applications, existing cured concrete surfaces where a detectable warning system is required, curb ramps, pedestrian crossings, parking areas, wheelchair ramps, top and bottom of stairs, or platforms.
 - .2 Sizes: 305 x 305 mm, 610 x 610 mm, 610 x 915, 610 x 1220 mm, 610 x 1524 mm or unless indicated otherwise.
 - .3 Colour: Federal Yellow or as selected by Consultant from manufacturer's standard colours.
 - .4 Acceptable Manufacturer:
 - .1 Access Tile® by Kinesik Engineered Products
 - .2 AlertTile® by Cityscape Supply Group
- .2 Surface Applied Fire-Resistant Composite Polymer Tile (TA-1c)
 - .1 Composite truncated dome tile with beveled edges meeting ULC-S102.2 fire standard (less 25 flame and 50 smoke).
 - .1 Application: Interior application at exit stair wells, vestibules to exit stairs and lobbies, corridors.
 - .2 Sizes: 305 x 305 mm, 305 x 1220 mm, 610 x 610 mm, 610 x 915 mm, 610 x 1220 mm, 610 x 1524 mm or unless indicated otherwise. Contact Manufacturer for additional sizes available.
 - .3 Colour: Federal Yellow or as selected by Consultant from manufacturer's standard colours.
 - .4 Acceptable Manufacturer:
 - .1 Access Tile FR® by Kinesik Engineered Products
 - .2 AlertTile® FR by Cityscape Supply Group
 - .3 Or accepted equal

2.2 **TEXTURAL AND COLOUR CONTRAST WARNING STRIP AND NOSING**

- .1 Slip resistance, weather resistance, UV resistance, stain resistance textural warning surfaces for edge and pathway marking with photoluminescent powder and non-slip materials. Configuration in accordance with Contract Drawings and conforming to manufacturer's printed instruction for accurate, secure installation Colour: as indicated on Drawings or selected by Owner.
- .2 Non-Photoluminescent Non-Slip Strips (TA-11)
 - .1 Hard-wearing silicon carbide, integrally bonded to aluminum substrate, anti-slip protection for step edge.
 - .2 Application: Indoor and outdoor use
 - .3 Sizes: 37.3 mm or 51 mm x 1.8 mm thick, unless indicated otherwise
 - .4 Collection: "N-30 Series" by Kinesik Ecoglo, or accepted equal

2.3 **ACCESSORIES**

- .1 Fasteners and anchors:
 - .1 As recommended by manufacturer for secure anchorage of tactile warning surfaces. Provide noncorrosive fasteners that are compatible with each material joined, and complying with the following:
 - .1 Furnish color appropriate nylon sleeve, stainless-steel fasteners for exterior use.
 - .2 Fastener Heads: for nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.
- .2 Adhesives:
 - .1 Tactile Walking Surface Indicators:
 - .1 Adhesives: As applicable for type of installation. Acceptable manufacturers Mapei, Bostik, Sika, Tactile Bond & Seal or accepted equal.
 - .2 Textural and Colour Contrast Warning Strip and Nosing:
 - .1 Adhesives: polyurethane adhesive, mechanically fastened or as recommended by the manufacturer
- .3 Sealant:
 - .1 As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

3 **Execution**

3.1 **EXAMINATION**

- .1 Verification of Conditions:
 - .1 Verify existing conditions and finishes are ready to receive specified work. Ensure backings are structurally sound, level and plumb within required

tolerances as indicated in 03 35 00. Notify Consultant in writing of unacceptable substrate conditions.

.2 Ensure compatibility of adhesion, reinforcing and fillers with adjacent substrate and component coming in contact with these products.

.3 Ensure manufacturers, examine substrate conditions, verify conditions are suitable for installation prior to commencement and review application procedures. If requested, submit written reports.

.2 Evaluation and Assessment:

.1 Prior to installation, set aside for further inspection and replacement, tiles that are sub-standard, fractured, chipped or has pinholes or voids that are unusable for cuts. Contractor shall replace substandard and/or pre-damaged tiles at no additional cost to the Owner.

.2 Before setting, examine tile backs for possible dust or other contaminants. If necessary, use a slightly damp towel and wipe tile backs to remove any dust or contaminant residues.

.3 Commencement of work implies acceptance of previously completed work.

3.2 **PREPARATION**

.1 Ensure substrates are clean and free of dust, oil, grease, paint, tar, wax, curing agent, primer, sealer, form release agent or any deleterious substance and debris which may prevent or reduce adhesion.

.2 Thoroughly clean the surface with an appropriate floor cleaner, ensuring all paint or sealant is removed.

.3 Provide templates and rough-in measurements as required.

3.3 **INSTALLATION**

.1 Install tactile warning systems and accessories to manufacturer's written instructions.

.2 Install securely and rigidly, bonded to substrate.

3.4 **FIELD QUALITY CONTROL**

.1 Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to the Owner.

.2 Manufacturer Services: Have manufacturer's representative visit site at commencement of work to give proper direction and thereafter at regular intervals to ensure proper workmanship.

3.5 **PROTECTION**

.1 Protect other parts of work from spatters, stains or damage.

.2 Protect finished work from foot traffic and heavy commercial and equipment traffic. Follow Product instructions for requirements.

.3 Protect finished work from damage by other trades and general abuse until substantial completion or acceptance.

.4 Protect installed tactile warning indicator tiles from damage during construction by covering with plywood.

3.6 **CLEANING**

- .1 Remove grout and other residue immediately while work progresses and before materials harden on tile surface.
- .2 Clean tile completely leaving no apparent cement laitance on the surface.
- .3 Clean adjacent surfaces that have been soiled or otherwise marred, to completely remove evidence of materials causing same.
- .4 Comply with manufacturer's maintenance manual for cleaning and maintaining tile surface.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **SUBMITTALS**

.1 Shop Drawings

- .1 Submit in accordance with Section 01 33 00.
- .2 Show toilet compartment and screen layout, dimensions, finishes, and other pertinent information.

.2 Samples: Submit two 300 mm x 300 mm corner samples of partition.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials in sequence to meet installation schedule. Provide protection from marring or other damage.
- .2 Carefully unload materials; handle and store in a manner to prevent damage. Remove unsatisfactory materials and replace to Consultant's satisfaction at no cost to Owner.

2 Products

2.1 **MATERIALS**

- .1 Toilet compartments: Hadrian "Academy", General Storage System "Epic", Shanahan "O.B.", or ASI Group Global "Floor Mounted Headrail Type" baked enamel or powder coating finished, sheet metal construction, floor mounted, headrail type.
- .2 Hardware: Heavy duty type, as follows: (Type 304 stainless steel as follows):
- .1 Panel-to-wall connection: Heavy duty aluminum "U" flanged brackets with two holes for connection to wall and four holes for connection to panel.
- .2 Panel-to-pilaster connection: Heavy duty full height continuous aluminum channel.
- .3 Latching device: Surface slide latch.
- .4 Hinges: Gravity type hinge sets; top hinge consisting of a pintle and opposing nylon gravity acting cam allowing door to be set in various positions. The bottom hinge shall be a nylon cam inserted into a nylon sleeve.
- .5 Accessories: Provide brackets and combination coat hook/bumper in regular compartments. Equip barrier-free compartments with door pull, and coat hook on side wall, projecting 25 mm maximum.

- .6 Screws: Long-life coated, theft-proof head sheet metal screws. Use shields designed for the wall to which panels and screens are connected to, so as to achieve a rigid installation.

2.2 **FABRICATION**

- .1 Visit Site and take necessary measurements required before fabrication.
- .2 Accurately follow methods of fabrication reinforcement and anchorage shown on reviewed Shop Drawings.
- .3 Cut, shear, straighten and work steel in a manner to prevent disfigurement of finished Work.
- .4 Use metal end caps only, in colour to match panels.
- .5 Reinforce doors, partitions and screens for hardware and for partition mounted tissue dispensers.
- .6 Ensure finished Work is free of warp, open seams, buckles and other surface defects detrimental to appearance.

3 **Execution**

3.1 **INSTALLATION**

- .1 Install compartments and screen plumb and square to building lines and according to manufacturer's printed directions. Secure to wall with brackets. Use three brackets per panel. Use two brackets per urinal screen. Mechanically fasten with screws and shields so that panels and screens are firmly attached.
 - .1 Set compartments 300 mm above finished floor.
 - .2 Set urinal screens 760 mm above finished floor.
- .2 Perform drilling of steel, masonry or concrete necessary to install the Work.
- .3 Install hardware and ensure it is visually aligned.
- .4 Maintain uniform consistent width between panels and pilasters, between panels and walls and between pilasters and walls such that persons using the compartments cannot be seen.
- .5 Test and adjust hinges and latches for ease of operation. Set hinges so doors stay open thirty degrees when compartment is not in use.
- .6 Touch up damaged shop paint to match original finish.

3.2 **CLEANING**

- .1 Remove factory installed strippable protective coating from metal panels.
- .2 Clean and make good surfaces soiled or damaged. Replace materials that cannot be satisfactorily cleaned and restored as determined by Consultant.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- .2 Furnish Products of one manufacturer to extent possible.

.2 General Requirements

- .1 The following products will be supplied by NEXT Plumbing Supply (NPS):
 - .1 Toilet Tissue Dispensers, Double Roll
 - .2 Paper Towel Dispensers (Barrier Free)
 - .3 Soap Dispensers – Wall Mounted
 - .4 Unit Mirrors
 - .5 Mirror Shelf
 - .6 Grab Bars:
 - .1 Straight
 - .2 L-shaped grab bar:
 - .3 Folding grab bar
 - .4 Stainless steel grab bar with padded back rest
- .2 As part of the Shop Drawing submittal, Contractor is to submit a by-building order form to the Consultant and Owner listing the items and quantities for each building the equipment is to be installed. Refer to the Appendices for the Plumbing and Accessories Order Form.
- .3 Once the Shop Drawings are reviewed and the order form quantities are verified by the Consultant and Owner, the Owner will submit the order form to NPS for processing as well as pay NPS for the order directly.
- .4 Contractor is to coordinate delivery of supplied items with NPS and store on site as needed prior to installation.
- .5 Material defects of the products and equipment are the responsibility of NPS and the Contractor to coordinate and replace as required with no extra expense to the Owner.
- .6 Replacement of any equipment or appurtenances listed in section 1.1.2.1 of this specification will be at the expense of the Contractor.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 CAN/CGSB-12.5-M - Mirrors, Silvered
- .2 AODA - Accessibility for Ontarians with Disabilities Act

- .3 TADG - Toronto Accessibility Design Guidelines
- .4 ETL - Electrical Testing Laboratories

1.3 **SUBMITTALS**

.1 Shop Drawings

- .1 Submit in accordance with Section 01 33 00.
- .2 Submit Shop Drawings in the form of catalogue cuts and fully illustrating specified materials with description of components, surface finishes, hardware and securement devices.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials in sealed cartons and containers with manufacturer's name and Product description clearly marked thereon.

1.5 **WARRANTY**

- .1 Warrant the following Work against defects and deficiencies for the period specified from date Work is certified as substantially performed in accordance with the general conditions of the Contract:
 - .1 Deterioration of mirror silvering: Ten years
- .2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective Work satisfactory to the Consultant and at no expense to the Owner.

2 Products

2.1 **TOILET TISSUE DISPENSERS (TPD)**

- .1 Surface mounted (TPD-4): 22 gauge stainless steel cabinet and doors in satin finish. All-welded construction, dispensing mechanism, inner housing and cam. Multi-roll, flush tumbler lock and 2 heavy-duty theft-resistant spindles to hold standard core toilet tissue rolls.
 - .1 Bobrick, Model No. B-2888
 - .2 Bradley, Model 5402
 - .3 Or accepted equal

2.2 **PAPER TOWEL DISPENSERS AND WASTE RECEPTACLE (PTD/WR)**

- .1 Surface Mounted (PTD/WR (S)):
 - .1 Supplied by Owner, installed by Contractor
 - .2 Type Type-304, 22 gauge stainless steel, satin finish, all welded construction, stainless steel doors secured to cabinet with full-length piano hinges and knob latch. and heavy gauge removable waste receptacle.
 - .1 Bobrick, Model No. 3699
 - .2 Or accepted equal

2.3 **SOAP DISPENSERS (SD)**

.1 Soap Dispenser

- .1 Supplied by Owner, installed by Contractor
- .2 Wall mounted (SD-1): automatic brushed stainless steel housing with satin finish, clear acrylic refill-indicator window and key lock, refillable plastic container, liquid type, 850 ml capacity container with no touch, sensor-activated valve.
 - .1 Bradley, Model No. 6A00-11 (Product No. 6A00110000)
 - .2 Bobrick, Model No. B-2012
 - .3 Or accepted equal
 - .4 Or accepted equal

2.4 **UNIT MIRRORS (MIR)**

- .1 6 mm float glass, thermosetting infrared cured paint backing with Poly-Glaze protective finish. Frame shall be one-piece, rolled formed stainless steel with bright annealed finish, channel return at rear with snap locking design and 16-gauge galvanized sheet steel backing. All edges protected by shock-absorbing, neoprene tubing.
 - .1 Bradley, Model No. 781-1836, 457 mm x 914 mm
 - .2 Bobrick, Model No. B-165 1836, 457 mm x 914 mm
 - .3 Or accepted equal

2.5 **GRAB BARS (GB)**

- .1 L-shaped grab bar (GB-1): Type 304 stainless steel, 18-gauge stainless steel tubing, 38 diameter, satin finish with peened gripping surface. Complete with standard mounting plates, concealed flanges and accessories.
 - .1 (GRB-1): 762 x 762 mm size: Bradley, Model No. 812-057 (Product No. 8122057000), or accepted equal
 - .2 (GRB-2): 1016 x 762 mm (customized size): Bradley, Model 812-057 configuration, or accepted equal
- .2 Straight grab bar type: Stainless steel, 38 mm diameter, 609.6 mm long, Type 304 stainless steel, 18-gauge tubing with satin finish, peened gripping surface, 38 mm maximum clearance from the wall, and complete with standard mounting plates, concealed flanges and accessories.
 - .1 (GRB-3): 762 mm long, Bradley, Model No. 812 001-30, or accepted equal
 - .2 (GRB-4): 914 mm long: Bradley, Model No. 812 001-36, or accepted equal
 - .3 (GRB-5): 1016 mm long: (customized size): Bradley Model 812 001 series, or accepted equal
 - .4 609 mm long: Bradley, Model No. 812 001-24 (Product No. 8122001240), or accepted equal

2.6 **CLOTHES HOOK (CTH)**

- .1 (CTH-1): Stainless steel, 14- gauge auto-release clothes hook with exposed satin finish, vandal -resistant, faceplate with sloped edges.
 - .1 Bobrick, Model B-983
 - .2 Bradley, Model No. SA36
 - .3 Or accepted equal
- .2 (CTH-2): Heavy duty clothes hook with 12 gauge concealed mounting, one-piece brass casing with satin nickel-pated finish. Hook shall be able to withstand 136 kg (300 lbs.)
 - .1 Bobrick, Model B-2116
 - .2 Bradley, Model 9119
 - .3 Or accepted equal

2.7 **STAINLESS STEEL SHELF (SHLF)**

- .1 Stainless steel, 18-8, type-304, 18-gauge (1.2mm) stainless steel with satin finish and all welded corners.
 - .1 Gamco, Model MS-18
 - .2 Bradley Model SA49
 - .3 Bobrick, Model B-295
 - .4 Or accepted equal

3 Execution

3.1 **INSTALLATION**

- .1 Install miscellaneous washroom and shower room accessories as per manufacturer's printed installation instructions.
- .2 Install grab bars to withstand minimum 1112 N (250 lb. pound-force) downward pull.
- .3 Install wall reinforcement for miscellaneous fixtures, equipment and accessories. Provide fire retardant treated wood blocking and minimum 18 gauge sheet steel secured to stud to support manufactured components and accessories. Provide wall reinforcement to support future adult change table designed for a minimum load of 1.33 kN. All anchoring devices shall be appropriate for specific wall construction.
- .4 Provide exposed screws of stainless steel or chrome plated steel to match units, with theft proof heads.
- .5 Adjust accessories for proper operation and verify mechanisms function smoothly.
- .6 Coordinate with Consultant and fill units with necessary supplies before final acceptance of building.
- .7 Clean and polish exposed surfaces.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 AODA - Accessibility for Ontarians with Disabilities Act

1.3 **SUBMITTALS**

.1 Shop Drawings

- .1 Submit in accordance with Section 01 33 00.
- .2 Show fabrication details including exact sizes and description of anchorage and hardware, trim, the nature of component parts and interface conditions with other Work.
- .3 Cross-reference components on Shop Drawings to the Contract working Drawings indicating location, number required and name of unit.

- .2 Locker and bench Drawings: Submit three copies of Drawings of each locker room showing locker and bench arrangement, numbering system (colour scheme) and number of lockers in the room, for Owner's control purposes. Drawings shall be on 215 x 280 mm (sheets.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Coordinate deliveries to comply with construction schedule and arrange for strategic off-the-ground, covered storage locations.
- .2 Properly wrap units with protective covering and put in suitable crates to prevent distortion and damage. Carefully unload, handle, and store to prevent damage.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS:**

- .1 Basis of Design: Salsbury Industries; www.lockers.com
- .2 Acceptable Manufacturers: The products of the following manufacturers may be acceptable if they meet or exceed the requirements of this specification.
- .1 Dasco Storage Solutions,
- .2 Shanahan's Manufacturing Limited,
- .3 Hadrian Manufacturing Inc. or
- .4 ASI/Watrous.
- .5 Salsbury Industries
- .6 Or equivalent.

2.2 MATERIALS - LOCKERS

- .1 Sheet steel: Cold rolled carbon steel, stretcher levelled or temper rolled to stretcher levelled standard of flatness.
- .2 Standard Lockers
 - .1 Single tier type, 380mm W x 460 mm D x 1830 mm H, ventilated, flat top and with metal base. 18-51000 by Salsbury Industries
 - .2 Double tier type, 380mm W x 380 mm D x 1830 mm H, ventilated, flat top and with metal base. 52000 by Salsbury Industries
- .3 Component Minimum Requirements
 - .1 Bodies: Minimum 0.61 mm thick (24 gauge) steel sheet with flanged backs and rib stiffeners on sides.
 - .2 Frames: Minimum 1.5 mm thick (16 gauge) steel sheet, box channel shape, welded and ground smooth, with two rubber door silencers on lock side of frame at approximately 38 mm from top and bottom of door.
 - .3 Doors: Rigid box construction, flush type consisting of minimum 0.91 mm thick (20 gauge) outer face and 0.61 mm thick (24 gauge) inner face. Exterior face shall incorporate a nickel plated lock pocket recess with matching pull and padlock locking system; padlock by Owner. Doors shall have number plates incorporating non-removable numerals, one number designated for each locker.
 - .4 Hang doors on pivot hinges, minimum two per door, or welded continuous piano hinge. Weld a one-piece fixed heavy hasp with plunger to frame for padlock locking system. Ensure plunger is integral with hasp and aligned with friction catch fixed in door. A single hasp shall lock each pair of doors.
 - .5 Ensure friction catch is complete with hidden fasteners and firmly holds plunger when door is in closed position.
 - .6 Accessories: Three single wall hooks.
 - .7 Locker bases: minimum 152mm legs with base closure panels fabricated from same material as locker body.
 - .8 Trim, filler panels: Minimum 0.76 mm thick (22 gauge) steel sheet.
 - .9 Ventilation: Lockers shall have provision for ventilation at top and bottom of face. Ventilate multi-compartment lockers through face and back.
- .4 Finish: Two coats of high grade alkyd baked enamel in one colour selected by Consultant from manufacturer's standard colour chart or baked urethane powder coating (in three separate colours for a) doors, b) trim/filler panels, frame, tops, including exposed sides, and c) interiors.) (Colours will be selected by Consultant from manufacturer's standard colour chart.) Finish paint shall have 60-65 percent minimum gloss and have successfully passed ASTM B117, four hundred hours of salt spray resistance.
- .5 Ensure finished units are free from sharp metal edges, with welds ground smooth.

2.3 MATERIALS - WOOD BENCHES

.1 Bench Seats

- .1 Construct of laminated hard maple or similar hardwood standard with the manufacturer, 33 mm thick, of widths and lengths shown, with rounded exposed corners and edges, and smoothly sanded surfaces. Finish wood tops with two coats of clear polyurethane varnish or other clear finish system standard with the manufacturer.
- .2 As an alternate, locker benches may be high density polyethylene solid plastic. Colour as selected by Consultant.

.2 Bench Supports

- .1 Provide steel pedestals for locker room benches, of minimum 33 mm O.D. steel pipe or tubing, with top and bottom steel flanges welded thereto and pre-drilled for expansion bolting to floor. Provide stainless steel anchor bolts. Finish pedestals with baked enamel to match lockers.

.3 Acceptable products and manufacturers:

- .1 Salsbury Wood Locker Bench 36" long and 9.5" deep, light finish, bolt mounted by Salsbury Industries or equivalent.

3 Execution

3.1 **PREPARATION**

- .1 Obtain and verify dimensions at the building Site before any locker fabrication takes place, and in ample time to prevent unnecessary delays in the Work.

3.2 **LOCKER INSTALLATION**

- .1 Fabricate and install metal locker units in accordance with reviewed Shop Drawings.
- .2 Install metal lockers on integral metal bases and to wood grounds where such lockers are alongside wall. Securely bolt lockers together in banks.
- .3 For recessed lockers, install metal trim across the top and down each battery end and at junctions with other materials.
- .4 Install end gables and similar trim material for sloping top lockers; install trim full height at battery end and at junctions with other materials. Where required, provide vertical full height filler panels.
- .5 Upon completion, test doors and adjust for ease of operation.

3.3 **BENCH INSTALLATION**

- .1 Anchor bench pedestals to floor with expansion bolts and secure wood bench tops of pedestals with wood screws applied from the underside. Provide a pedestal at each end of a bench and not over 1800 mm between end pedestals.

3.4 **CLEAN-UP**

- .1 Polish units before final acceptance by Consultant.

End of Section

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- 1 General
 - 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
 - 1.2 **REFERENCES**
 - .1 Conform to the latest edition of the following:
 - .1 AODA - Accessibility for Ontarians with Disabilities Act
 - 1.3 **SUBMITTALS**
 - .1 Submit Shop Drawings in accordance with Section 01 33 00.
 - .2 Shop Drawings shall contain detailed description, and bear item numbers, marked to show quantity, colour, model numbers, fabrication details, and installation instructions. (Submit in bound volumes.)
 - 1.4 **DELIVERY, STORAGE AND HANDLING**
 - .1 Deliver packaged materials in original, undamaged containers with manufacturer's labels and seals intact. Handle and store materials in accordance with manufacturer's and Supplier's recommendations to prevent damage thereto.
 - 1.5 **PROTECTION**
 - .1 Protect the 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.
- 2 Products
 - 2.1 **CORNER GUARDS (CORRIDORS AND PUBLIC AREAS)**
 - .1 16 gauge Type 304 stainless steel, #4 satin finish, 50 mm wide wings with radiused edges and pre-drilled for countersunk screws (4 staggered long-life coated screws per 1200 mm lengths), supplied in longest lengths possible.
 - 2.2 **KITCHEN APPLIANCES**
 - .1 Kitchen appliances specified below shall be by the same manufacturer.
 - .2 Cooktop: 36" built-in electric cooktop, smooth top, stainless steel finish and black top with digital display, heat indicator. Bosch "Benchmark Series NET666SUC" or accepted equal.
 - .3 Dishwasher: 24" built-in stainless steel dishwasher with 3 loading racks, 38 dBA. Bosch "Benchmark Series SHX89PW75N" or accepted equal.
 - .4 Hood Range: 36" wide, under the cabinet stainless steel range fan, 3 speed canopy hood, LED task lights, 4 speed touch control setting, LED display. KitchenAid "KVUB606DSS" or accepted equal.
 - .5 Microwave: 24" wide stainless steel microwave, 1200 W, by Bosch or accepted equal.

- .6 Refrigerator: Double-glass sliding door refrigerator.
- .7 Wall Oven: 30" wide stainless steel, single wall self-cleaning oven, built-in, 4.6 cubic ft. Bosch "500 Series HBL5351UC" or accepted equal.

2.3 **CORNER GUARDS**

- .1 1.3 mm thick Type 304 stainless steel, #4 satin finish, 65 mm wide wings x 1200 mm long, with radiused edges and pre-drilled for countersunk screws (four staggered long-life coated screws per 1200 mm lengths).

2.4 **PRECAST BUMPER CURBS / WHEEL STOPS**

- .1 35 MPa compressive strength at twenty-eight days, air entrained, smooth finished with chamfered edges, 140 mm x 250 mm x 2400 mm 5½" x 10" x 8 ft long sections, with two anchor holes.
- .2 Grout: Pre-mixed, non-shrink, flowable type, Euclid "Euco NS", Master Builders "Construction Grout", Sika "Grout 212" or "M-Bed Standard", W.R. Meadows "CG 86", CPD "Non-Shrink" or Dayton Superior "1107 Advantage Grout"; without aggregate fillers.

2.5 **SECURITY/TRAFFIC MIRRORS**

- .1 Round Convex Mirror – Z Bracket
 - .1 Vandal and shatter resistant, acrylic, convex, circular mirror with hardboard backing, 26" diameter, 160° wide angle view, complete with metal "Z" mounting bracket and aluminum rim. Include all required mounting hardware.
 - .1 Use: Indoor
 - .2 Size: 26" H x 26" W
 - .3 Acceptable manufacturer: "W639226D" by Seton, PLXR by C.R. Laurence or approved equal by Global Industrial
- .2 Round Convex Mirror – Telescopic Bracket
 - .1 Vandal and shatter resistant, acrylic, convex, circular mirror with hardboard backing, 36" diameter, 160° wide angle view, complete with adjustable "T" mounting bracket. Include all required mounting hardware.
 - .1 Use: Indoor
 - .2 Size: 36" H x 36" W
 - .3 Acceptable manufacturer: "W639336D" by Seton, PLXR by C.R. Laurence or approved equal by Global Industrial

2.6 **BOLLARDS**

- .1 Exterior Pipe Bollards
 - .1 Concrete filled, hot dipped galvanized steel bollards. Fabricated in HSS in accordance with CSA G40.20/G40.21, Grade 350W, Class H or Schedule 40 steel pipe, grade B, in accordance with ASTM A53/53M
 - .2 Sizes of bollard as indicated on Drawings.
 - .3 Pipe Finish: ICI Devoe 201 or approved equivalent two-part polyamide epoxy tie coat, and exterior alkyd enamel topcoat conforming to CAN/CGSB-1.59-M.

2.7 **PUSH PLATE SWITCH**

- .1 Refer to ADO requirements in appendices, hardware schedules and Section 10 00 00.

3 Execution

3.1 **INSTALLATION**

- .1 Install miscellaneous specialties perfectly rigid in accordance with manufacturers' printed directions.
- .2 After installation, test-operate and adjust operable parts as required for ease of operation.
- .3 Precast Bumper Curbs / Wheel Stops
 - .1 Compact grade and secure bumper curbs in place with 600 mm long x 12 mm diameter anchor bar pins. Drive top of pins to slightly below top of curb. Grout holes with non-shrink grout.

End of Section

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- 1 General
- 1.1 **SECTION INCLUDES**
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- 1.2 **QUALITY ASSURANCE**
 - .1 Workmanship shall be of highest quality, in accordance with best standard practice for installation of this type of furniture. Execute Work in accordance with drawings, Specifications, and manufacturer's printed directions.
- 1.3 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Submit Shop Drawings for the fabrication and installation of Work of this section for review in accordance with Section 01 33 00.
 - .2 Show and describe items, dimensions, finishes, installation details, anchors and fastenings, details of furniture construction and related work. and location of each furniture unit.
 - .2 Colour charts and finish samples:
 - .1 Submit colour charts and finishes for the fabrication and installation of Work of this section for review in accordance with Section 01 33 00.
- 1.4 **DELIVERY, HANDLING AND STORAGE**
 - .1 Handle components with care and provide protection for surfaces against marring or other damage. Ship and store members with cardboard or other resilient spacers between surfaces. Use lifting chokers of material which will not damage surface of steel members.
- 1.5 **ASSIGNED FURNITURE WORK**
 - .1 The City of Toronto's furniture vendors shall supply, deliver to Site and install furniture based on "generic" furniture layouts and a furniture and equipment schedule.
 - .2 The City's furniture vendor will be assigned to the Contractor. It will be the Contractor's responsibility to:
 - .1 Confirm orders
 - .2 Schedule and coordinate deliveries of various furniture items
 - .3 Provide supervision and oversee installation
 - .4 Store as required
 - .5 Provide security
 - .6 Provide all required voice/data/power connections
 - .7 Clean and polish furniture

1.6 **UNASSIGNED FURNITURE WORK**

- .1 Any furniture not supplied by the City of Toronto's furniture vendors and shown on the Drawings are to be Provided by the Contractor.
- .2 The City of Toronto may supply stored furniture to be installed by the Contractor.
- .3 In addition to the above, it will be the Contractor's responsibility to:
 - .1 Confirm orders
 - .2 Schedule and coordinate deliveries of various furniture items
 - .3 Provide supervision and oversee installation
 - .4 Store as required
 - .5 Provide security
 - .6 Provide all required voice/data/power connections
 - .7 Clean and polish furniture.

2 Products

2.1 **INDOOR FURNITURE**

- .1 Furniture shall come with attachments, brackets, hardware, etc required to be fully assembled and functioning per the manufacturer's instructions.
- .2 Colour chart and finishes for all items specified shall be submitted to the Consultant for selection in accordance with 1.3 Submittals.
- .3 Desks:
 - .1 Supplied and installed by Owner's vendor.
 - .2 Adjustable height rectangular desk, finishes to be approved by the Owner.
- .4 Desk Chairs:
 - .1 Supplied and installed by Owner's vendor.
 - .2 Adjustable height office chair; 5-star base with casters and arms.. Multi-tilt mechanism, forward tilt, and back lock. Back rest made of upholstered fabric.
- .5 Lunch Room Table and Chairs:
 - .1 Supplied and installed by Owner's vendor.
 - .2 Table Acceptable Product and Manufacturer:
 - .1 "More Than Five Table - No: COMT5RDL" by Coalesse or accepted equivalent.
 - .3 Chairs Acceptable Product and Manufacturer:
 - .1 "Less Than Five Lounge - No: COLT5L" by Coalesse or accepted equivalent.

.6 Work Benches:

- .1 Supplied and installed by Contractor.
- .2 Freestanding stainless steel workbench, 48"W x 24"D x 35"H, 18 gauge T-430 stainless steel top with no drip edge and 5" backsplash. Top to be reinforced with heavy gauge channel supports. 18 gauge adjustable galvanized steel lower shelf. 1-5/8" diameter galvanized steel legs with 1" adjustable feet
- .3 Acceptable Product and Manufacturer:
 - .1 "BK Resources 430 Stainless Steel Workbench" by Global Industrial Canada or accepted equivalent.

.7 Storage Cabinets:

- .1 Supplied and installed by Contractor.
- .2 Industrial grade steel storage cabinet, 22 gauge steel body, reinforced with 16 gauge C-channel steel frame. Smooth panels with no exposed bolts or sharp edges. 20 gauge steel door, reinforced complete with 5-knuckle hinges. 3-point locking system with chrome handles and built-in key lock. Internal ventilation louvres on back of cabinet and 22 gauge steel shelves. Powder Coat finish: black.
- .3 Size: 610mm x 915mm x 1981mm (24" D x 36" W x 78"H)
- .4 Acceptable Product and Manufacturer:
 - .1 "Tennsco Deluxe Storage Cabinet" by Global Industrial Canada or accepted equivalent.

.8 Storage Bin Cabinets:

- .1 Supplied and installed by Contractor.
- .2 All-welded, heavy duty 14 gauge steel cabinet with hook-on bins. Full height welded piano hinges. Reinforced double doors open to 180 degrees. Fully welded louvered panels reinforce door and hold hook-on bins. Maximum weight capacity of 650 lbs per door (evenly distributed). Textured powder coat finish: Gray
- .3 Size: 457mm x 915mm x 2134mm (18" D x 36" W x 84"H)
- .4 Acceptable Product and Manufacturer:
 - .1 "Durham Storage Bin Cabinet" by Global Industrial Canada or accepted equivalent.

.9 Mobile Storage Cabinets:

- .1 Supplied and installed by Contractor.
- .2 Heavy-duty mobile tool cabinet, 400 lb capacity per drawer, full open drawers and full-width handle. 12 drawers of different heights - (2) 3" (6) 4" (2) 8". Locking drawers complete with divider kits. Powder coat finish: Black
- .3 Size: 685mm x 1524mm x 952.5mm (27" D x 60" W x 37-1/2"H)

.4 Acceptable Product and Manufacturer:

- .1 "Rousseau 12 Drawer Heavy-Duty Double Mobile Modular Drawer Cabinet" by Global Industrial Canada or accepted equivalent.

.10 Tool Storage:

- .1 Supplied and installed by Contractor.

- .2 Clamshell top gas shock tool storage on 5" x 2" soft compound locking swivel casters. 8" deep top compartment, 6 outlet poser strip, 3 drawers, soft close slides. Powder coat finish: Red

- .1 Size: 508mm x 940mm x 1067mm (20" D x 37" W x 42"H)

.2 Acceptable Product and Manufacturer:

- .1 "Proto Modular Utility Cart W/3 Drawers" by Global Industrial Canada or accepted equivalent.

2.2 **GENERAL FABRICATION REQUIREMENTS**

- .1 For shop welding conform to the requirements of CSA W59.1. Have work done by a firm fully certified according to CSA W47. All welders employed in the field shall be qualified as Class "O" as defined in CSA W47.
- .2 Make Work in true planes with adequate fastenings. Build and erect Work plumb, true, square, straight, level and accurate to sizes detailed, free from distortion or defects detrimental to appearance or performance.
- .3 Grind exposed welds flush and smooth to match adjacent surfaces.

3 Execution

3.1 **INSTALLATION**

- .1 Install furniture in accordance with manufacturer's instructions.
- .2 Use only workers skilled in the Work of this section. Do Work to best standard practice.
- .3 Fit and assemble Work in shop where possible. Execute Work according to details and reviewed Shop Drawings. Where shop fabrication is not possible, make trial assembly in shop.

3.2 **CLEANING**

- .1 Promptly as Work proceeds and upon completion, clean up and remove from the site on a daily basis, all rubbish and surplus materials resulting from Work under this section.
- .2 On completion, touch up marred or abraded finished surfaces.
- .3 Wipe down surfaces to remove fingerprints and markings and leave in clean conditions to the satisfaction of the Consultant.
- .4 To prevent damage to finishes, clean surfaces of furniture with cleaners recommended by the manufacturer.

End of Section

1 General

1.1 **SUMMARY**

- .1 The vehicle lifts are intended to be pneumatically powered through its control console to lift heavy duty trucks and fleet vehicles at certain heights for maintenance specifically of its undercarriage. Heights shall be adequate for undercarriage access. The lift system shall be accessible for maintenance.

1.2 **SECTION INCLUDES**

- .1 Supplied by Owner, installed by Contractor:
 - .1 Above ground two post lifts.
- .2 Supplied and installed by Contractor:
 - .1 Above ground four post lifts (Alignment rack)

1.3 **RELATED SECTIONS**

- .1 Section 03 30 00 – Concrete: Footings & Foundations (or See Structural Specifications)
- .2 Section 26 05 00 – Common Works Results for Electrical

1.4 **SUBMITTALS**

- .1 Submit under provisions of Section 01 30 00 – Administrative Requirements.
- .2 Product Data: Manufacturer's data sheets on each product to be used, including:
 - .1 Preparation and instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation Methods.

1.5 **QUALITY ASSURANCE**

- .1 Manufacturer's qualifications: The lift company selling the product shall possess ISO-9001 certification.
- .2 Installer qualifications: For warranty validation, installation shall be performed by qualified factory authorized and trained personnel.
- .3 Product requirements / design standards and certification: The lift shall be certified by a Nationally Recognized Testing Laboratory (NRTL) to the ANSI/ALI ALCTV (current edition) "Standard for Automotive Lifts: Safety Requirements for Construction, Testing, and Validation".

1.6 **DELIVERY, STORAGE AND HANDLING**

- .1 Store products in manufacturer's unopened packaging until ready for installation.
- .2 Store and dispose of solvent-based materials, and materials used with solventbased materials, in accordance with requirements of local authorities having jurisdiction.

1.7 **PROJECT CONDITIONS**

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 **WARRANTY**

- .1 Manufacturer's Warranty: Lift system shall be warranted for a minimum period of 2 years for parts and 2 years for labor.

2 PRODUCTS

2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Steril-Koni
- .2 Rotary
- .3 Or accepted equal

2.2 **ABOVE GROUND TWO POST LIFTS**

.1 General Description

The lift shall consist of two posts with symmetrical column design with pneumatic direct-pull high efficiency lifting. It has a closed loop hydraulic system for hydraulic contamination prevention. It is equipped with padded shut off bar, high tech gear style arm restraints and low-profile arms.

.2 Higher Lifting Capacity Units

.1 Lifting Capacity

- .1 Lift shall be capable of raising 9,100 kg.
- .2 Lifting/Lowering Rate: 20 seconds

.2 Dimensions

- .1 The lifting height shall be not more than 2,035 mm as measured from the point of adapter contact at full rise to the finished floor. Height to shut off shall be 3,735 mm.
- .2 It shall have an overall height not more than 4,572 mm with the space to have a minimum headroom of 4,576 mm.
- .3 Floor space shall have minimum width of 4,089 mm with the lift's inside column width of 3,213 mm.

.3 Lifting Units

- .1 Lifting units shall be pneumatically powered, high strength heavy gauge steel columns. It shall have large gusseting on substantial base plate foundations.

.4 Arms

- .1 It shall have heavy duty reinforced gusseting.
- .2 Two stage front and rear arms that can be easily extended and retracted from 1,626 mm 881 mm respectively while lying on the floor for vehicle spotting.
- .3 It shall be coupled with light adapter extensions at a minimum height of 152 mm.

.5 Adapter Extensions

- .1 It shall have eight (8) aircraft grade threaded aluminum truck adapter extensions. Four 125 mm and four 250 mm adapters for vehicle lifting.
- .2 It shall have a storage through a column bracket.

.3 Lower Lifting Capacity Units

.1 Lifting Capacity

- .1 Lift shall be capable of raising 8,164 kg.

- .2 Lifting/Lowering Rate: 20 seconds
- .2 Dimensions
 - .1 The lifting height shall be not more than 2,114 mm as measured from the point of adapter contact at full rise to the finished floor. Height to shut off shall be 3,735 mm.
 - .2 It shall have an overall height not more than 3,930 mm with the space to have a minimum headroom of 3,956 mm.
 - .3 Floor space shall have minimum width of 3,921 mm with the lift's inside column width of 3,038 mm.
- .3 Lifting Units
 - .1 Lifting units shall be pneumatically powered, high strength heavy gauge steel columns. It shall have large gusseting on substantial base plate foundations.
- .4 Arms
 - .1 It shall have heavy duty reinforced gusseting.
 - .2 Two stage front and rear arms that can be easily extended and retracted from 1,549 mm 965 mm respectively while lying on the floor for vehicle spotting.
 - .3 It shall be coupled with light adapter extensions at a minimum height of 139.7 mm.
- .5 Adapter Extensions
 - .1 It shall have eight (8) aircraft grade threaded aluminum truck adapter extensions. Four 125 mm and four 250 mm adapters for vehicle lifting.
 - .2 It shall have a storage through a column bracket.
- .4 Controls
 - .1 The control system shall conform to all current NEC, UL 201 and OSHA codes.
 - .2 The control system shall be built-in to the unit, factory tested complete with safety devices.
 - .3 The control system details such as operating guide and instructions shall be provided to the Client by the manufacturer complete with personnel training.
- .5 Acceptable Manufacturer
 - .1 Manufacturer and equipment provider to coordinate, check and review dimensions and site condition applicability.
 - .2 Manufacturer:
 - .1 Rotary
 - .2 Steril Koni
 - .3 Or Approved Equal

2.3 **ABOVE GROUND FOUR POST LIFTS (ALIGNMENT RACK)**

.1 General Description

The lift shall pneumatic powered consisting of heavy duty four post alignment lift for automotive vehicle use. It shall be complete with slip plates and turn plates for universal alignment.

.2 Lifting Capacity

.1 Lifting Capacity shall be 15,874 kg.

.2 Capacity Jacks shall have one or two – 9,071 kg.

.3 Alignment Rack

.1 Overall Height shall be 2,489 mm.

.2 It shall have galvanized 762 mm wide runways with built in slip plates and turnplates.

.3 Alignment wheelbase shall be 7,620mm.

.4 It shall have louvered approach ramps.

.5 It shall have 7 lock heights with galvanized cables and pulleys complete with protective covering

.4 Controls

.1 The rack shall be provided with fully integrated alignment console controls with push button functions for alignment rack full control. Low voltage wiring between console and rack assembly shall be by manufacturer. Power supply to console to be provided by electrical contractor.

.2 Built-in sensors for alignment rack operation shall be provided.

.5 Acceptable Manufacturer

.1 Manufacturer and equipment provider to coordinate, check and review dimensions and site condition applicability.

.2 Manufacturer:

.1 Hunter

.2 Steril Koni

.3 Or Approved Equal

3 **EXECUTION**

3.1 **EXAMINATION**

.1 Do not begin installation until substrates have been properly prepared.

.2 If substrate preparation is the responsibility of another installer, notify architect of any unsatisfactory preparation before proceeding.

3.2 **PREPARATION**

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 **INSTALLATION**

.1 Install in accordance with manufacturer's instructions. Test for proper operation, and re-test if necessary until satisfactory results are obtained.

3.4 **PROTECTION**

- .1 Protect installed products until completion of project.
- .2 Touch-up, repair or replace damaged products before substantial completion.

3.5 **TRAINING**

- .1 Provide minimum two hour training sessions for three lift operators

3.6 **COMMISSIONING**

- .1 Upon completion of the installation, standard manufacturer start-up and testing procedures, installer to provide a final commissioning report containing the following:
 - .1 Verification Test, Performance Test, O&M, Training.
 - .2 Substantial completion of the building's construction phase is dependent on the Design Team and Owner's acceptance of the final commissioning report.

End Of Section

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- 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, REGULATIONS AND STANDARDS**
 - .1 Comply with municipal and 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 Revisions issue: Latest version as amended to date.
 - 1.3 **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
 - .7 NFPA - All relevant sections
 - 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.
- .5 Prepare construction/installation/fabrication drawings, coordinated with other trades and contracts, as required.
 - .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 shown 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 manufacturer's 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.

.3 Review Before Proceeding (HOLD)

- .1 Where the word "HOLD" appears on drawings and other Contract Documents, the Work is included in the Contract.
- .2 Execute such Work only after verification of dimensions, verification of materials and obtaining Consultant's written permission to proceed.

1.5 **COORDINATION AND EXAMINATION**

.1 Reference

- .1 To Section 01 10 00.

.2 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.

.3 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.

1.6 **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, 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.

1.7 **PROVISION FOR FUTURE**

- .1 Future Equipment
 - .1 Where indicated as reserved for future equipment or services, leave identified space clear and install services and equipment so that connections can be made in the future.

1.8 **SUBMITTALS**

- .1 Shop Drawings
 - .1 Conform to Section 01 33 00 and the following.
 - .2 Shop Drawings showing more than one size or model will not be considered unless properly marked up.
 - .3 For electrically driven, and fuel fired appliances, provide the following information:
 - .1 Electrical characteristics including voltage, phase, frequency and power rating.
 - .2 For motors, NEMA, class and efficiency ratings.
 - .3 Fuel input ratings including flow rates and pressures.
 - .4 Equipment performance ratings, including flow rates, pressures, efficiencies, part load values and/or efficiencies (IPLV's), plotted flow characteristics (pump and fan curves) with operating points clearly plotted.
 - .4 For other equipment include the following information:
 - .1 Equipment performance ratings, including flow rates, pressures drops.
 - .2 Electrical control power requirements.
 - .5 For all equipment, include the following:
 - .1 Equipment dimensions and weights.
 - .2 Itemized product description with optional items clearly marked as being included.
 - .6 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 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.
- .4 Coordinate equipment which attaches to and/or where external wiring provided connects to other equipment.
 - .1 Do such coordination whether such equipment is supplied under this or other contracts or subcontracts, for which relevant information will be provided by Owner/Consultant.
- .7 Shop Drawings shall conform to the requirements of NFPA 13, NFPA 14, NFPA 20, and other relevant sections as necessary.

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

- .1 Reference
 - .1 Conform to Section 01 33 00.
 - .2 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 Conform to Section 01 33 00.
 - .2 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 Conform to Section 01 33 00.
 - .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.

1.12 **CLEANING, TESTING AND APPROVAL RECORDS**

.1 Records

- .1 Maintain records of all pressure tests and flushing and sterilization tests, glycol/water concentrations, inspections and approvals by the plumbing inspector.
- .2 Forward these tests to the Owner on completion of the Work in accordance with Section 01 33 00.
- .3 Forward to Consultant, copy of records on site on completion of each test, cleaning operation, etc.

1.13 **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.

1.14 **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.

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 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 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.

2.3 **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 Pipe Hangers and Supports.

2.8 **VIBRATION AND SEISMIC RESTRAINT**

- .1 In accordance with Section 23 05 48 Noise and Vibration Control, and Section 23 05 49 Seismic Control.

2.9 **IDENTIFICATION FOR EQUIPMENT AND PIPING**

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

2.10 **GAUGES – WHERE APPLICABLE**

- .1 Pressure Gauge
 - .1 90 mm dial and overload stops and dial range approximately double the operating pressure, with 1% accuracy.
 - .2 Polished brass case, phosphor bronze bushed rotary movement, bronze bourdon tube
 - .3 Needle valve: Round handle, with NPS ¼ connecting piping or tubing with each gauge. Each gauge shall be provided with a snubber.
 - .4 Acceptable Manufacturers:
 - .1 Trerice
 - .2 Ashcroft
 - .3 Winters
 - .4 Weksler
- .2 Thermometers
 - .1 225 mm scale, straight adjustable angle tubular glass type with red appearing mercury in lens front tube.
 - .2 Cast aluminum case, and brass stem complete with separable socket, and combination Celsius/Fahrenheit scale.
 - .3 Scale range to be approximately double the operating temperature range of the particular system in which thermometers are to be installed.
 - .4 Stems to be of sufficient length to provide for proper insertion in piping or equipment in which they are installed to ensure correct temperature readings.

- .5 Acceptable Manufacturers
 - .1 Trerice
 - .2 Ashcroft
 - .3 Weksler
 - .4 Winters
- .3 Level Gauges
 - .1 150 mm diameter dial, with graduated scale with minor markings, and numbers at major depth levels.
 - .2 Scale range to be a minimum of 110% higher than overflow level of tank.
 - .3 Black finished cast aluminum case, adjustable micrometer type pointer, stainless steel bourdon tube and stainless steel rotary type movement. Dial range to be 0 to 18 m.
 - .4 Acceptable Manufacturers
 - .1 Ashcroft
 - .2 Trerice
 - .3 Winters
 - .4 Weksler
- 2.11 **SUPERVISORY SWITCHES – WHERE APPLICABLE**
 - .1 Tamper Switches
 - .1 120 volt, N.O. switches on riser valves and other isolating valves. Listing: ULC, FM approved.
 - .2 Acceptable Manufacturers
 - .1 Potter Electric
 - .2 System Sensor
 - .3 Viking
 - .2 Flow Switches
 - .1 120 volt, N.O. switches in risers in locations indicated on Drawings. Listing: ULC, FM approved.
 - .2 Acceptable Manufacturers
 - .1 Potter Electric
 - .2 System Sensor
 - .3 Viking
- 2.12 **FIRE DEPARTMENT PUMPER (INLET) CONNECTIONS – WHERE APPLICABLE**
 - .1 Wall Siamese Fittings - Flush Type

- .1 Cast brass body, brass plate, brass swivel adapters and brass plugs with polished finish. ULC listed and FM approved.
- .2 64 mm "Ontario" standard hose threads with caps and chains
- .3 Double inlet clappers
- .4 Imprinted escutcheon plate, embossed "SPRINKLER SYSTEM CONNECTION", "STANDPIPE" or "AUTOSPKR AND STANDPIPE" as required.
- .5 Ball drip on yard side of Siamese check valve.
- .6 Acceptable Manufacturers
 - .1 National Fire Equipment Ltd.
 - .2 Wilson and Cousins
 - .3 Croker
- .2 Sidewalk Siamese Fitting - Standpipe Mounted
 - .1 Free-standing double inlet with 500 gpm capacity, ULC listed and FM approved
 - .2 Cast brass construction
 - .3 64 mm "Ontario" standard hose thread with caps and chains
 - .4 Double inlet clappers
 - .5 Imprinted escutcheon plate embossed "SPRINKLER SYSTEM CONNECTION", "STANDPIPE" or "AUTO SPKR AND STANDPIPE" as required.
 - .6 Acceptable Manufacturers
 - .1 National Fire Equipment
 - .2 Wilson and Cousins
 - .3 Croker

2.13 **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)/Tyco
 - .2 National Fire Equipment
 - .3 Flag Fire Equipment
- .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: Polished chrome plated
- .8 Acceptable Manufacturers
 - .1 National Fire Equipment
 - .2 Herbert Williams
 - .3 Wilson and Cousins

2.14 **SIGNS**

- .1 Enamelled steel with fire department red enamel background, white letters; inscription in accordance with (NFPA) (FM) Standards.
- .2 150 mm x 150 mm for automatic control valves and alarm valves.
- .3 50 mm x 150 mm for other valves.
- .4 Fitted on control valves, shut-off valves, drain valves and test valves.

2.15 **CONTROL AND MONITORING SYSTEMS (FUTURE BAS INTEGRATION)**

- .1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:
 - .1 Delta Controls
 - .2 Reliable Controls
 - .3 Schneider Electric SmartX Series
 - .4 Distech Controls
 - .5 Johnson Controls Facility Explorer
 - .6 Honeywell CIPer series, Spyder Models 5 or 7
- .2 BAS System Integration:
 - .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving

- .5 Project Haystack naming convention
- .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
- .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.
- .3 Licensing Requirements
 - .1 Licenses shall be provided to and in the name of the City of Toronto
 - .2 Licenses shall be perpetual, transferrable, assignable and royalty free.
- 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 **EQUIPMENT INSTALLATION**
 - .1 Set equipment in place, align, connect and place in operation with:
 - .1 Controls set for efficient, stable operation.
 - .2 Initial lubrication and oil sumps filled.
 - .3 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.
 - .4 Install heater vents complete with necessary supports, hangers, braces, roof flashing, storm collar, and round top.
- 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.
- .4 Protect finished floor slabs from scuffing, cracking, chipping, staining, cutting and other damage resulting from Work of this Contract.
 - .1 Place a 19 mm thick plywood underlaid with 25 mm thick polystyrene insulation board adhered to same, over floor areas when working from, or over, such surfaces.
 - .2 Provide such protection below hoist rigs, ladders, pallets of material, and in other circumstances where the flooring is exposed to potential damage.
 - .3 Work damaged due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Owner, at no increase in Contract Price.

3.4 **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.

3.5 **FIRE EXTINGUISHERS**

- .1 Provide fire extinguishers as follows:
 - .1 In each fire hose cabinet
 - .2 One extinguisher for each 300 m² of floor area in an electrical or mechanical service room.
 - .3 In each extinguisher cabinet and at intervals to comply with the local fire code.
 - .4 At each fire hose reel, rack or tray, mounted to wall construction with substantial wall brackets provided with extinguishers.
 - .5 Type: Class ABC unless shown otherwise.
 - .6 As shown on drawings.

End of Section

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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" or their derivatives includes the Work of Divisions 21, 22, 23, and 25, unless otherwise specified.
- .3 Piping systems:
 - .1 Storm drainage system within building(s) including roof drains and connection to buried storm sewer 1.5 m outside building wall
 - .2 Sanitary drainage and venting system within building(s) including connection to buried sanitary sewer 1.5 m outside building wall
 - .3 Domestic cold, hot and recirculating water piping to plumbing fixtures within building
 - .4 Domestic cold water piping to 1.5 m outside building wall
 - .5 Natural gas piping
 - .6 Excavation, bedding, and backfilling of pipe trenches for buried piping inside building and to 1.5 m outside
- .4 Equipment:
 - .1 City water meter
 - .2 Plumbing specialties
 - .3 Drainage specialties
 - .4 Plumbing fixtures and fittings
 - .5 Hot water storage tank(s) and heater(s)
 - .6 Pumps

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 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 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.
- .5 Prepare construction/installation/fabrication drawings, coordinated with other trades and contracts, as required.
 - .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 manufacturer's 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.
- .3 Review Before Proceeding (HOLD)
 - .1 Where the word "HOLD" appears on Drawings and other Contract Documents, the Work is included in the Contract.
 - .2 Execute such Work only after verification of dimensions, verification of materials and obtaining Consultant's written permission to proceed.

1.5 **COORDINATION AND EXAMINATION**

- .1 Reference
 - .1 To Section 01 10 00.
- .2 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.
 - .3 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.
- 1.6 **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 Temporarily remove existing plumbing fixtures to suit new construction; reconnect fixtures at completion of the Work.
 - .1 Do not reuse existing fixtures in new locations.
 - .4 Cut back and cap existing services not being used, so that finished Work presents a neat and clean appearance.
 - .5 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.
- 1.7 **PROVISION FOR FUTURE**
 - .1 Future Equipment

- .1 Where indicated as reserved for future equipment or services, leave identified space clear and install services and equipment so that connections can be made in the future.

1.8

SUBMITTALS

.1 Shop Drawings

- .1 Conform to Section 01 33 00 and the following:
- .2 Shop Drawings showing more than one size or model will not be considered unless properly marked up.
- .3 For electrically driven, and fuel fired appliances, provide the following information:
 - .1 Electrical characteristics including voltage, phase, frequency and power rating.
 - .2 For motors, NEMA, class and efficiency ratings.
 - .3 Fuel input ratings, including flow rates and pressures.
 - .4 Equipment performance ratings, including flow rates, pressures, efficiencies, part load values and/or efficiencies (IPLV's), plotted flow characteristics (pump and fan curves) with operating points clearly plotted.
- .4 For other equipment include the following information:
 - .1 Equipment performance ratings, including flow rates, pressures drops.
 - .2 Electrical control power requirements.
- .5 For all equipment, include the following:
 - .1 Equipment dimensions and weights.
 - .2 Itemized product description with optional items clearly marked as being included.
- .6 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 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.

.4 Coordinate equipment which attaches to and/or where external wiring provided connects to other equipment.

.1 Do such coordination whether such equipment is supplied under this or other contracts or subcontracts, for which relevant information will be provided by Owner/Consultant.

1.9 **AS-BUILT" RECORD DRAWINGS**

.1 Reference

.1 Conform to Section 01 33 00.

.2 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 Conform to Section 01 33 00.

.2 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 Conform to Section 01 33 00.

.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.

1.12 **CLEANING, TESTING AND APPROVAL RECORDS**

.1 Records

.1 Maintain records of all pressure tests and flushing and sterilization tests, glycol/ water concentrations, inspections and approvals by the plumbing inspector.

.2 Forward these tests to the Owner on completion of the Work in accordance with Section 01 33 00.

- .3 Forward to Consultant, copy of records on site on completion of each test, cleaning operation, etc.

1.13 **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.

1.14 **TRADE QUALIFICATIONS**

.1 Applicable to the following trades:

- .1 Plumbers

.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.

2 Products

2.1 **MOTORS AND WIRING**

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

2.2 **METERS AND GAUGES**

- .1 In accordance with Section 23 05 19 Meters

2.3 **PIPE, FITTINGS AND VALVES**

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

2.4 **EXPANSION FITTINGS AND LOOPS**

- .1 In accordance with Section 23 05 24 Piping Specialties

2.5 **HANGERS AND SUPPORTS**

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

2.6 **VIBRATION AND SEISMIC RESTRAINT**

- .1 In accordance with Section 23 05 48 Noise and Vibration Control and 23 05 49 Seismic Restraint
- 2.7 **IDENTIFICATION FOR EQUIPMENT AND PIPING**
 - .1 In accordance with Section 23 05 53 Mechanical Identification
- 2.8 **PIPING INSULATION**
 - .1 In accordance with Section 23 07 19 Piping Insulation
- 2.9 **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.
- 2.10 **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.
- 2.11 **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.
- 2.12 **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
- 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 Balancing Valves
 - .1 Where two or more branches connect to a domestic hot water recirculating line, provide each return branch with a globe or circuit balancing valve.
 - .3 Air Handling Equipment Drains

- .1 Provide drains for fan casings, air handling equipment, and low points in ductwork in locations and in arrangements as indicated on the Drawings, or as required by design.
- .2 Drain piping is as specified for sanitary drainage, with deep seal copper trap.
- .3 Install trap seal equivalent to not less than one and one-half times the maximum static pressure in duct system.

3.3 **EQUIPMENT INSTALLATION**

- .1 Set equipment in place, align, connect and place in operation with:
 - .1 Controls set for efficient, stable operation.
 - .2 Initial lubrication and oil sumps filled.
 - .3 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, discolorations, tool marks, and other defects.
- .3 Thoroughly clean finished surfaces before acceptance of Work.
- .4 Install heater vents complete with necessary supports, hangers, braces, roof flashing, storm collar, and round top.

3.4 **FLUSHING AND STERILIZATION**

- .1 Sterilize water piping connected to municipal water supply 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 fifteen minutes or longer when directed by the Consultant.
- .3 After flushing of the system is completed, perform a twenty-four 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 thirty 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 **SPARE PARTS**

- .1 Furnish spare parts
 - .1 One set of packing glands for each size of pump gland.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One set of V-belts for each drive.

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

3.6 **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.
- .4 Protect finished floor slabs from scuffing, cracking, chipping, staining, cutting and other damage resulting from work of this Contract.
 - .1 Place a 19 mm thick plywood underlaid with 25 mm thick polystyrene insulation board adhered to same, over floor areas when working from, or over, such surfaces.
 - .2 Provide such protection below hoist rigs, ladders, pallets of material, and in other circumstances where the flooring is exposed to potential damage.
 - .3 Work damaged due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Owner, at no increase in Contract Price.

3.7 **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.

End of Section

- 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 in accordance with Section 01 33 00.
 - .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data in accordance with Section 01 33 00.
 - 1.3 **REFERENCE STANDARDS**
 - .1 Back-flow preventers: To CAN/CSA B64 standard series
- 2 Products
 - 2.1 **BACK FLOW PREVENTERS**
 - .1 General
 - .1 Products from Watts have been used as a guide to establish standard of construction. Comparable Products are acceptable from the following manufacturers:
 - .1 Watts
 - .2 Honeywell/Braukmann
 - .3 Zurn Wilkins
 - .4 Cla-Val
 - .5 Apollo
 - .6 Conbraco
 - .2 Vacuum Breakers, Pressure Type (PVB)
 - .1 To CSA B64.1.2 for back-siphonage, no back pressure.
 - .2 Working pressure: To 1000 kPa (150 psig).
 - .3 Working temperature: To 60°C (140°F).
 - .4 NPS ½ to NPS 2: Anti-siphon pressure vacuum breaker complete with bronze body and spring loaded single float and disc with independent first check, shut off valves and bronze type test cocks for winterization draining. Springs should be of stainless steel construction.
 - .3 Double Check Valve Assemblies (DCVA)

- .1 To CSA B64.5
- .2 Two independent positive seating check valves with captured springs and seat discs. The valve seat and discs shall be replaceable. All internal components shall be serviceable by access cover(s).
- .3 Working pressure: To 1200 kPa (175 psig).
- .4 Working temperature: To 60°C (140°F).
- .5 NPS ½ to NPS 2: Complete with quarter turn shut-off valves, bronze strainer and test cocks.
- .6 NPS 2½ to 10: Complete modular check valve assemblies with centre stem guiding, non-rising stem gate valves, test cocks and strainer.
- .4 Backflow Preventer with Intermediate Atmospheric Vent (DCAP)
 - .1 To CSA B64.8.
 - .2 Two independent check valves with intermediate vacuum breaker and relief vent.
 - .3 Working pressure: To 1200 kPa (175 psig).
 - .4 NPS ½ to NPS ¾: All bronze construction complete with integral strainer, union connection on inlet and outlet.
- .5 Dual Check Vacuum Breaker for Vending Machines
 - .1 To CSA B64.8.
 - .2 Dual check valve, ball check valve and atmospheric vent.
 - .3 Working pressure: To 1000 kPa (150 psig).
 - .4 NPS 3/8: Stainless steel body construction.
- .6 Reduced Pressure Principle (RPP)
 - .1 To CSA B64.4.
 - .2 Two independent check valves with captured springs, access for maintaining internals, replaceable valve seats, intermediate relief valve, shut-off valves and ball type test cocks.
 - .3 Working pressure: To 1200 kPa (175 psig).
 - .4 NPS ½ to NPS 2: Complete with quarter turn shut-off valves and bronze strainer.
 - .5 NPS 2½ to NPS 10: Complete with non-rising stem, shut-off gate valves and strainer.
 - .6 Backflow preventer test kit: Pressure gauge, colour coded needle valves and hose, adaptors, replaceable hose filters and valve stem seals, carrying case.

2.2 MISCELLANEOUS EQUIPMENT

- .1 Make-up Water Feeder Valves
 - .1 Line size, complete with adjustable pressure reducing valve, anti-siphon check and strainer. Products from the following manufacturers are acceptable.

- .1 Taco
 - .2 Armstrong
 - .3 Watts
 - .2 Water Pressure Reducing Valve
 - .1 Spring loaded, field adjustable, strainer, replaceable seat. Access for servicing internal components. Products from the following manufacturers are acceptable.
 - .1 Watts
 - .2 Zurn
 - .3 Conbraco
 - .3 Shock Absorbers
 - .1 Water hammer arrestor, sized in accordance with P.D.I.-WH201. Products from the following manufacturers are acceptable.
 - .1 Watts
 - .2 Zurn Shoktrol
 - .3 PPP Inc.
 - .4 Non-Freeze Wall Hydrants (WH)
 - .1 "WH-1": Non-freeze box type, flush mounting to wall, with NPS 3/4 hose connection, self-draining, integral hose end vacuum breaker, hinged locking cover, galvanized wall sleeve, ground joint union elbow adapter and operating key. Products from the following manufacturers are acceptable.
 - .1 Ancon
 - .2 Zurn
 - .3 MI Fab
 - .2 "WH-2": Non-freeze exposed type, with NPS 3/4 hose connection, self-draining, integral hose end vacuum breaker, galvanized wall sleeve, ground joint union elbow adapter and operating key.
 - .1 Ancon
 - .2 Zurn
 - .3 MI Fab
 - .5 Hose Bibbs (HB)
 - .1 Rough brass construction with hose end spout, size as indicated.
 - .1 Emco
 - .2 Cambridge Brass
- 3 Execution
- 3.1 **INSTALLATION - MISCELLANEOUS**

- .1 Back Flow Preventers
 - .1 Provide backflow preventers selected in conformance to CSA B64.10, where a connection is made between any system conveying potable water and a system carrying non-potable water or any other liquid.
 - .2 Install backflow preventers where shown on Drawings, in accordance with manufacturers recommendations, and as follows:
 - .1 Locate RPP devices at 1.2 mm above finished floor.
 - .2 Locate VBP devices exposed as close to fixture connection as possible.
 - .3 Provide drain collector at relief valves and NPS 3/4 drain from DCAP and RPP devices and run drain to nearest floor drain.
 - .3 Testing:
 - .1 Provide the services of an independent inspection agency to verify operation of all backflow prevention devices provided with testing ports.
 - .2 Provide inspection tag on each such device.
 - .3 Submit test results to building plumbing inspector and Consultant.
 - .2 Make-up Water Valves
 - .1 Locate in domestic water lines to heating and cooling systems where shown.
 - .3 Water Pressure Reducing Valves
 - .1 Locate in domestic water lines as shown, with capacity and pressure reduction ratings as shown.
 - .2 Provide pressure gauge on downstream side of pressure relief valve, complete with pet-cock.
 - .3 Provide pressure relief valve suitably sized and pipe to drain.
 - .4 Shock Absorbers
 - .1 Locate shock absorbers in hot and cold water lines:
 - .1 At far ends of mains
 - .2 At branch lines to each flush valve and quick closing valve
 - .3 At dead ends of branch piping or to groups of plumbing fixtures
 - .4 At isolated individual plumbing fixtures
 - .5 Wall Hydrants
 - .1 Verify wall thickness at each hydrant to ensure correct hydrant length.
 - .6 Hose Bibbs
 - .1 Mount 1050 mm above finished floor.
 - .2 Provide a line mounted vacuum breaker selected for continuous pressure.
- End of Section

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- 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 in accordance with Section 01 33 00.
 - .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data in accordance with Section 01 33 00.
- 2 Products
 - 2.1 **DRAINAGE SPECIALTIES**
 - .1 Acceptable Manufacturers
 - .1 Watts
 - .2 Zurn Industries Ltd.
 - .3 MI Fab
 - .2 Products from Watts have been used as a guide to establish the standard of construction. Comparable Products are acceptable from the above listed manufacturers. Sizes are as shown on Drawings.
 - 2.2 **FLOOR DRAINS**
 - .1 General Construction
 - .1 Drain body to have tapped primer connection.
 - .2 The type letter allocated to the following list of floor drains identifies that particular drain on the Drawings.
 - .2 FD-"A"
 - .1 Two-piece Dura coated cast iron body with double drainage flange, weep holes, non-puncturing flashing collar, adjustable 13 mm thick, 150 mm diameter polished nickel bronze strainer, and push-on, caulked or "MJ" bottom outlet.
 - .3 FD-"B"
 - .1 Two-piece Dura coated cast iron body with double drainage flange, weep holes, non-puncturing flashing collar, adjustable 13 mm thick, 150 mm diameter polished nickel bronze strainer, sediment bucket, and push-on, caulked or "MJ" bottom outlet.

- .4 FD-"D"
 - .1 Two-piece Dura coated cast iron body with double drainage flange, weep holes, non-puncturing flashing collar, adjustable 125 diameter nickel bronze combination strainer and 100 mm x 225 mm oval funnel, and push on, caulked or "MJ" bottom outlet.
- .5 FD-"E"
 - .1 Two-piece Dura coated cast iron body with double drainage flange, weep holes, non-puncturing flashing collar, adjustable 100 mm diameter cast iron above floor hub and push-on, caulked or "MJ" bottom outlet.
- .6 FD-"F"
 - .1 Dura coated cast iron body with 300 mm square fixed top, double drainage flange, clamp device, weep holes, heavy duty Dura coated iron grate, removable sediment bucket, and push on, caulked or "MJ" bottom outlet.
- .7 FD-"H"
 - .1 Dura coated cast iron scupper drain with flashing flange, removable bolted brass sloping grate with flange serving as flashing clamp, and ninety degree threaded outlet.
- .8 Floor Drain Traps and Primers
 - .1 Trap seal primer valves: Cast brass body, integral vacuum breaker and NPS ½ sweat connections.
 - .2 Automatic flush tank for priming of trap: Automatic syphon, tank liner, concealed top cover, bottom supply and screw driver stop.
 - .3 As an alternative to automatic flush tanks electronic trap seal primer system with air gap and 13 mm solenoid valve.

2.3 TRENCH DRAINS AND CATCH BASINS

- .1 Trench drains (Type TD2): Complete assembly of polymer concrete 0.6% continuous sloped channels, in meter length with connection to create continuous sloping. Trench drains to be Aco Drain S100K, S200K and S300K and run as shown on Drawings complete with 100, 200, 300 mm Class F slotted iron (DIN 19580) 4182 psi f bike accessible grate complete with boltless locking mechanism.
- .2 Inline catch basins to be polymer concrete Aco Drain Series 600 500 x 350 x 675 mm deep (short base) for S100K trenches. Grating to match trench drains grating (type CB2 as per drawings).
- .3 Individual fiberglass catch basins: ACO F880, 610 mm x 610 mm x 685 mm deep body complete with Class E cast iron slotted grate (type CB3 as per drawings).
- .4 Refer to ACO load rating for Class E for catch basins, and Class F for trench drains.

2.4 **DRAINAGE CLEANOUTS**

.1 Buried Piping

- .1 Flush floor type: Cast iron ferrule with inside caulked or spigot connection outlet, seal plug and nickel brass frame, cover suitable for type of floor in which it is to be installed, e.g. tile, terrazzo, carpet, concrete, etc. and push on, caulked or "MJ" bottom outlet. Provide membrane clamp if installed on membrane floors.

.2 Exposed Piping

- .1 Cast iron piping in exposed location or in accessible pipe chases: Cast iron body with straight threaded, coated plug having a tapered shoulder that seats against a lead seal.
- .2 Copper stack piping in exposed locations or in accessible pipe chases: Bronze cleanout tee, bronze ferrule and cover, secured to ferrule by bronze cap screws.
- .3 Access cover for cleanouts concealed in walls: Type to suit wall surface and construction.
- .4 Cover for cleanouts at base of vertical sanitary stacks or rainwater leaders: Bolted type, neoprene gasket, and brass cap screws or bolt studs, unless shown otherwise on Drawings.

2.5 **MISCELLANEOUS PRODUCTS**

.1 Back-Water Valves

- .1 Cast iron body with gasketed cover, removable bronze disc and seat, and access cover.
- .2 In finished areas, provide nickel bronze frame and round scoriated type cover.

3 Execution

3.1 **INSTALLATION**

.1 Floor Drains

- .1 Provide each floor drain installation with a deep seal "P" trap unless otherwise shown, complete with trap primer connection tapping to conform to code requirements.

.2 Floor Drain Primers

- .1 Provide each floor drain with a trap seal primer.
- .1 Exception: Floor drains located in shower stalls, group showers and other locations where the floor is exposed to water on a daily basis.
- .2 Use trap seal primer valves where a domestic cold water line serving a washroom fixture (preferably a water closet) is within 15.25 m of the floor drains.
- .1 Above ground floor drains: Provide an NPS ½ Type K copper pipe to primer connection on drain body.
- .2 Below ground floor drains: Provide an NPS ½ Type K copper pipe to within 300 mm of the floor line. Provide 9.5 mm white polybutylene tubing from this point and connect to drain body.

- .3 Install trap primer in truss space or other accessible location, or as directed by Consultant.
- .4 In other areas with remote floor drains, use an automatic flush tank.
- .3 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.
- .4 Back-Water Valves
 - .1 Provide where shown.
- .5 Trench Drains and Catch Basins
 - .1 Construct units in accordance with manufacturer and Consultant details indicated, plumb and true to alignment and grade. Bring manufacturer's representative on site for evaluation of existing site conditions and specific installation measures.
 - .2 Complete units as pipe laying progresses.
 - .3 Coordinate and cooperate installation with general trades.
 - .4 Set precast concrete base on 150 mm minimum granular bedding, placed and compacted to 100% Standard Proctor Maximum Dry Density to ASTM D698, under Section 31 23 33.
 - .1 Precast Units
 - .2 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base. Make each successive joint watertight with rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination thereof.
 - .3 Clean surplus mortar and joint compounds from interior surface of unit as Work progresses.
 - .4 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.
 - .5 Place frame and cover on top section to elevation. If adjustment is required, use precast concrete ring.
 - .6 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
 - .7 Height Adjustment of Catch Basins
 - .1 Adjust height by deletion or addition of mortared precast concrete ring as required to match the finished floor elevation surrounding the catch basin. Where raised, roughen existing top to ensure proper bond and extend to required elevation.
 - .2 Set gratings and frames to required elevation.

- .8 Inside repair garage install, for automatic flushing, a process water 38 mm (1½") line parallel to the central trench.
- .6 Expansion Joints
 - .1 Provide vertical expansion joints near top of drainage pipe risers where total riser height exceeds 10 m from ground level.
 - .2 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

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- 1 General
 - 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
 - .2 Conform with all sections of Division 1, 21, 22, 23 and 25 as applicable.
 - 1.2 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Submit Shop Drawings in accordance with Section 01 33 00.
 - .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data in accordance with Section 01 33 00.
- 2 Products
 - 2.1 **OIL INTERCEPTORS, GREASE INTERCEPTOR**
 - .1 Prefabricated Option
 - .1 Polyester resin basin or double wall steel.
 - .2 Control panel with level monitoring and local alarm.
 - .3 Suitable for underground installation.
 - .4 Extended manway to suit installation depth.
 - .5 Thirty year warranty against leakage, corrosion and structural failure.
 - .6 Discharge to 10 ppm hydrocarbons.
 - .7 Internal oil reservoir with alarm monitoring system, remote control unit mounted in visible area complete with light and audio alarm.
 - .8 Cam and groove couplers
 - .1 Cam and groove complete with dust PWG type "D" and "DP", 100 mm diameter for oil interceptor through the wall remote discharge line. Product to be interchangeable with oil interceptor.
 - .9 Acceptable Manufacturers:
 - .1 Proceptor Model OMC 6000 - Green Turtle Technologies – oil interceptor
 - .2 Proceptor Model GMC 500 - Green Turtle Technologies – grease interceptor
 - .3 Zurn
 - .4 STRIEM
 - .10 Control and Monitoring Systems (Future BAS Integration)

- .1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:
 - .1 Delta Controls
 - .2 Reliable Controls
 - .3 Schneider Electric SmartX Series
 - .4 Distech Controls
 - .5 Johnson Controls Facility Explorer
 - .6 Honeywell CIPer series, Spyder Models 5 or 7
- .2 BAS System Integration:
 - .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
 - .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
 - .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.
- .3 Licensing Requirements
 - .1 Licenses shall be provided to and in the name of the City of Toronto
 - .2 Licenses shall be perpetual, transferrable, assignable and royalty free.

2.2 **CONCRETE MANHOLE INCLUDING CAST IRON COVER**

- .1 Provide concrete 1500 mm diameter maintenance manhole manufactured in accordance with OPSD 701.011 including precast base slab riser, transition, gaskets, heavy duty gas tight 792 mm diameter cast iron cover square frame with circular cover per OPSD 401.030 and hollow aluminum steps as per OPSD 405.010.
- .2 Height and configuration as per Drawings.
- .3 Manufacturer: M CON, Ottawa, 1-800-267-5515, or accepted equal.

2.3 **CAST IRON COVERS**

- .1 Provide square frames and cover for sanitary sump pit as per Drawings.

3 Execution

3.1 **INSTALLATION**

- .1 Oil Interceptors and Manholes
 - .1 Install interceptors in accordance with manufacturer's recommendations including concrete embedding at base to prevent buoyancy.
 - .2 Connect interceptor vents and manhole vents to outside as shown on Drawings.
 - .3 For oil interceptors, install discharge lines as shown on Drawings.
 - .4 Coordinate installation and concrete Work with general trades.
 - .5 Install control box on closest wall with disconnect switch in compliance with Section 26 05 02.

End Of Section

- 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 in accordance with Section 01 33 00.
 - .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data in accordance with Section 01 33 00.
- 2 Products
 - 2.1 **PUMP GENERAL REQUIREMENTS**
 - .1 The following are minimum construction requirements, unless specified elsewhere.
 - .1 Pump casings:
 - .1 Close grained cast iron or cast bronze as specified.
 - .2 Fitted with casing or impeller wear rings, or both.
 - .2 Impellers:
 - .1 Enclosed bronze or duralloy.
 - .2 Dynamically balanced.
 - .3 Mounted on carbon steel shaft fitted with stainless steel or bronze sleeves.
 - .3 Seals:
 - .1 Suction pressures less than 690 kPa (100 psi): Fitted with mechanical seals.
 - .2 Stuffing box pressure in excess of 690 kPa (100 psig): Balanced type seals.
 - .3 Pumps with packing glands: Fitted with stainless steel shaft sleeves for full length of stuffing box.
 - .4 Performance
 - .1 Characteristic curve to be continuously rising to from run-out to shut-off.
 - .2 Select pump to operate within flow range from 30% below point of maximum efficiency to 10% above that point for impeller diameter chosen.

- .3 Installed impeller diameter not to exceed 90% of maximum impeller diameter catalogued for pump casing.
- .4 Motors to be sized for continuous operation without motor overload at runout condition for impeller size and rotational speed selected.

2.2 **SANITARY SUMP PUMPS**

.1 Construction

- .1 Simplex (Duplex) pump set.
- .2 Centrifugal sewage pump, vertical, shaft driven, single stage, non-clog.
- .3 Cast iron casing and cast iron semi-open impeller, alloy steel shaft.
- .4 Ball thrust bearing, bronze guide bearings, grease lubrication.
- .5 Cast iron motor support.
- .6 Motor.
- .7 Schedule 40 black steel pump leg and discharge pipe.

.2 Fitments

- .1 Aluminum cover plate complete with structural steel curb frame suitable for grouting into a concrete sump, and heavy gasket.
- .2 Coordinate delivery of curb frame to meet construction requirements. Frame will be installed by General Trades when pouring concrete sump.
- .3 300 x 300 mm inspection cover in the cover plate.
- .4 NPS 3 vent tapping.
- .5 Sleeved holes for mounting float rods.

.3 Access Ladder

- .1 Provide a hot dipped galvanized steel ladder 450 mm wide.
- .2 75 x 13 mm stringers.
- .3 19 mm diameter rungs at 300 mm o.c.
- .4 Provide first step 150 mm below manhole.
- .5 Locate steps in concrete formwork before concrete is poured.

.4 Simplex Pump Control

- .1 Simplex Pump automatically controlled by liquid level switch mounted on a bracket attached to floor plate.
- .2 Complete with brass float rod, limit stops, float rod guide, and seamless copper float.
- .3 Single point power supply.

.5 Duplex Pump Control

- .1 Duplex pumps automatically controlled by (a mechanical) (an electric) alternator.
- .2 Automatically alternates lead pump and operates both pumps on high flow demand.
- .3 Provide alternator control assembly complete with starters, mounting bracket, brass float rod, limit stops, float rod guide, copper float and control transformer.
- .4 Single (Dual) point power supply.

.6 Manufacturers

- .1 S.A. Armstrong
- .2 ITT-Goulds
- .3 Paco
- .4 Aurora
- .5 Pentair - Hydromatic

2.3 **SUBMERSIBLE SUMP PUMP**

.1 Construction

- .1 Bronze (Cast iron) construction with semi-open type bronze impeller to pass solids of 32 mm diameter.
- .2 Stainless steel shaft.
- .3 Integrally cast base and discharge elbow.
- .4 Motor with built-in thermal overload protection, and sealed from contact with pumped fluid.

.2 Pump Control

- .1 Automatic operation by a diaphragm actuated, factory set, integral liquid level control (floats to be oil resistant).
- .2 Complete with 3 m long ULC approved waterproof, three-wire power cable with U-ground moulded plug.

.3 Manufacturers

- .1 Xylem Flygt
- .2 Goulds
- .3 Little Giant
- .4 Grundfos
- .5 Pentair - Hydromatic

2.4 **PROCESS SUMP PUMP CONTROLS**

- .1 Where Required
 - .1 Process effluent sump tanks.
 - .2 Where shown on Drawings.
- .2 Level Control
 - .1 Magentrol Model 103 F EP/VP-TDM-S13-S13 explosion proof electrical liquid level control, Arrangement No. 1.
 - .2 Suitable for liquid operating conditions of 20°C (68°F) and specific gravity of 0.90 to 1.0.
 - .3 Level controller to be supplied with 3 m of cable and NPS 4 1035 kPa (150 lb) steel mounting flange.
 - .4 Install level control inside NPS 8, Schedule 40 steel stilling pipe with NPS 4 flange at top. Cut four 50 mm wide x 300 mm high slots in top and bottom of NPS 8 stilling pipe starting 75 mm above bottom and 75 mm below cover plate.
- .3 Sequence of Operation
 - .1 When level in pit drops to 300 mm above bottom of pit, level controls stop pump.
 - .2 When level in pit rises to 900 mm above bottom of pit, level controls start pump.

2.5 **CONTROL AND MONITORING SYSTEMS (FUTURE BAS INTEGRATION)**

- .1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:
 - .1 Delta Controls
 - .2 Reliable Controls
 - .3 Schneider Electric SmartX Series
 - .4 Distech Controls
 - .5 Johnson Controls Facility Explorer
 - .6 Honeywell CIPer series, Spyder Models 5 or 7
- .2 BAS System Integration:
 - .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention

- .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
 - .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.
 - .3 Licensing Requirements
 - .1 Licenses shall be provided to and in the name of the City of Toronto
 - .2 Licenses shall be perpetual, transferrable, assignable and royalty free.
 - 3 Execution
 - 3.1 **INSTALLATION**
 - .1 General
 - .1 Make piping and electrical connections to pumps.
 - .2 Check pump rotation.
 - .3 Set up and adjust controls.
 - .4 Pipe drain tapping to drain.
 - .5 Install gauges.
 - .2 Sanitary Sump Pumps
 - .1 Power wiring between starters and pump motors. Line side wiring will be connected to starters under (Division 26) (a separate Electrical Contract).
 - .2 Provide gate valve and non-slam counterweighted check valve and flexible metal hose just above cover plate, in discharge line from each pump. Set counterweight arm in horizontal position.
 - .3 Keep discharge piping clear of pumps to facilitate removal from sump.
 - .4 Align pump assembly after mounting and securing cover plate.
 - .3 Submersible Sump Pump
 - .1 Provide check valve just below cover plate in discharge line from each pump.
- End of Section

1 General

1.1 **SCOPE**

- .1 Furnish and install compressed air piping necessary for a complete installation, as shown, specified, or required.

1.2 **SUBMITTALS**

- .1 Submit Product data covering catalog items. If catalog is general in nature, indicate the specific items (and related accessories) proposed for use.
- .2 Submit copies of all test reports.
- .3 Where specified, submit certificates stating that the Work conforms to the Specifications.
- .4 Submit Shop Drawings to show compliance with the Contract Documents.

1.3 **REFERENCE STANDARDS**

- .1 American Society for Testing and Materials (ASTM)
- .2 American National Standards Institute (ANSI)

2 Products

2.1 **SCOPE**

- .1 This section defines acceptable piping, fittings and valves for general plant compressed air piping systems from 0 to 125 psig.

2.2 **ABOVEGROUND PIPING**

- .1 Aboveground pipe sizes up through 50 mm (2"), screwed and mechanical joints

<u>Item</u>	<u>Rating</u>	<u>Material</u>	<u>Remarks</u>
Pipe	Schedule 40	Black steel	ASTM A53
Screwed fittings	150 lb	MI	ASTM A197, banded
Screwed unions	250 lb	MI	ASTM A197, ground joint brass-iron
Screwed couplings	Standard	Black steel	ASTM A53

- .2 Aboveground pipe sizes 63 mm (2½") and larger, welded joints

<u>Item</u>	<u>Rating</u>	<u>Material</u>	<u>Remarks</u>
Pipes 63 mm to 254 mm	Schedule 40	Black steel	ASTM A53, Grade B, ERW
Welded flanges	150 lb	Forged steel	ASTM A105, ANSI B16.5 weld neck
Welded fittings	Standard	Black steel	ASTM A234, butt welding
Gaskets		Composition	1/16" thick
Nuts and bolts		Steel	ASTM A307, Grade B, hex head, machine bolts

- .3 For 63 mm and larger horizontal pipe runs, provide a bottom tap drip leg at 30.5 m intervals. Provide a drip leg at the bottom of vertical piping. Drip leg shall be 63 mm pipe (150 mm long) and a 19 mm ball valve drain.

- .4 Branch connections, two-thirds of main size and smaller shall be made with weldolets or threadolets. Branch connections larger than two-thirds of main size shall be made with tees, laterals, or crosses. Mitre bends, field fabricated reducers and nozzle welds are prohibited. Long radius elbows and welding neck flanges shall be used. The use of slip-on welding flanges is prohibited, except where they are Owner approved for a specific application.
- .5 Roll or groove pipe and coupling is not allowed in any occupied area, nor is it allowed in unoccupied areas without Owner prior approval.

2.3 VALVES

- .1 Filter/Regulator/Lubricator
 - .1 Provide filter/regulator/lubricator assembly NPS ¾ adjustment range 5 to 100 psi metal with site glass as manufactured by "Speed Aire".
- .2 Screwed valves up through 50 mm:
 - .1 Ball valves shall be two-piece 600-pound WOG bronze with Teflon trim.
 - .2 Gate valves shall be Class 125 bronze with solid wedge disc, rising stem.
 - .3 Globe valves shall be Class 150 bronze with composition disc.
 - .4 Check valves shall be Class 200 bronze, swing type, re-grindable.
 - .5 All gate and globe valves shall be rising stem and back seating for package under operating pressure.
 - .6 Pressure relief valve inlet size 50 mm, outlet size 50 mm, maximum working pressure 125 psig, relief set up at 125 psig. Type: ASME safety relief valve, bronze body. Air release capacity: 2114 cfm.
 - .7 For Pressfit system use style 589 brass body ball valve with chrome plated ball and stainless-steel end with Grade T nitrile O-ring.

	Figure Number				
Manufacturer	Gate	Globe	Check	Ball	Ball (full port)
Conbraco "Apollo"	----	----	----	70-100 series	77-100 series
Crane	428	7TF	36	----	----
Hammond	IB640	IB413T	IB944	8501	8301
Milwaukee	148	590	508/518	BA100	BA125
Nibco	T-111	T-235Y	T-453B	T-580-70	T-585-70
Powell	500	150A	560	----	----
Walworth	55	W95	W420	----	----
Watts	----	----	----	B6000	B6080

- .3 Butterfly valves, 63 mm through 300 mm
 - .1 Butterfly valves shall be used unless directed by drawings not to be used. Gate valves are not to be used. The valves shall be rated for bubble tight shut off on vacuum service or line pressure differential up to 150 psig and maximum 82°C (180°F) temperature. The valves shall be capable of bi-directional mounting, and the valve body shall have an extended neck when required to allow for full insulation thickness.

- .2 Operating mechanism shall be position lever lock, handle lever not more than 450 mm for valves through 125 mm diameter and worm gear or screw enclosed type for larger sizes. Where valves are indicated to be chain operated, all sizes shall be equipped with chain length for proper stowage and operation.
- .3 Valves shall be suitable for dead end service. Valve body shall be of the full threaded lug construction, for double flange bolting (bolted from both sides). Drilled through or wafers are NOT approved.

<u>Item</u>	<u>Remarks</u>
Body	Ductile iron, threaded lug
Disc	Stainless steel
Seat	Replaceable Buna-N (aka Nitrile, Hycar) or Viton
Shaft	Stainless steel with hex, square or flat service connection to disc. Locking of disc to shaft by means of screws or pins is NOT approved.
Shaft seals	O-rings or packing (oil proof)
Bearings	Valves shall have top and bottom bronze or stainless steel bearings

- .4 Approved butterfly valve manufacturers:

- .1 Hammond
- .2 Keystone (Tyco)
- .3 Milwaukee
- .4 Nibco
- .5 Norris/O'Bannon
- .6 Stockham (Crane)

- .4 Flanged valves 63 mm and larger:

- .1 All gate and globe valves shall be rising stem and back seating for re-packing under pressure.
- .2 Gate valves shall be class 125 iron body; bronze trimmed with outside screw and yoke and bronze stem.
- .3 Globe valves shall be class 125, iron body, bronze trimmed with outside screw and yoke and bronze stem.
- .4 Check valves shall be class 125, iron body, bronze trimmed, swing type with bronze seat and stainless-steel pin or globe type, center guided, cast iron body, bronze trim, ASTM A126, class 125 with stainless steel spacing.

<u>Manufacturer</u>	<u>Figure Number</u>			
	<u>Gate</u>	<u>Globe</u>	<u>Check (swing)</u>	<u>Check (globe)</u>
Crane	465-1/2	351	373	----
DFT Durabla	----	----	----	Model GLC
Hammond	IR1140	IR116	IR1124	IR9354
Milwaukee	F-2885	F-2981	F-2974	1800 series
Mueller	----	----	----	105MAP
Nibco	F-617-0	F-718-B	F-918-B	F-910
Powell	1793	241	559	----
Walworth	W726F	W906F	W928F	----

3 Execution

3.1 **NOT APPLICABLE**

End Of Section

- 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 (125 psi) (1035 kPa (150 psi))
 - .3 Efficiency and Stand-by Loss Ratings
 - .1 To ASHRAE/IES 90.1b
 - .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 33 00.
 - .2 Minimum warranty on tanks, accessories and parts shall be minimum of 5 years.
- 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 replaceable magnesium anode

- .2 50 mm mineral wool or foam injected insulation
- .3 Baked enamelled steel jacket housing
- .4 Zinc plated copper sheathed medium watt immersion elements arranged for flip-flop operation controlled by close tolerance positive snap action thermostats
- .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 to 54 kW
 - .2 As indicated on Drawings.
- .3 Manufacturer
 - .1 A.O. Smith
 - .2 J.H Wood
 - .3 Bradford White
 - .4 Rheem

2.3 **HEAVY DUTY ELECTRIC TANK-TYPE**

- .1 Construction
 - .1 Glass lined steel tank with replaceable magnesium anode
 - .2 R16 50 mm mineral wool or foam injected insulation
 - .3 Baked enamelled steel jacket housing
 - .4 Incoloy medium watt immersion elements arranged for flip-flop operation controlled by close tolerance positive snap action thermostats
 - .5 Manual reset high temperature limit switch
 - .6 Built-in and factory pre-wired controls including contactors, complete with pilot light and switch, sequencing, time clock, low water cutoff, circuit fusing, alarm bell, modulating step control
 - .7 Handhold cleanout
 - .8 Hose threaded drain valve
 - .9 ASME rated temperature and pressure relief valve
- .2 Electrical
 - .1 As indicated on Drawings.

.3 Manufacturer

- .1 A.O.Smith
- .2 J.H Wood
- .3 Bradford White
- .4 Rheem

2.4 **HIGH CAPACITY/HIGH STORAGE ELECTRIC TANK**

.1 Construction

- .1 Glass lined steel tank with replaceable magnesium anode
- .2 ASME construction
- .3 50 mm fibreglass insulation
- .4 Baked enamelled steel jacket housing
- .5 Incoloy medium watt immersion elements arranged for flip-flop operation controlled by close tolerance positive snap action thermostats
- .6 Manual reset high temperature limit switch
- .7 Built-in and factory pre-wired controls including contactors, complete with pilot light and switch, sequencing, time clock, low water cutoff, control and power circuit fusing, alarm bell, modulating step control, terminal blocks, safety door interlock, manual limiting switches
- .8 Magnetic contactors UL rated for 100,000 cycles
- .9 Handhold cleanout
- .10 Hose threaded drain valve
- .11 ASME rated temperature and pressure relief valve

.2 Electrical

- .1 As indicated on Drawings.

.3 Manufacturer

- .1 A.O.Smith
- .2 J.H Wood
- .3 PVI
- .4 Rheem

2.5 **INSTANTANEOUS WATER HEATER**

.1 Construction

- .1 Low watt density, copper sheathed electric heating elements, flange mounted for easy removal.

- .2 Hot dipped galvanized steel tank, with minimum of 25 mm thick insulation, and baffles to direct flow of water across all elements.
 - .3 Full automatic controls and control panel mounted on heater, including manual reset high temperature safety cut-out, thermostat, magnetic contactor and control transformer.
 - .4 Pressure temperature relief valve.
 - .2 Manufacturers
 - .1 Rheem
 - .2 Patterson-Kelly
 - .3 Bosch
 - .4 A.O. Smith
- 2.6 **CONTROL AND MONITORING SYSTEMS (FUTURE BAS INTEGRATION)**
- .1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:
 - .1 Delta Controls
 - .2 Reliable Controls
 - .3 Schneider Electric SmartX Series
 - .4 Distech Controls
 - .5 Johnson Controls Facility Explorer
 - .6 Honeywell CIPer series, Spyder Models 5 or 7
 - .2 BAS System Integration:
 - .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
 - .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
 - .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.
 - .3 Licensing Requirements
 - .1 Licenses shall be provided to and in the name of the City of Toronto

.2 Licenses shall be perpetual, transferrable, assignable and royalty free.

3 Execution

3.1 **INSTALLATION**

.1 General

.1 Provide structural steel for horizontal mounted tanks and for instantaneous heaters.

.2 Provide valved drain from each tank to nearest funnel or hub drain.

.3 Pipe-up T&P relief valve down to floor.

.4 Connect up to cold water supply lines and domestic hot water distribution piping.

.5 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

- 1 General
- 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Products, equipment and services necessary to complete the Work of this section.
 - .2 General Requirements
 - .1 The following products will be supplied by NEXT Plumbing Supply (NPS):
 - .1 Lavatories
 - .1 L1
 - .2 L1H (Barrier Free Use)
 - .3 L2H
 - .2 Urinals
 - .1 U1H
 - .3 Water Closets
 - .1 W1
 - .2 W1H
 - .3 W2
 - .4 W2H
 - .5 W3
 - .6 W3H
 - .2 As part of the Shop Drawing submittal, Contractor is to submit a by-building order form to the Consultant and Owner listing the items and quantities for each building the equipment is to be installed in. Refer to the Appendices for the Plumbing and Accessories Order Form
 - .3 Once the shop drawings are reviewed and the order form quantities are verified by the Consultant and Owner, the Owner will submit the order form to NPS for processing as well as pay NPS for the order directly.
 - .4 The Contractor is to coordinate delivery of supplied items with NPS and store on site as needed prior to installation.
 - .5 Material defects of the products and equipment are the responsibility of NEXT and the Contractors to coordinate and replace.
 - .6 Replacement of any equipment or appurtenances listed in section 1.1.2.1 of this specification will be at the expense of the Contractor.

1.2 **REFERENCES**

- .1 Conform to the latest edition of the following:
 - .1 AODA - Accessibility for Ontarians with Disabilities Act
 - .2 TADG - Toronto Accessibility Design Guidelines

1.3 **SUBMITTALS**

- .1 Shop Drawings
 - .1 Submit Shop Drawings in the form of catalogue cuts and fully illustrating specified materials with description of components, surface finishes, hardware and securement devices.

1.4 **WARRANTY**

- .1 Warrant the following Products against defects and deficiencies for a period of two years from date Work is certified as substantially performed in accordance with the general conditions of the Contract:
- .2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective Product satisfactory to the Consultant and at no expense to the Owner.

2 Products

2.1 **PLUMBING FIXTURES**

- .1 General Requirements
 - .1 CSA approved plumbing fixtures and fittings, of make, type and size specified herein.
 - .2 Comply with the current water saving ratings of the Ontario Building Code, and ASHRAE/IEEE 90.1.
 - .1 Lavatories: Maximum 8.3 L/min at 413 kPa (60 psig)
 - .2 Urinals: Maximum 3.8 L/flush
 - .3 Water closets: Maximum 6.0 L/flush
 - .4 Shower heads: Maximum 9.5 L/min
 - .3 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.

2.2 **LAVATORIES**

- .1 Lavatories - Type L1H (Barrier Free Use)
 - .1 Type: Wall hung, vitreous china.

- .2 Lavatory: White, 508 mm x 464 mm for barrier free use, dilled for concealed arm carrier with single faucet hole and overflow, complete with semi-pedestal P-trap cover.
 - .1 American Standard "Decorum with EverClean" No. 9024.001EC.020
- .3 Supply fitting: Electronic, adjustable infrared sensor-activated faucet, polished chrome finish, single hole mounting, magnetic solenoid valve.
 - .1 Moen Align Sensor Faucet – 8559AC (Electronic No-Touch Hardwired)
 - .1 Moen AC Conversion Kit - 182538
 - .2 Moen AC Transformer – 104630
- .4 Lavatory supplies: Chrome plated polished brass, ¼ turn ball valve angle stop, convertible ¼ turn/loose key handles, horizontal extension tubes, escutcheons and flexible copper risers. Products from the following manufacturers are acceptable.
 - .1 McGuire Supply Kit - H170LK-BV-RB
- .5 Trap: Adjustable durable solid brass "P" trap with 32 mm O.D outlet, adjustable rotation on tube outlet, slip joint inlet and cleanout plug. Products from the following manufacturers are acceptable:
 - .1 McGuire No. MC-8872CB
- .6 Sanitary Covering:
 - .1 McGuire MC-PW-2000 PW2000 PROWRAP
- .7 Waste fitting: Drain with open grid strainer, cast brass one piece top and tailpiece.
 - .1 McGuire No. 155A
- .8 Basin carrier: Heavy duty steel uprights with integral welded feet., concealed arms, wall flanges to attach to backing plate secured in wall with locking device and levelling screws, wall mounted steel plated hardware. Type and model as recommended by manufacturer for each wall hung basin to suit wall construction. Products from the following manufacturers are acceptable.
 - .1 Watts No. WCA-411-CA-481
- .9 Water Mixing Valve
 - .1 Powers Point of use Under Counter Thermostatic Mixing Valve
 - .1 LFE480-10
- .2 Lavatories Type L1:
 - .1 Type: Countertop, self-rimming, vitreous china
 - .2 Lavatory: White, self-rimming, rear/front overflow, drilled for 100 mm supply fitting.
 - .1 American Standard "Aqualyn" #0475.047.020 518 x 441 mm

- .3 Supply fitting: Electronic, adjustable infrared sensor-activated faucet, polished chrome finish, single hole mounting, magnetic solenoid valve.
 - .1 Moen Align Sensor Faucet – 8559AC (Electronic No-Touch Hardwired)
 - .1 Moen AC Conversion Kit - 182538
 - .2 Moen AC Transformer - 104630
 - .3 McGuire Supply Kit - H170LK-BV-RB
- .4 Lavatory supplies: Chrome plated polished brass, ¼ turn ball valve angle stop, convertible ¼ turn/loose key handles, horizontal extension tubes, escutcheons and flexible copper risers. Products from the following manufacturers are acceptable.
 - .1 McGuire Supply Kit - H170LK-BV-RB
- .5 Trap: Adjustable durable solid brass “P” trap with 32 mm O.D outlet, adjustable rotation on tube outlet, slip joint inlet and cleanout plug. Products from the following manufacturers are acceptable:
 - .1 McGuire No. MC-8872CB
- .6 Waste fitting: Chrome plated drain with open grid strainer with adjustable offset waste connection, cast brass construction.
 - .1 McGuire No. 155A
- .7 Sanitary Covering
 - .1 McGuire MC-PW-2000 PW2000 PROWRAP.
- .8 Trap: NPS 1¼ adjustable tubular chrome plated polished cast brass "P" Trap with cleanout and wall escutcheon. Products from the following manufacturers are acceptable.
 - .1 McGuire No. 8872CB
- .9 Water Mixing Valve
 - .1 Powers Point of use Under Counter Thermostatic Mixing Valve
 - .1 LFE480-10
- .3 Lavatories Type L2H: (Barrier Free Use):
 - .1 Type: Countertop, self-rimming with rim sealant, vitreous china
 - .2 Lavatory: White, for barrier free use, self-rimming with sealant, overflow, drilled for 100 mm supply fitting.
 - .1 American Standard "Aqualyn" #0475.047.020 518 x 441 mm
 - .3 Supply fitting: Electronic, adjustable infrared sensor-activated faucet, polished chrome finish, single hole mounting, magnetic solenoid valve.
 - .1 Moen Align Sensor Faucet – 8559AC (Electronic No-Touch Hardwired)
 - .1 Moen AC Conversion Kit - 182538

- .2 Moen AC Transformer - 104630
- .3 McGuire Supply Kit - H170LK-BV-RB
- .4 Waste fitting: Chrome plated drain with open grid strainer with adjustable offset waste connection, cast brass construction.
 - .1 McGuire No. 155WC
- .5 Trap: NPS 1¼ adjustable tubular chrome plated polished cast brass "P" Trap with cleanout and wall escutcheon. Products from the following manufacturers are acceptable.
 - .1 McGuire No. 8872CB
- .6 Sanitary Covering
 - .1 McGuire MC-PW-2000 PW2000 PROWRAP.
- .7 Lavatory supplies: Chrome plated polished brass, ¼ turn ball valve angle stop, convertible ¼ turn/loose key handles, horizontal extension tubes, escutcheons and flexible copper risers. Products from the following manufacturers are acceptable.
 - .1 McGuire No. H170LK-BVRB
- .8 Water Mixing Valve
 - .1 Powers Point of use Under Counter Thermostatic Mixing Valve
 - .1 LFE480-10

2.3 URINALS

- .1 Urinals - Type U1H (Barrier Free Use)
 - .1 Type: Wall hung, exposed electronic "No Touch" automatic flush valve.
 - .2 Urinal: White, vitreous china, washdown, with integral extended shields, and trap; complete with 19 mm top spud, non-metallic strainer, outlet connection and wall hanger.
 - .1 American Standard "Washbrook FloWise" No.6590001.020
 - .3 Automatic flush control: Exposed, chrome plated, 1.9 L factory set flow, quiet action diaphragm type, urinal flushometer complete with infrared sensor with solenoid operated flush controller circuitry, back-check angle stop, vacuum breaker located above urinal.
 - .1 Moen Sensor Operated WC flush valve – 8315AC05
 - .1 Moen AC Transformer - 104630
 - .4 Carrier: Complete Steel hanger plate with epoxy coated steel uprights with welded feet support. Products from the following manufacturers are acceptable.
 - .1 Watts No. CA-321

- .5 Wall cleanout: Urinal cleanout with stainless steel access cover and stainless steel vandal proof securing screw. Products from the following manufacturers are acceptable:

- .1 American Standard "WUCO"

2.4 **WATER CLOSETS**

.1 Water Closets - Type W1 - Flushometer Valve

- .1 Type: Wall hung, exposed flush valve, vitreous china.
- .2 Closet bowl: White, vitreous china with Everclean antimicrobial surface, syphon-jet bowl with elongated bowl, direct-fed siphon jet action, concealed trap and NPS 1½ top spud.
 - .1 American Standard "Afwall Millennium FloWise " No. 3351.101.020
- .3 Flush valve: Exposed, sensor-operated, complete with angle stop, 1½ high back pressure vacuum breaker with spud coupling and flange, vandal-resistant cap.
 - .1 Moen Sensor Operated WC flush valve – 8311AC12
 - .1 Moen AC Transformer - 104630
- .4 Closet seat: White, solid plastic elongated open front seat, less cover with reinforced stainless steel check hinge and post nuts and washers.
 - .1 Centoco – 500STSCC
- .5 Closet carrier: Type and model as recommended by manufacturer for each wall hung closet to suit wall construction. Products from the following manufacturers are acceptable.
 - .1 Watts No. ISCA-101-L/R-M11

.2 Water Closets - Type W1H (Barrier Free Use) - Flush Valve

- .1 Type: Wall hung, flushometer valve
- .2 Closet bowl: White, vitreous china, direct-fed syphon-jet, elongated bowl and 38 mm top spud, concealed trapway. Bowl height from floor to rim 400 mm - 410 mm.
 - .1 American Standard "Afwall Millennium FloWise" No. 3351.101.002
- .3 Flush valve: Exposed, sensor-operated, complete with angle stop, 1½ high back pressure vacuum breaker with spud coupling and flange, vandal-resistant cap.
 - .1 Moen Sensor Operated Flush Valve – 8311AC12
 - .1 Moen AC Transformer – 104630
 - .2 Moen 24" Flush Tube - 104585
- .4 Toilet seat: White, elongated solid plastic, heavy duty open front, less cover, stainless steel check hinges with gasket,
 - .1 Centoco 500 Series No. 500STSCC

- .5 Toilet Back Rest:
 - .1 Bobrick – CM-16104
- .6 Closet carrier: Type and model as recommended by manufacturer for each wall hung closet to suit wall construction. Products from the following manufacturers are acceptable.
 - .1 Watts No. ISCA-101-L/R-M11
- .3 Water Closets - Type W2 - Flush Valve
 - .1 Type: Floor mounted, bottom outlet, flush valve.
 - .2 Closet bowl: White vitreous china, syphon-jet bowl with elongated bowl, condensation channel, bolt caps and 38 mm top spud, and china bolt caps.
 - .1 American Standard "Madera" No. 3451.001.020
 - .3 Flush valve: Exposed, sensor-operated, complete with angle stop, 1½ high back pressure vacuum breaker with spud coupling and flange, vandal-resistant cap.
 - .1 Moen Sensor Operated Flush Valve – 8311AC12
 - .1 Moen AC Transformer – 104630
 - .4 Closet seat: White solid plastic elongated open front seat, less cover, reinforced stainless steel check hinges and post nuts and washers..
 - .1 Centoco 500 Series No. 500STSCC
- .4 Water Closets - Type W2H (Barrier Free Use) - Flush Valve
 - .1 Type: Floor mounted, bottom outlet, flush valve.
 - .2 Closet bowl: White vitreous china, syphon-jet bowl with elongated bowl, condensation channel, bolt caps and 38 mm top spud, and china bolt caps.
 - .1 American Standard "Madera" No. 3461.001.020
 - .3 Flush valve: Exposed, sensor-operated, complete with angle stop, 38 mm high back pressure vacuum breaker with spud coupling and flange, vandal-resistant cap.
 - .1 Moen Sensor Operated Flush Valve – 8311AC12
 - .1 Moen AC Transformer – 104630
 - .2 Moen 24" Flush Tube - 104585
 - .4 Closet seat: White solid plastic elongated open front seat, less cover, reinforced stainless steel check hinges and post nuts and washers.
 - .1 Centoco 500 Series No. 500STSCC
- .5 Toilet Back Rest:
 - .1 Bobrick – CM-16104

.5 Water Closets - Type W3

- .1 Type: Floor mounted, back outlet, pressure assist flush tank, low consumption.
- .2 Closet combination: White vitreous china, siphon jet flush closet bowl with elongated rim and close coupled vitreous china pressure assisted closet tank complete with fittings.
 - .1 American Standard "Cadet RH PA Universal Bowl – White
 - .1 American Standard – PA Tank, 1.1 GPF White
- .3 Closet seat: White, heavy duty, solid plastic elongated open front with cover, with stainless steel check hinges and stainless steel posts and nuts.
 - .1 Centoco No. 820STS
- .4 Closet supply: NPS 3/8 with lockshield, rigid copper sweat tube nipples, combination V.P. loose key handle, turn ball angle stop and wall escutcheon and flexible risers. Products from the following manufacturers are acceptable.
 - .1 McGuire No. MC-H172LK-BV

.6 Water Closets - Type W3H (Barrier Free Use) - Pressure Assist Tank

- .1 Type: Floor mounted, back outlet, pressure assist flush tank.
- .2 Closet combination: White vitreous china, siphon jet flush trap closet bowl with elongated rim and close coupled vitreous china pressure assisted closet tank complete with fittings.
 - .1 American Standard "Cadet RH PA Universal Bowl – White
 - .1 American Standard – PA Tank, 1.1 GPF White
- .3 Closet seat: White, heavy duty, solid plastic elongated open front with cover, with stainless steel check hinges and stainless steel posts and nuts.
 - .1 Centoco No. 500STSCC
- .4 Closet supply: 13 mm turn ball valve angle stops, coppers sweat nipples, combination V.P. loose key stop and wall escutcheon and flexible copper risers. Products from the following manufacturers are acceptable.
 - .1 McGuire No. MC-H172LK-BV

2.5 **SERVICE SINK**

.1 Mop Sinks - Type M2

- .1 Type: Pre-cast terrazzo floor mounted.
- .2 Sink: 610 x 610 mm, precast terrazzo with one-piece integral stainless-steel cap on all four sides and integral drain with strainer. "P" trap under floor.
 - .1 Stern Williams Serviceptor No. SB-900
 - .2 Fiat
 - .3 Or accepted equal

- .3 Faucets: Mop sink supply fitting with vacuum breaker, integral stops, cross or lever handles, rigid spout with pail hook, brace to wall, minimum 787 mm hose and stainless steel hanger, adjustable wall flanges and NPS ½ IPS connections.
 - .1 Chicago Faucets No. 897-RCF-Hose
 - .2 American Standard
 - .3 Delta
 - .4 Zurn
 - .5 Or accepted equal
- .2 Mop Sinks - Type M3
 - .1 Type: Terrazzo floor mounted corner mop sink.
 - .2 Sink: Precast terrazzo 711 x 711 x 304 mm deep, floor mounted, with stainless steel cast integral cap on front drop and integral drain with strainer, "P" trap under floor, and two stainless steel wall guards.
 - .1 Stern Williams No. CRS2200
 - .2 Fiat
 - .3 Or accepted equal
 - .3 Faucets: Mop sink supply fitting with vacuum breaker, integral stops, cross or lever handles, rigid spout with pail hook, brace to wall, 787 mm rubber hose and coupling, adjustable wall flanges and NPS ½ IPS connections.
 - .1 American Standard No. GL-8344.111-002
 - .2 Chicago Faucets
 - .3 Delta
 - .4 Zurn
 - .5 Or accepted equal

2.6 **STAINLESS STEEL SINKS**

- .1 Stainless Steel Sinks - Type S1 (Barrier Free Use)
 - .1 Single compartment: 406 x 533 x 127 mm OD undermount, stainless steel sink drawn from 18-10 Type 304 heavy gauge stainless steel, with undercoating, and complete with 90 mm stainless steel crumb cup strainer and brass tailpiece.
 - .1 Franke Commercial UCS6105P
 - .2 Blanko
 - .3 Kindred Industries Limited
 - .4 AMI Industries

- .2 Faucets: Chrome plated solid cast brass deck type sink supply fitting with 232 mm swing spout, single lever handle and maximum 8.3 L/min flow, water saver aerator, pull-out spray with adjustable spray pattern, lock & turn activation button, 10 mm compression inlets, braided flexible supply hoses.
 - .1 American Standard No. 7074100.002
 - .2 Chicago Faucets
 - .3 Delta
 - .4 Zurn
 - .5 Or accepted equal
- .2 Stainless Steel Sinks - Type S2 (Barrier Free Use)
 - .1 Double compartment: 451 x 784 x 127 mm OD undermount stainless steel sink drawn from 18-10 Type 304 heavy gauge stainless steel, with undercoating, and complete with 90 mm stainless steel crumb cup strainers and brass combination tailpiece.
 - .1 Franke Commercial UCD6405P
 - .2 Blanko
 - .3 Kindred Industries Limited
 - .4 AMI Industries
 - .2 Faucets: Chrome plated solid cast brass deck type sink supply fitting with 232 mm swing spout, single lever handle and maximum 8.3 L/min flow, water saver aerator, pull-out spray with adjustable spray pattern, lock & turn activation button, 10 mm compression inlets, braided flexible supply hoses.
 - .1 American Standard No. 7074100.002
 - .2 Chicago Faucets
 - .3 Delta
 - .4 Zurn
 - .5 Or accepted equal
- .3 Stainless Steel Sinks - Type S3 (Barrier Free Use)
 - .1 Single compartment: 406 x 533 x 127 mm OD undermount, stainless steel sink drawn from 18-10 Type 304 heavy gauge stainless steel, with undercoating, and complete with 90 mm stainless steel crumb cup strainer and brass tailpiece.
 - .1 Franke Commercial UCS6105P
 - .2 Blanko
 - .3 Kindred Industries Limited
 - .4 AMI Industries

- .2 Faucets: Electronic "No-Touch" AC powered faucet, chrome plated finish, cast brass body, high arc spout, single hole only, single lever handle and 5.7 L/min flow, pull-down spray with adjustable spray pattern, 10 mm compression inlets, braided flexible supply hoses.
 - .1 Moen Align with MotionSense No. 7565EC
 - .2 American Standard
 - .3 Chicago Faucets
 - .4 Delta
 - .5 Zurn
 - .6 Or accepted equal
- .4 Stainless Steel Sinks - Type S4 (Barrier Free Use)
 - .1 Double compartment: 451 x 784 x 127 mm OD undermount stainless steel sink drawn from 18-10 Type 304 heavy gauge stainless steel, with undercoating, and complete with 90 mm stainless steel crumb cup strainers and brass combination tailpiece.
 - .1 Franke Commercial UCD6405P
 - .2 Blanco
 - .3 Kindred Industries Limited
 - .4 AMI Industries
 - .2 Faucets: Electronic "No-Touch" AC powered faucet, chrome plated finish, cast brass body, high arc spout, single hole only, single lever handle and 5.7 L/min flow, pull-down spray with adjustable spray pattern, 10 mm compression inlets, braided flexible supply hoses.
 - .1 Moen Align with MotionSense No. 7565EC
 - .2 American Standard
 - .3 Chicago Faucets
 - .4 Delta
 - .5 Zurn
 - .6 Or accepted equal
- .5 Fittings
 - .1 Trap: Adjustable cast brass 38 mm "P"-trap 38 mm with cleanout.
 - .2 Sanitary Covering: PW2000 PROWRAP or accepted equal.
 - .3 Supplies: Pair 12 mm rough stops with flexible risers.
 - .1 Acceptable manufacturers for trap and supplies:
 - .1 McGuire

- .2 Zurn
- .3 Kohler
- .4 Water Mixing Valve
 - .1 Lawler TMM-1070
 - .2 Symmons
 - .3 Powers
 - .4 Leonard
 - .5 Zurn
 - .6 Or accepted equal
- .5 Provide tee, adaptors and flexible copper tubing to suit installation.

2.7 **SHOWER**

- .1 Individual Showers - Type SH2
 - .1 Type: Non-scald pressure balance shower valve with lever handle, integral service stops or check stops, deluxe shower head with adjustable spray pattern and 9.5 L/min at test pressure of 550 kPa flow restrictor, bent arm and escutcheon.
 - .1 Symmons No. 1-100

The above-mentioned manufacturer/trade name/catalogue number has been used as a guide to establish the standard of construction and style. Comparable Products from the following manufacturers are acceptable.

 - .2 Zurn
 - .3 Delta
- .2 Individual Showers - Type SH2H (Barrier Free Use)
 - .1 Type: Non-scald pressure balancing shower trim and mixing valve with high temperature limit stop, shower head with flow restrictor, wall mount shower arm and wall flange, hand shower set with 1752 mm flexible hose, vacuum breaker bracket, and wall supply. In-wall 3-way diverter trim and valve kit with single lever handle.
 - .1 Chicago Faucets No. SH-PB1-13-040
 - .2 Leonard
 - .3 Delta

2.8 **MISCELLANEOUS**

- .1 Below Deck Mechanical Water Mixing
 - .1 Type: Bronze body, temperature adjusting dial, high temperature thermostatic limit stop, shut-off valve with automatic reset.

- .2 Capacity: 1.9 L/min to 19 L/min at 140 kPa (20 psig) pressure drop, or as shown. Products from the following manufacturers are acceptable:
 - .1 Lawler Model No. TMM-1070
 - .2 Symmons
 - .3 Powers
 - .4 Leonard
 - .5 Or accepted equal
- .2 Combination Fixture – Type WLP1H (Barrier Free Use)
 - .1 Type: Combination fixture, on-floor mounting, wall waste outlet
 - .1 Acorn Penal-Ware 1449-LO-2-03-M-DMS-1.6GPF-FVH
 - .2 Closet Bowl: Heavy gauge type 304 stainless steel, satin finish toilet bowl, blowout jet flushing action
 - .3 Flush valve: Chase mounted hydraulic flush valve, 6.0 LPF
 - .4 Lavatory: Heavy gauge type 304 stainless steel, satin finish, standard oval lavatory bowl
 - .5 Supply fitting: Deck mounted spout, 5.4 LPM, Air-Trol pneumatic single temperature metering
 - .6 Waste fitting: 60mm OD toilet waste outlet and 38mm OD LAV standard elbow waste outlet
 - .7 Toilet seat: Integral contoured seat
 - .8 Fire-resistant and sound-deadened cabinet
 - .9 Grab bar: positioned behind toilet installed to cabinet and to wall
 - .10 Water Mixing Valve
 - .1 Thermostatic Mixing Valve
 - .1 Powers
 - .2 Acorn
- 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 Showers:
 - .1 Adjust valve so that maximum temperature will be not more than 40°C
- .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 between 400 and 460 mm above the floor
 - .2 Horizontal position is between 460 and 480 mm between centerline of fixture and at least one adjacent side wall
 - .3 Lavatory:
 - .1 Top not more than 840 mm above floor
 - .2 Horizontal position is not less than 460 mm from centerline of fixture and side wall
 - .3 Insulate exposed supplies
 - .4 Showers:
 - .1 Locate shower head complete with hose and slide rail to be within reach of the seated position
- .3 Wall Hung Lavatories and Urinals
 - .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.
- .5 Floor Mounted Water Closets
- .6 On sloping floors, where the slope exceeds 6 mm from the back to the front of the fixture, level the fixture by grouting the base until the slope is within the above limits.

End of Section

- 1 General
 - 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
 - 1.2 **REFERENCES**
 - .1 Comply with applicable requirements of the latest issue of the following references:
 - .1 ANSI Z358.1-1998 - Emergency Eyewash and Shower Equipment
 - 1.3 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Submit Shop Drawings in accordance with Section 01 33 00.
 - .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data in accordance with Section 01 33 00.
- 2 Products
 - 2.1 **SAFETY STATIONS**
 - .1 Eyewash Fountain - Type EE1
 - .1 Eyewash fountain: Complete with stainless steel receptor, two chrome plated aerator heads, separate flow control for each head, mounted on NPS 1½ pipe standard with floor flange (mounted on wall) (mounted in countertop) and NPS ½ supply and (NPS 1½ drain) (NPS 1½ chrome plate waste trap) (connections through countertop) and push-to-operate ball valve.
 - .2 Pipe standard mounted
 - .1 Haws No. 7361
 - .2 Bradley No. S19-210B
 - .3 Wall mounted
 - .1 Haws No. 7460 BT
 - .2 Bradley No. S19-220B
 - .3 Speakman
 - .4 Countertop mounted
 - .1 Haws No. 7301 DM
 - .2 Bradley No. S19-260
 - .3 Speakman

.2 Emergency Mixing Valve

- .1 Type packaged, mixing cold and hot water to maintain a set outlet temperature of 15-29°C.
- .2 Construction: thermostatic mixing valve, failure to close on loss of cold water, failure to close on loss of hot water, cold water by-pass outlet temperature gauge.
 - .1 Haws No. TWBS.EWE
 - .2 Leonard
 - .3 Speakman
 - .4 Bradley

3 Execution

3.1 **INSTALLATION**

.1 Emergency Eyewash Stations

- .1 Install eyewash stations in accordance with manufacturers instructions.
- .2 On pipe standards, plug spare tee branches if not used.

.2 Emergency Blending Valve Stations

- .1 Mount valve station with top of case at 1.5 m above finished floor.
- .2 Provide lock-shield valves on inlet hot and cold water connections. Wire seal the valves in the open position.

End of Section

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 Contractor" or their derivatives includes the work of Division 21, 22, 23 and 25 unless otherwise specified.

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 Pressure vessel inspection

.3 Piping and boiler inspection

.4 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.
- .5 Prepare Construction/Installation/Fabrication Drawings, coordinated with other trades and contracts, as required.
 - .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 Consultant's 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 shown 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 manufacturer's 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.
 - .3 Review Before Proceeding (HOLD)
 - .1 Where the word "HOLD" appears on Drawings and other Contract Documents, the Work is included in the Contract.
 - .2 Execute such Work only after verification of dimensions, verification of materials and obtaining Consultant's written permission to proceed.
- 1.5 **COORDINATION AND EXAMINATION**
- .1 Reference
 - .1 To Section 01 10 00.
 - .2 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.
 - .3 Coordination
 - .1 Coordinate Work of Mechanical Division 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.
 - .4 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.

1.6 **SCAFFOLDING AND HOISTING EQUIPMENT**

- .1 References
 - .1 To Section 01 10 00.
- .2 Building Attachments
 - .1 Obtain prior written Consultant's approval before drilling, cutting or welding of the building steel or building structure for erection of materials or equipment.
- .3 Overloading
 - .1 During installation of mechanical work, do not load any part of the building structure with a load greater than it is capable of bearing.
 - .2 Should any accident occur or damage result through the violation of this requirement, the contractor shall be held solely responsible.
 - .3 Design temporary supports used during installation as being equivalent to permanent supports.
 - .4 Remove temporary supports at completion of Work.

1.7 **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.

1.8 **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, 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.
- 1.9 **PROVISION FOR FUTURE**
 - .1 Future Equipment
 - .1 Where indicated as reserved for future equipment or services, leave identified space clear and install services and equipment so that connections can be made in the future.
- 1.10 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Conform to Section 01 33 00 and the following.
 - .2 Shop Drawings showing more than one size or model will not be considered unless properly marked up.
 - .3 For electrically driven, and fuel fired appliances, provide the following information:
 - .1 Electrical characteristics including voltage, phase, frequency and power rating.
 - .2 For motors, NEMA, class and efficiency ratings
 - .3 Fuel input ratings, including flow rates and pressures
 - .4 Equipment performance ratings, including flow rates, pressures, efficiencies, part load values and/or efficiencies (IPLV's), plotted flow characteristics (pump and fan curves) with operating points clearly plotted.

- .4 For other equipment include the following information:
 - .1 Equipment performance ratings, including flow rates, pressures drops.
 - .2 Electrical control power requirements.
- .5 For all equipment, include the following:
 - .1 Equipment dimensions and weights.
 - .2 Itemized product description with optional items clearly marked as being included.
- .6 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 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.
 - .4 Coordinate equipment which attaches to and/or where external wiring provided connects to other equipment.
 - .1 Do such coordination whether such equipment is supplied under this or other contracts or subcontracts, for which relevant information will be provided by Owner/Consultant.

1.11 **“AS-BUILT” RECORD DRAWINGS**

- .1 Reference
 - .1 Conform to Section 01 33 00.
 - .2 Maintain an accurate dimensional record of all underground piping and all deviations and changes in aboveground piping and equipment.

1.12 **INSTALLATION AND START-UP INSTRUCTIONS**

- .1 Reference
 - .1 Conform to Section 01 33 00.
 - .2 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

.1 Reference

- .1 Conform to Section 01 33 00.
- .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 CLEANING, TESTING AND APPROVAL RECORDS

.1 Records

- .1 Maintain records of all pressure tests and flushing and sterilization tests, glycol/water concentrations, inspections and approvals by the plumbing inspector.
- .2 Forward these tests to the Owner on completion of the Work in accordance with Section 01 33 00.
- .3 Forward to Consultant, copy of records on site on completion of each test, cleaning operation, etc.

1.15 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.

1.16 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.

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 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 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.

2.2 **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.

2.3 **CONTROL AND MONITORING OF MECHNAICAL SYSTEMS (FUTURE BAS INTEGRATION)**

- .1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:
 - .1 Delta Controls
 - .2 Reliable Controls
 - .3 Schneider Electric SmartX Series
 - .4 Distech Controls
 - .5 Johnson Controls Facility Explorer
 - .6 Honeywell CIPer series, Spyder Models 5 or 7
- .2 BAS System Integration:
 - .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
 - .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
 - .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.
- .3 Licensing Requirements
 - .1 Licenses shall be provided to and in the name of the City of Toronto
 - .2 Licenses shall be perpetual, transferrable, assignable and royalty free.

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 **PHASE AND POWER OF 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 Supports For Any Suspended Items
 - .1 Do not fasten/attach to or extend through steel pan type roofs or through concrete slab roofs.
- .4 Beam Clamps
 - .1 Two-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
 - .4 Taylor Pipe Supports

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 (15 HP) 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.
 - .4 Fixed sheaves:
 - .1 Motors of 11 kW (15 HP) and greater: Solid type.
- .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
 - .3 Construction (except fan drives):
 - .1 Total enclosure type fabricated of minimum 1.3 mm (18 gauge) black sheet steel.
 - .2 Hinged side to allow access for lubrication, inspection or removal of the drive parts.
 - .3 Maximum clearance of openings in guards to rotating parts: Not to exceed 13 mm.
 - .4 Make provision for slide rail adjustment.
 - .4 Construction for fan drives:
 - .1 V-belt drives: Total enclosure type as specified above.
 - .2 Enclosure sides: 13 mm mesh, 2.7 mm wire screening.
 - .3 Tachometer holes at shaft centres, reinforced as required to maintain rigidity of guard.
 - .5 Flexible drive coupling guards:
 - .1 Location: Between motor and driven equipment.
 - .2 Minimum 1.3 mm (18 gauge) black sheet steel, securely fastened to the equipment baseplate and readily removable.
 - .3 Leave a clearance of approximately 13 to 25 mm between the guard and the coupling.
 - .4 Extend the guard to within 13 mm of both motor and driven equipment housing.
 - .6 Rework any substandard guards supplied with mechanical equipment to conform to the above requirements.

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 (12 gauge) bonderized steel.
 - .2 Fabricated of 2.5 mm (12 gauge) 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.
 - .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
 - .3 Fabricated Equipment Supports (Floor Stands and Ceiling or Wall Mounted Supports)
 - .1 Structural steel members of welded construction or steel pipe and fittings, suitably braced and secured to the floor by mild steel floor pads or pipe flanges with bolts or anchors.
- 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 **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.

3.3 **EQUIPMENT SUPPORTS**

.1 Housekeeping Bases and Pads

- .1 Construct bases and pads for all mechanical equipment as required to allow the proper performance of the equipment.
 - .1 Exception: Bases and pads detailed on the Structural Drawings are for purposes of design intent only.
- .2 Construction:
 - .1 20 m deformed dowel anchors to concrete slabs (six per base or pad).
 - .2 Drill slabs and grout dowels in place.
 - .3 Bond pads and bases to floor. Use grout and bonding agent according to manufacturer's printed instructions.
 - .4 Height of bases and pads: Minimum of 150 mm or as shown.
 - .5 Width and length: Sufficient to extend 75 mm beyond centreline of anchor bolts, or to extend a minimum of 50 mm beyond equipment base.
 - .6 Chamfer all upper perimeter edges of base.

- .7 On approval of the Consultant, concrete pads of 150 mm maximum thickness may be poured under equipment after equipment is set in place, with concrete fully vibrated into place under the equipment base plate.
- .3 Layout coordination:
 - .1 Verify size of bases shown on Structural Drawings with actual requirements and advise the Consultant and the respective trades if change in size or shape of pad is required.
- .4 Anchor bolts:
 - .1 Supply anchor bolts required for mechanical equipment unless indicated otherwise on the Drawings.
 - .2 Sleeve anchor bolts.
 - .3 Supply anchor bolts and sleeves to trade constructing bases in sufficient time for setting in formwork prior to placing concrete and provide anchor bolt location drawing or template for locating anchor bolts.
 - .4 Check anchor bolt locations for proper position before concrete is poured.
- .2 Setting and Alignment of Equipment - Rotating Equipment (fans, pumps, etc):
 - .1 Use millwrights to set and align to lines established with an engineer's level.
 - .2 Shim equipment using standard brass or bronze shim stock of suitable thickness to provide proper level and alignment.
 - .3 Place 25 mm minimum thick grout between equipment base and concrete pad or foundation.
 - .4 Have Consultant approve equipment settings for equipment mounted on concrete pads or foundations prior to grouting.
 - .5 Re-check alignment prior to start-up of equipment.
- .3 Floor Stands
 - .1 Provide stands for floor mounted equipment.
 - .2 Secure to the floor by mild steel floor pads or pipe flanges with bolts or anchors.
- .4 Ceiling or Wall Mounting
 - .1 Where ceiling or wall mounting is indicated or required, provide a suspended platform, bracket or shelf.
 - .2 Materials: Standard steel members and steel plates of welded construction throughout.
 - .3 Attach to building steel with rod hangers and beam clamps, or attach to precast structure as the case may be.
 - .4 Place additional structural steel as required between building steel where beam spacing does not meet requirements.

- .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.
- .5 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).
- 3.4 **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.
 - .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.

3.5 **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.

3.6 **FLASHINGS**

- .1 Flash and counterflash all gas vent stacks through roof, with Thaler Model MEF-4A.
- .2 Safety vents, plumbing vents and all other pipes passing through roofs, stack flashings will be supplied and installed by roofing trade, unless otherwise shown on Drawings.

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 firestopping in accordance with manufacturer's instructions and ULC listing requirements.
 - .3 Provide a written report on completion of firestopping, by area or floor if necessary, indicating the Work is completed and ready for inspection. Do not cover over firestopping, including installation of walls and ceilings, until Work is inspected.

3.8 **ACCESS DOORS**

- .1 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
- .5 VAV boxes
- .6 Control equipment

3.9 SPARE PARTS

- .1 Furnish spare parts
 - .1 One set of packing glands for each size of pump gland.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket for each heat exchanger
 - .4 One glass for each gauge glass
 - .5 One set of V-belts for each drive
 - .6 One filter cartridge or set of filter media for each filter or filter bank installed

3.10 PROTECTION

- .1 Protect Work and materials from weather and other hazards before, during, and after erection, 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.
- .4 Protect finished floor slabs from scuffing, cracking, chipping, staining, cutting and other damage resulting from work of this Contract.
 - .1 Place a 19 mm thick plywood underlaid with 25 mm thick polystyrene insulation board adhered to same, over floor areas when working from or over, such surfaces.
 - .2 Provide such protection below hoist rigs, ladders, pallets of material, and in other circumstances where the flooring is exposed to potential damage.
 - .3 Work damaged due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Owner, at no increase in Contract Price.

3.11 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.

3.12 **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 Buried drainage
 - .2 Before installation of roofing membrane
 - .3 Before closure of service shafts and pipe chases
 - .4 Before closure of walls
 - .5 Before closure of ceilings
 - .6 Equipment demonstration and training
 - .7 Substantial Performance and deficiency review
 - .8 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 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 16.
- .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.

3.13 **PERFORMANCE TESTING AND BALANCING**

- .1 Refer to 23 08 00 series.

3.14 **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 sections of Division 23.

- .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.

3.15 **ACCEPTANCE**

- .1 After all equipment has been installed and adjusted and all systems balanced:
 - .1 Conduct performance tests in the presence of the Consultant and the Owner.
 - .2 Arrange the time for these tests at the convenience of the Consultant 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.

End of Section

- 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 26: Electrical
 - .1 Power wiring between the electrical distribution system and motor or equipment.
 - .2 Motor Control Centres (MCC).
 - .3 Motor starters including variable frequency drives and soft-start starters, except where specified as an integral component of the mechanical equipment.
 - .4 Fused or unfused disconnects, except where specified as an integral component of the mechanical equipment.
- 1.3 **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.
- 1.4 **CODES AND REGULATIONS; PERMITS, COSTS AND FEES**
 - .1 Codes
 - .1 Electrical Safety Authority (ESA).
 - .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.
- 1.5 **QUALITY ASSURANCE**
 - .1 Contractor Qualifications
 - .1 Electrical wiring for mechanical trades work performed by a specialist firm with an established reputation in this field.
- 1.6 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Submit in accordance with Section 01 33 00.
 - .2 Include nameplate data, motor efficiencies, NEMA rating and insulation rating.
 - .3 Warranty shall be minimum of 4 years. Provide extendable option.

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 (1/2 HP).
- .2 Voltage, frequency and RPM as scheduled.

.3 Three Phase Motors, 350 W to 525 W (1/2 HP to 3/4 HP)

.1 EEMAC, Class B, Type F insulation, squirrel cage induction, continuous duty, ball bearing.

- .1 Voltage, frequency and RPM as scheduled.
- .2 Motor type: ODP with 90°C (194°F) temperature rise (TEFC with 80°C (176°F) temperature rise) unless otherwise scheduled.
- .3 1800 RPM or as scheduled.

.4 Three Phase Motors, 750 W (1 HP) and Larger

.1 EEMAC, T-Frame, Class B, Type F insulation, squirrel cage induction, continuous duty, ball or sleeve bearing.

- .1 Motor efficiency: Premium efficiency.
- .2 Voltage and frequency as scheduled.
- .3 Motor type: TEFC with 80°C (176°F) temperature rise (ODP with 90°C (194°F) temperature rise) unless otherwise scheduled.
- .4 1800 RPM or as scheduled.

.5 Three Phase Motors, 750 W (1 HP) and Larger, Variable Frequency Drive Applications

.1 EEMAC, T-Frame, Class B, Type F triple build, form wound insulation, squirrel cage induction, continuous duty, ball bearing, 40°C (104°F) temperature rise.

- .1 Motor efficiency: Premium efficiency.
- .2 Inverter duty rated.

- .3 Maximum speed turndown: 25%.
 - .4 Voltage and frequency as scheduled.
 - .5 Motor type: ODP for variable torque applications, TEFC for constant torque applications.
 - .6 1800 RPM or as scheduled.
- .6 Multiple Speed Motors
 - .1 For 2:1 speed ratios: Single winding consequent pole (two winding).
 - .2 For all other speed ratios: Two winding.
- .7 Grounding Lug
 - .1 Motors less than 15 kW (20 HP):
 - .1 Ground lug on motor terminal box.
 - .2 Motors 15 kW (20 HP) and larger:
 - .1 Directly bolted to motor frame.
 - .2 Located inside terminal box on motor.
- .8 Winding Temperature Sensors - RTD's
 - .1 Where required:
 - .1 Motors greater than 224 kW (300 HP).
 - .2 Inverter duty motors greater than 112 kW (150 HP).
 - .2 Type:
 - .1 RTD sensor in each winding, wired to separate terminal box on side of motor.
 - .2 RTD relay/control circuit by others.
- .9 Winding Temperature Sensor Protection
 - .1 Where required:
 - .1 Motors 37 kW (50 HP) up to 225 kW (300 HP).
 - .2 Motors 18.6 kW (25 HP) up to 30 kW (40 HP) located in air ducts, plenum chambers or in air stream inside air conditioning equipment.
 - .2 Type:
 - .1 Winding temperature sensor wired to disconnect motor on high temperature.
 - .2 120 V control transformer.
 - .3 "Push-to-Test" red pilot light (high winding temperature).
 - .4 Reset button.

- .5 Supply control unit to the Contractor under Division 26 for installation in motor starter.
- .6 Acceptable Manufacturers:
 - .1 Siemens Canada Limited - PTC thermistor with 3-UN2131 tripping unit
- .10 Winding Temperature Thermostat
 - .1 Where required:
 - .1 Single phase, and three phase motors up to 15 kW (20 HP) located in air ducts, plenum chambers or in air stream inside air conditioning equipment.
 - .2 Type:
 - .1 Klixon Motor winding thermostats.

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, 120 VAC 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.

2.3 **EQUIPMENT SERVICE LIGHTS**

- .1 Service Lights
 - .1 LED type with tempered glass globe and wire guard (silicone free).
 - .2 Acceptable Manufacturers:
 - .1 Crouse Hinds
 - .2 Killark
- .2 Switches
 - .1 Twenty ampere, single pole, with pilot light, installed in cast metal box.

.2 Acceptable Manufacturers:

- .1 Hubbell
- .2 P & S
- .3 Arrow Hart
- .4 Leviton

2.4 **CORROSION PROTECTION ANODES**

.1 Sacrificial Anode

- .1 High grade electrolytic zinc, 99.99% pure: To ASTM B-418 Type II.
- .2 Supplied with 5 mm diameter minimum steel core with #8 TWH stranded connecting wire or bolt-on strap connection where required.

2.5 **CONTROL AND MONITORING SYSTEMS (FUTURE BAS INTEGRATION)**

.1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:

- .1 Delta Controls
- .2 Reliable Controls
- .3 Schneider Electric SmartX Series
- .4 Distech Controls
- .5 Johnson Controls Facility Explorer
- .6 Honeywell CIPer series, Spyder Models 5 or 7

.2 BAS System Integration:

- .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
- .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
- .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.

.3 Licensing Requirements

- .1 Licenses shall be provided to and in the name of the City of Toronto

- .2 Licenses shall be perpetual, transferrable, assignable and royalty free.

3 Execution

3.1 **INSTALLATION**

.1 Motor and Equipment Control

- .1 Motor control centre, 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, unit heaters and cabinet unit heaters.
 - .2 Hardwire interlock wiring between control devices (pressure switches, temperature switches, limit switches, etc.) and motor starters.
 - .3 Between junction box provided by Division 26, to switch and equipment service lights.

- .2 Provided by Electrical Division 26:

- .1 Power wiring at all voltages 120 VAC and higher to motors or equipment.
 - .2 To junction box on adjacent wall, column or ceiling for equipment service lights (marine lights).

.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 Equipment Service Lights

- .1 Mount switches in accessible location on outside of plenum.
- .2 Provide one switch for each fan system.
- .3 Provide minimum of one marine light per 3 m length of plenum.

.5 Grounding

- .1 Ground electrical equipment and wiring in accordance with Electrical Safety Authority and local authority's rules and regulations.

.6 Corrosion Protection Anodes

- .1 Provide external corrosion protection anodes for:
 - .1 Buried ductile iron water mains, fittings, and hydrants
 - .2 Metallic services as shown.

End of Section

- 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 Contractor Certification
 - .1 Contractors providing Work regulated under O.Reg. 220/01 Boilers and Pressure Vessels are to be holders of a Technical Standards and Safety Authority (TSSA) certificate of authorization to conduct this Work, including:
 - .1 Pressure piping fabrication and installation
 - .2 Boiler and pressure vessel repairs and alterations
 - .2 Registration
 - .1 Register with the TSSA, and pay associated registration and inspection costs, for pressure piping systems regulated under O.Reg. 220/01 Boilers and Pressure Vessels.
 - 1.3 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Submit valve Shop Drawings in accordance with Section 01 33 00.
- 2 Products
 - 2.1 **BEDDING AND BACKFILL**
 - .1 Materials
 - .1 From bottom of trench to 300 mm above top of pipe:
 - .1 New Granular "A" material of bank run sand and gravel or crushed stone of non-organic nature.
 - .2 From 300 mm above top of pipe to underside of gravel sub base or landscaping soil:
 - .1 New granular material conforming to OPSS 1010 Granular "B" requirements.
 - .2 Samples
 - .1 Submit handcarry samples of backfill materials in heavy duty, clear plastic bags to the Consultant at the Job site prior to purchasing.
 - .2 Material delivered to the Job site will be inspected by the Consultant and any material considered unsuitable will be rejected.

2.2 **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.

2.3 **PIPE AND FITTINGS - PRESSURE PIPING - FERROUS**

.1 General

- .1 Pressure class and pipe schedules as shown on piping data sheets unless specified herein.
- .2 Galvanized pipe and fittings: Where indicated on piping data sheets unless specified herein.
- .3 Grooved piping systems - acceptable manufacturers:
 - .1 Victaulic
 - .2 Anvill Gruvlok
 - .3 Shurjoint

.2 Pipe

- .1 Carbon steel - general use
 - .1 Black carbon steel: To ASTM A53 Grade B, seamless or ERW
 - .2 Black carbon steel, for fire protection systems: To ASTM A795, A53, A135
 - .3 Bevelled, plain or grooved ends as per piping data sheets
 - .4 For buried pipe: "Yellow Jacket" polyethylene jacket coating, minimum 22 mil thickness
- .2 Carbon steel - grooved - fire protection systems
 - .1 Black carbon steel: To ASTM A120, seamless or ERW
 - .2 Grooved ends
- .3 Stainless steel
 - .1 Type 304: To ASTM A312
 - .2 Bevelled ends

.3 Tubing

- .1 Stainless steel
 - .1 Type 316 seamless, fully annealed and welded, redrawn, fully annealed suitable for bending: To ASTM A269
 - .2 Maximum hardness: Rockwell B80

- .4 Fittings
 - .1 Threaded
 - .1 Black banded malleable iron threaded fittings: To ASTM A197 and ANSI B16.3
 - .2 Black cast iron threaded fittings: To ASTM A126 Class A and ANSI B16.1
 - .2 Flanged
 - .1 Galvanized cast iron, flanged flat face: To ASTM A126 Class A and ANSI B16.1
 - .2 Black cast iron flanged flat face: To ASTM A126 and ANSI B16.4
 - .3 Drainage
 - .1 Standard galvanized cast iron drainage fittings: To ANSI B16.12
 - .4 Socket welded
 - .1 Forged steel socket welding type: To ASTM A105 Grade 2 and ANSI B16.11
 - .2 For underground pipe: Protect joints and fittings with Shaw "Shrink-Sleeves" or a coating of Denso Paste wrapped with Denso Tape applied with at least 50% overlap
 - .5 Butt welded
 - .1 Seamless carbon steel butt weld fittings, with wall thickness to match pipe: To ASTM A234 WPB and ANSI B16.9
 - .2 For underground pipe: Protect joints and fittings with Shaw "Shrink-Sleeves" or a coating of Denso Paste wrapped with Denso Tape applied with at least 50% overlap
 - .3 Long radius elbows
 - .6 Grooved
 - .1 NPS 10 and less: Ductile iron to ASTM A536 Grade 65-45-12
 - .2 NPS 12 and over: Same material as pipe to ASTM A234, with grooved ends to CSA B242-M
 - .7 Stainless steel (pipe)
 - .1 Seamless stainless steel type 304/304L butt weld fittings, with wall thickness to match pipe: To ASTM A312 WPW 304/304L
 - .2 3000# stainless steel socket welded fittings: To ASTM A182
 - .3 Stainless steel threaded fittings
 - .4 Grooved Fittings:
 - .1 ASTM A403 or factory-fabricated from ASTM A312 stainless steel pipe.

- .2 NPS 2 and Smaller: Pressure-Sealed, cold drawn stainless steel with elastomer O-ring seals (grade to suit the intended service), suitable for operating pressure to 3450-kPa (500-psi).
- .8 Stainless steel (tubing)
 - .1 Type 316: To ASTM A182
 - .2 Parker "Triple-Lok" 37 degree flared tube fittings, Swagelock two-ferrule four-piece joint, Union Carbide
- .5 Unions
 - .1 General use
 - .1 Black malleable iron with brass ground joint and screwed ends: To ASTM A197 and ANSI B2.1
- .6 Flanges
 - .1 Welded
 - .1 Forged steel raised face slip-on or weld neck type: To ASTM A181 Grade 1 and ANSI B16.5
 - .2 Provide flat faced flanges for connection to cast iron valves, or equipment having a flat faced flange
 - .2 Screwed
 - .1 Cast iron, galvanized, flat face, screwed: To ASTM A126 Class A and ANSI B16.1
 - .3 Grooved
 - .1 Hinged, two piece, shouldered or keyed cast ductile iron: To ASTM A536 Grade 65-45-12
 - .2 Synthetic rubber gaskets, selected for service: To ASTM D2000
 - .3 Lock bolt
 - .4 Stainless steel (pipe)
 - .1 1.6 mm raised face, forged stainless steel: To ASTM A182 and ANSI B16.5
- .7 Flange Gaskets
 - .1 General service water < 94°C (200°F) maximum pressure: 1720 kPa (250 psig)
 - .1 1.6 mm thick red rubber, ring type for raised face flanges
 - .2 Full face type for flat faced flanges
 - .2 Hot water 94°C - 152°C (200°F - 305°F) maximum pressure: 6890 kPa (1000 psig)
 - .1 1.6 mm thick Garlock No. 3000 with nitrile binder flat ring type, or equivalent asbestos-free material manufactured by Anchor or Phelps

- .3 High temperature hot water 153°C - 232°C (306°F - 450°F) maximum pressure: 8200 kPa (1200 psig)
 - .1 1.6 mm thick Garlock No. 3500 PTFE gasket with silica binder flat ring type, or equivalent asbestos-free material manufactured by Anchor or Phelps
- .4 Gas piping, coolant piping, waste oil piping, maximum pressure: 6890 kPa (1000 psig)
 - .1 1.6 mm thick Garlock No. 3000 with nitrile binder flat ring type, or equivalent asbestos-free material manufactured by Anchor or Phelps
- .5 Stainless steel piping
 - .1 1.6 mm thick graphite with Type 316 stainless steel insert manufactured
- .6 For Van Stone flanges increase gasket thickness to 3.2 mm thick.
- .8 Flange Bolting
 - .1 General use
 - .1 Semi-finished hex head machine bolts, carbon steel: To ASTM A193 Grade B7
 - .2 Semi-finished hex nuts, carbon steel: To ASTM A194 Grade 2H
 - .2 High pressure piping
 - .1 Semi-finished hex head machine bolts, carbon steel: To ASTM A307 Grade A
 - .2 Semi-finished hex nuts, carbon steel: To ASTM A307 Grade A
 - .3 Stainless steel flanges
 - .1 Stainless steel bolt studs, hex head, machine finished: To ASTM A193, Grade B8 and ANSI B18.21
 - .2 Machine finished stainless steel heavy hex nuts: To ASTM A194, Grade 8 and ANSI B18.22
- .9 Couplings
 - .1 Grooved for Carbon Steel Pipe
 - .1 Cast segmented ductile iron: To ASTM A536 Grade 65-45-12
 - .2 Grooved machine type: To CSA B242-M or similar
 - .3 Oval track-head bolts and heavy hex nuts: To ASTM A183 & A449
 - .4 Synthetic rubber gaskets, selected for service: To ASTM D2000
 - .1 Grade EHP EPDM gaskets suitable for water temperatures up to 120°C (250°F).

- .5 Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9. Installation-Ready for complete installation without field disassembly.
- .6 Flexible Type: For use in locations where vibration attenuation and stress relief are required. Standard of Acceptance:
- .7 Two-segment couplings for pipe sizes NPS 14 and larger, with lead-in chamfer on housing key.

	At pump connections and concealed piping	Mechanical rooms and exposed piping
Victaulic	Fig 77, 177 or W77	Fig 107N or W07
Anvil (Gruvlok)	Fig 7001	Fig 7401
Shurjoint	Fig 7705	Fig 7771

- .2 Grooved for Stainless Steel Pipe:
 - .1 Housings: Ductile iron to ASTM A536 Grade 65 45 12 or stainless steel to ASTM A351, Grade CF8M.
- .3 Grooved machine type: To CSA B242-M or similar
 - .1 NPS 12 and smaller Schedule 5S or 10S pipe shall be roll grooved using a grooving tool specifically designed for stainless steel pipe.
- .4 Rigid: Housing key shall engage the bottom of the groove:
 - .1 Victaulic Style 89 (ductile iron) or 489 (stainless steel)
 - .2 Anvil Gruvlok
 - .3 Shurjoint
- .5 Flexible Type: For use in locations where vibration attenuation and stress relief are required:
 - .1 Victaulic Style 77S and 77-DX
 - .2 Anvil Gruvlok
 - .3 Shurjoint
- .6 Two-segment couplings for pipe sizes NPS 14 and larger, with wide-width gasket and lead-in chamfer on housing key:
 - .1 Victaulic Style W89 (rigid)
 - .2 Anvil Gruvlok
 - .3 Shurjoint
- .10 Miscellaneous
 - .1 Plugs
 - .1 Class 3000, threaded, square head, machined from solid steel or forging: To ASTM A105 Grade 2

- .2 Closures, welded
 - .1 Schedule 40 seamless butt welded caps, carbon steel, with wall thickness to match pipe: To ASTM A234 Grade B
- .3 Thread compound
 - .1 General service: Teflon tape or Master metallic compound
 - .2 Petroleum based fluids service: Teflon base pipe thread compound
 - .3 Ammonia service: X-Pando or approved equal
- .11 Press Fitting System – Stainless Steel
 - .1 Pipe
 - .1 Schedule 10S stainless steel: To ASTM A312 Type [304/304L] [316/316L], with plain ends
 - .2 Size NPS ½ to NPS 2
 - .2 Fittings, couplings and adapters
 - .1 Housing: Type 304L [316L] stainless steel, minimum 1.65mm wall thickness
 - .2 Maximum working pressure 2068kPa (300PSI).
 - .3 Self contained Grade E EPDM O-ring seals for water services, up to +110°C (+230°F)
 - .4 Adapter fittings at valves and equipment connections
 - .5 Certified to NSF 61
 - .6 Acceptable manufacturers:
 - .1 Victaulic Vic-Press
 - .2 Anvil AnvilPress

2.4 **PIPE AND FITTINGS - PRESSURE PIPE - NON FERROUS**

- .1 Copper Tubing
 - .1 Tubing
 - .1 Type “L” hard drawn copper tubing: To ASTM B88
 - .2 Fittings
 - .1 Wrought copper, solder joint, pressure type
 - .2 Solder to threaded adaptors as screwed valves or equipment
 - .3 Unions
 - .1 All bronze construction with ground joint
 - .2 Either solder joint or screwed ends as required

- .3 Grooved Joint: Copper-tube dimensioned couplings, consisting of two ductile iron housings cast with offsetting angle-pattern bolt pads. Installation-Ready, for direct stab installation without field disassembly:
 - .1 Victaulic Style 607N.
 - .2 Anvil Gruvlok CTS COPPER SYSTEM
 - .3 Shurjoint
- .2 Copper Pipe
 - .1 Pipe
 - .1 Seamless copper pipe standard sizes: To ASTM B42
OR
 - .2 Seamless red brass pipe standard sizes: To ASTM B43
 - .2 Fittings
 - .1 Brass or bronze threaded water fittings: To ANSI B16.15 "Cast Bronze Threaded Fittings (Classes 125 and 250)"
 - .2 Grooved: Wrought copper to ASME B16.22 or cast bronze to ASME B16.18, manufactured to copper-tube dimensions.
 - .1 Victaulic Copper Fittings
 - .2 Anvil Gruvlok CTS COPPER SYSTEM
 - .3 Shurjoint
 - .3 Flanges and flange fittings
 - .1 Brass or bronze flanges and flange fittings: To ANSI B16.24 "Bronze Pipe Flanges and Flanged Fittings (Class 150 and 300)"
 - .4 Flange gaskets
 - .1 1.6 mm thick red rubber, full face type
 - .5 Flange bolting
 - .1 Semi-finished hex head machine bolts, carbon steel: To ASTM A193 Grade B7
 - .2 Semi-finished hex nuts, carbon steel: To ASTM A194 Grade 2H
- .3 Copper - Refrigerant Piping
 - .1 Pipe
 - .1 Type ACR copper tubing, soft annealed or hard drawn
 - .2 Type ACR copper tubing, hard drawn: To ASTM B280
 - .3 Deoxidized and dehydrated, with ends factory sealed and identified by the manufacturer as being suitable for refrigeration service

- .2 Fittings
 - .1 Heavy wrought copper, solder joint type
 - .2 Adapter fittings at screwed connections
 - .3 On NPS 5/8 and less, flareless compression type
- .3 Unions
 - .1 Rating: 150°C (300°F) maximum temperature rating, 2760 kPa (400 psi) working pressure
 - .2 Brass tail piece adaptors for copper tubing, forged steel flanges, steel bolts, bronze nuts and asbestos-free fibre gasket
 - .3 Acceptable manufacturers: Henry Valve Company Type P30
- .4 Flexible hose
 - .1 Bronze construction with braided wire exterior jacket and union connection on one end
 - .2 Minimum length: Six times the diameter of the hose
 - .3 Rating: suitable for 150°C (300°F) maximum temperature and 2760 kPa (400 psi) working pressure
 - .4 Acceptable manufacturers: Flexonics or Anaconda
 - .5 Coiled section of soft annealed tubing may be used instead of hose on lines not larger than NPS 5/8
- .5 Sight glass
 - .1 Provided in refrigeration piping
 - .2 Combination moisture and liquid indicator feature and extended ends for solder joint connection
- .6 Filter dryer
 - .1 Provided in refrigeration piping
 - .2 Replaceable cartridge type
- .4 PVC Pipe
 - .1 Pipe and fittings
 - .1 PVC with solvent welded socket fittings: To CSA B137.3
 - .2 Victaulic Company PGS-300 CPVC Piping system may be used on water and chemical services where IPS size Schedule 80 CPVC pipe is approved for use. Pipe and fittings shall be cut grooved to Victaulic's PGS-300 groove specification. Schedule 80 CPVC pipe shall meet the requirements of ASTM F441 and ASTM D1784 - minimum cell classification 23447 Pipe.

- .5 Polyethylene Pipe
 - .1 Pipe and fittings
 - .1 Flexible polyethylene: Certified to CSA B137.1
- 2.5 **PIPE AND FITTINGS - PRESSURE - BURIED**
 - .1 Copper - Buried
 - .1 Pipe
 - .1 Type "K" soft annealed tubing: To ASTM B88
 - .2 Fittings
 - .1 Wrought copper, solder joint pressure type
 - .2 Compression type or cold flared fittings as manufactured by Mueller or Emco
 - .2 Polyethylene - Buried - Water
 - .1 Pipe
 - .1 Series 160 psi polyethylene pipe: Certified to CSA B137.1
 - .2 Smooth finish free of imperfections such as grooves and ripples
 - .2 Fittings
 - .1 Nylon insert type, with serrated ends and insert adapters with threaded end where threaded connections are required: To ASTM D2609
 - .2 Secure pipe to insert fittings by using two stainless steel type clamps over each insert end of fitting
 - .3 Where water service enters building, provide transition from plastic to copper no more than 450 mm above the floor
 - .3 Polyethylene - Buried - Gas
 - .1 Pipe
 - .1 Series 120 psi polyethylene pipe: Certified to CSA B137.1
 - .2 Smooth finish free of imperfections such as grooves and ripples
 - .2 Fittings
 - .1 Series 125 polyethylene socket welding type: Certified to CSA B137.1
 - .2 Heat fusion joints, installed in accordance with manufacturer's installation manuals
 - .3 Install in accordance with CSA Z184-M and Z184S1

- .4 PVC - Buried
 - .1 Pipe
 - .1 Class 150 PVC DR18 pressure type, PVC resin: To ASTM D1784
 - .2 Class 200 PVC DR14 pressure type, PVC resin: To ASTM D1784
 - .2 Fittings
 - .1 Class 250 cast grey iron or ductile iron, mechanical joint ends to AWWA C110
 - .2 Tar coated outside
 - .3 Cement mortar lined: To AWWA C104
 - .4 Polyethylene encasement: To AWWA C105
 - .3 Joints
 - .1 To AWWA C-900 and CAN-B137.3
 - .2 Maximum working pressure: 1035 kPa at 23°C (150 psi at 74°F)
- .5 Glass Fiber Reinforced Epoxy Resin - Buried
 - .1 Pipe
 - .1 Type 1 (Filament-Wound) Grade 1 (Glass Fibre Reinforced Epoxy Resin pipe) Class H (Thermoplastic Resin Liner) pipe: to ASTM D2996 classification 11HZ5001
 - .2 Pipe designed in accordance with ASTM D2992 and D2996
 - .3 Maximum working pressure: 2413 Pa at 23°C (350 psi at 73°F) or as approved by ULC
 - .4 Integral bell, push-on type joints

2.6 **PIPE AND FITTINGS - DRAINAGE SYSTEMS**

- .1 Cast Iron Soil Pipe
 - .1 Pipe and fittings
 - .1 Cast iron soil pipe: To CAN/CSA-B70-M
 - .2 Plain end pipe and fittings
 - .2 Joints
 - .1 Bell and spigot, with lead and oakum joints
 - .2 NPS 8 and smaller: Neoprene sleeves with stainless steel gear type clamps, where approved by local authorities
- .2 Acid Resistant Cast Iron Soil Pipe
 - .1 Pipe and fittings
 - .1 High silicon alloy acid resistant cast iron

- .2 Sleeve couplings: Inner Teflon sleeve, outer neoprene sleeve and two bolt stainless steel sleeve clamp
 - .3 Bell and spigot joints, with acid proof rope packing and lead
 - .4 (Split flange joints with flange bolts) (Bell and spigot joints)
 - .5 (Gaskets for split flange joints: 1.6 mm thick, Garlock style 3000 with nitrile binder or equivalent asbestos-free material manufactured by Anchor)
- .3 PVC Soil Pipe
- .1 Pipe - below grade - sanitary and storm drainage
 - .1 All sizes: To CAN/CSA-B181.2 "PVC Drain, Waste and Vent Pipe and Pipe Fittings"
 - .2 Bell and spigot ends
 - .3 Rubber ring gaskets with bell
 - .2 Pipe - below grade - storm drainage (alternate)
 - .1 2" to 6": To CSA B182.1-M
 - .2 8" and up: To CSA B182.2-M
 - .3 Bell and spigot ends
 - .4 Rubber ring gaskets with bell
 - .3 Pipe - above grade - sanitary and storm drainage
 - .1 All sizes: To CAN/CSA-B181.2 "PVC Drain, Waste and Vent Pipe and Pipe Fittings"
 - .2 Plain end with solvent weld joints
 - .3 ABS or PVC solvent cement
 - .4 Pipe - above grade - storm drainage (alternate)
 - .1 NPS 2" to 6" ABS: To CSA B182.1-M
 - .2 8" and up: To CSA B182.2-M
 - .3 Plain end with solvent weld joints
 - .4 ABS or PVC solvent cement
 - .5 Pipe – Concrete Embedded Gravity Drain:
 - .1 Schedule 40 solvent weld rigid PVC drain, waste and vent pipe and fittings in accordance with CSA B181.2.
 - .2 Fittings: PVC injection moulded, solvent weld type ends.

- .6 Weeping tile (foundation drainage)
 - .1 Perforated PVC BDS solvent. Weld sewer and drain pipe in accordance with CSA B182.1 [or perforated high density polyethylene (HDPE) per ASTM D 3350].
 - .2 Minimum stiffness of 210 kPa at 5% deflection per ASTM D2412.
- .7 Fire stop seal for combustible pipe
 - .1 Certification: to CAN4-S115-M tested at a pressure differential of 50 Pa (0.007 psi)
 - .2 Fire stop rating: Class F
 - .3 Fire resistance rating: Not less than that of the fire separation being penetrated
- .8 Acceptable Manufacturers:
 - .1 3M - Ultra Plastic Pipe Device
- .4 Copper - DWV
 - .1 Pipe
 - .1 Hard drawn copper drainage tube (DWV): To ASTM B306
 - .2 Drainage fittings
 - .1 Wrought copper solder joint: To ANSI B16.29
 - .2 Cast brass solder joint: To CSA B158.1
 - .3 Manufacturer standard heat fusion tool system
- 2.7 **PIPE AND FITTING – ABOVEGROUND PRESSURIZED DRAIN (PUMP DISCHARGE):**
 - .1 Galvanized steel:
 - .1 NPS 2-1/2 and smaller:
 - .1 Schedule 40 galvanized steel pipe, in accordance with ASTM A53/A53M.
 - .2 Fittings: Malleable iron galvanized, screwed, in accordance with ANSI/ASME B16.3.
 - .3 Joints: Threaded, in accordance with ANSI/ASME B1.20.1.
 - .2 NPS 3 and larger:
 - .1 Schedule 40 galvanized steel pipe, in accordance with ASTM A53/A53M.
 - .2 Fittings:
 - .1 Flanged: Galvanized ductile iron, flanged, in accordance with ANSI/ASME B16.5.
 - .2 Grooved: Rigid grooved coupling, hot-dip galvanized, flush seal gaskets, and roll grooved piping.
 - .1 Victaulic Style 107

- .2 Anvil Gruvlok, Fig. 7401
 - .3 Shurjoint
 - .3 Gasket: Styrene-Butadiene (SBR) or Ethylene - Propylene Diene Monomer (EPDM). [For oily waste use Nitrile].
 - .2 Copper:
 - .1 NPS 2 1/2 and smaller:
 - .1 Copper Type M hard copper pipe, in accordance with ASTM B88.
 - .2 Fittings: Wrought copper, solder joint, in accordance with ASME B16.29.
 - .1 Solder material: Lead free solder (tin-antimony or tin-silver).
 - .2 NPS 3 and larger:
 - .1 Copper Type M hard copper pipe, in accordance with ASTM B88. Roll grooved.
 - .2 Fittings: Wrought copper roll grooved
 - .3 Couplings: Flush seal gasket.
 - .1 Victaulic Style 606 or 607 Rigid grooved coupling
 - .2 Anvil Gruvlok, Fig 6400
 - .3 Shurjoint
 - .3 Gasket: EPDM. [For oily waste use Nitrile].
 - .3 PVC
 - .1 Schedule 40 solvent weld rigid PVC pressure pipe and fittings in accordance with CSA B 137.3, and ASTM D1785 or ASTM D2241.
 - .2 Fittings: PVC injection molded, solvent weld type ends, and friction fit
- 2.8 **PIPE AND FITTING – BURIED AND CONCRETE EMBEDDED PRESSURIZED DRAIN (PUMP DISCHARGE):**
 - .1 PVC
 - .1 Schedule 40 solvent weld rigid PVC pressure pipe and fittings in accordance with CSA B 137.3, and ASTM D1785 or ASTM D2241.
 - .2 Fittings: PVC injection molded, solvent weld type ends, and friction fit
- 2.9 **VACUUM TRUCK CONNECTION:**
 - .1 Above ground: Galvanized steel pipe, in accordance with ASTM A53/53M.
 - .1 Fittings:
 - .1 Flanged: Galvanized ductile iron, flanged, in accordance with ANSI/ASME B16.5.
 - .2 Grooved: Rigid grooved coupling, hot-dip galvanized, flush seal gaskets, and roll grooved piping.

- .3 Couplings:
 - .1 Victaulic Style 107 hot-dip galvanized couplings
 - .2 Anvil Gruvlok, Fig. 7401
 - .3 Shurjoint
 - .4 Gasket: Nitrile [SBR or EPDM]
 - .2 Buried and Concrete Embedded PVC
 - .1 Schedule 40 solvent weld rigid PVC pressure pipe and fittings in accordance with CSA B 137.3, and ASTM D1785 or ASTM D2241.
 - .2 Fittings: PVC injection molded, solvent weld type ends, and friction fit.
- 2.10 **VALVES**
- .1 General
 - .1 Gate valves re-packable under pressure, when fully open
 - .2 Plug valves packed with lubricant suitable for service
 - .3 Globe and check valves provided with composition discs suitable for type of service
 - .4 Renewable seats on iron body valves
 - .5 Materials
 - ASTM B62 Bronze valves - gate, globe and check - steam rated 125 and 150 psig
 - ASTM B61 Bronze valves - gate, globe and check - steam rated 200 and 350 psig
 - ASTM B283 C3770 Brass valves - ball valves
 - ASTM A126 Class B Iron valves - gate, globe and check
 - .6 Markings
 - MSS-SP-25 Steam or WOG (water, oil and gas) rated pressure, manufacturer's trademark, size
 - .7 End Connections
 - ANSI B2-1 Threaded ends
 - ANSI B16.18 Soldered ends
 - ANSI B16.10 Face to face dimensions
 - .8 Testing and Materials
 - MSS-SP-80 Bronze valves, gate, globe and check
 - MSS-SP-70 Iron gate valves
 - MSS-SP-85 Iron globe valves
 - MSS-SP-71 Iron check valves
 - MSS-SP-67 Butterfly valves

.2 Gate Valves

.1 GTV 1

.1 Class 125 bronze body, threaded ends, solid or split wedge disc, rising stem

- | | | |
|----|----------------|-----------|
| .1 | Crane | Fig 428 |
| .2 | Jenkins | Fig 990AJ |
| .3 | Nibco | T-111 |
| .4 | Toyo Red-White | Fig 293 |
| .5 | Kitz | Fig 24 |

.2 GTV 2

.1 Class 125 iron body, OS&Y bronze mounted, flanged ends

- | | | |
|----|----------------|-----------|
| .1 | Crane | Fig 465 ½ |
| .2 | Jenkins | Fig 454J |
| .3 | Nibco | F-617 |
| .4 | Toyo Red-White | Fig 421JA |
| .5 | Kitz | Fig 72 |

.3 GTV 3

.1 Class 125 bronze body, threaded ends, rising stem, wedge disc, screw-in bonnet

- | | | |
|----|----------------|-----------|
| .1 | Crane | Fig 428 |
| .2 | Jenkins | Fig 990AJ |
| .3 | Nibco | T-111 |
| .4 | Toyo Red-White | Fig 293 |
| .5 | Kitz | Fig 24 |

.4 GTV 4

.1 175 psi working pressure, to AWWA C-500, non-rising stem, iron body, bronze mounted, renewable seat rings, stuffing box and packing gland, mechanical joint ends. Valve box to grade, with guide plate and cover identifying the service. Valves and valve box finish: Two heavy coats of coal tar enamel. Provide one extension key for each valve box installed

.2 Valve

- | | | |
|----|---------|------------------|
| .1 | MAS | W10-A-NL-FF-B-HW |
| .2 | Jenkins | Fig 2397A |

- .3 Box
 - .1 Bibby VB Series
 - .2 Canada Valve Fig 1322
 - .3 Mueller Fig A769
- .5 GTV 5
 - .1 175 psi WOG, ULC and FM approved, iron body, bronze mounted, cast iron disc, resilient seat, mechanical joint ends, non-rising stem, square operating nut. Finish: Two heavy coats of coal tar enamel
 - .1 Clow
 - .2 Mueller Canada
 - .3 MAS W10-A-NL-FF-B-HW
- .6 GTV 6
 - .1 175 psi WOG, ULC and FM approved, iron body, bronze mounted, OS&Y, flanged ends
 - .1 Clow
 - .2 Mueller Canada
 - .3 Nibco F-607
 - .4 MAS W10-A-RS-FF-B-HW
- .7 GTV 7
 - .1 Class 125, bronze body, wedge disc, non-rising stem, solder ends
 - .1 Crane Fig 13240
 - .2 Jenkins Fig 993AJ
 - .3 Toyo Red-White Fig 281
 - .4 Kitz Fig 41
 - .5 Nibco S-113
- .8 GTV 13
 - .1 Main stop valve, service box of required length with ribbed cover brought up flush to finished grade or floor, shut-off key
 - .1 Mueller Corporation
- .3 Globe Valves
 - .1 GLV 1
 - .1 Class 125 bronze body, threaded ends, solid or split wedge disc, rising stem
 - .1 Crane Fig 5TF

- | | | | |
|----|-------------|--|-----------------------|
| | .2 | Jenkins | Fig 106BJ |
| | .3 | Nibco | T-211 |
| | .4 | Toyo Red-White | Fig 221 |
| | .5 | Kitz | Fig 09 |
| .2 | GLV 2 | | |
| | .1 | Class 125 iron body, bronze mounted, yoke bonnet, composition disc, renewable and regrindable bronze set ring, flanged | |
| | .1 | Crane | Fig 351 |
| | .2 | Jenkins | Fig 2342J |
| | .3 | Nibco | F-718-B |
| | .4 | Toyo Red-White | Fig 400 |
| | .5 | Kitz | Fig 76 |
| .3 | GLV 3 | | |
| | .1 | Class 125 bronze body, composition disc and solder ends | |
| | .1 | Crane | Fig 1310 |
| | .2 | Jenkins | Fig 995AJ |
| | .3 | Kitz | Fig 10 |
| | .4 | Nibco | S-211-Y |
| .4 | GLV 10 | | |
| | .1 | Class 450, maximum 3100 kPa (450 psi) working pressure, 135°C (275°F) maximum temperature rating, bronze body, forged brass wing cap seal, back seating, molded ring packing, forged brass bolted bonnet with bonnet seal, solder ends | |
| | .1 | Henry Valve Co. | Fig 203 – Globe style |
| | .2 | Henry Valve Co. | Fig 216 – Angle style |
| .4 | Ball Valves | | |
| | .1 | BV 1 | |
| | .1 | Class 150-600 WOG brass body, threaded ends, Teflon ends, Teflon seats, Teflon packing, bronze or chrome plated, solid ball and lever handle with plastic protector, AGA and CGA approved for gas service | |
| | .1 | Crane | Fig F9201 |
| | .2 | Jenkins | Fig 201J |
| | .3 | Worcester Econ-O-Mite | Fig 4211T |
| | .4 | NCI | TFP600 |

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|----|------------------|---|----------------------|
| | .5 | NCI | TFP601 |
| | .6 | Neles-Jamesbury | Fig 351 |
| | .7 | Toyo Red-White | Fig 5044A |
| | .8 | Kitz | Fig 58 |
| | .9 | M.A.S. | Fig B-3 |
| | .10 | Bray Flow-Tek | SB5 |
| .2 | BV 2 | | |
| | .1 | Class 150-600 WOG brass body, soldered ends, Teflon ends, Teflon seats, Teflon packing, bronze or chrome plated, solid ball and lever handle with plastic protector, AGA and CGA approved for gas service | |
| | .1 | Crane | Fig F9202 |
| | .2 | Jenkins | Fig 202J |
| | .3 | Worcester Econ-O-Mite | Fig 4211 |
| | .4 | NCI | SFP600 |
| | .5 | NCI | SFP601 |
| | .6 | Neles-Jamesbury | Fig 341 |
| | .7 | Toyo Red-White | Fig 5044A or 5049A |
| | .8 | Kitz | Fig 58 or 59 |
| | .9 | Apollo | Fig 77-100 or 77-200 |
| | .10 | MAS | Fig B-3 or B-4 |
| | .11 | Bray Flow-Tek | Triad SP |
| .5 | Butterfly Valves | | |
| | .1 | BFV 1 | |
| | .1 | Class 150 full tapped lug type, cast iron body, bronze disc, 304 stainless steel shaft, EPDM seat, notched top plate | |
| | .2 | Lever lock handle for valve sizes NPS 6 and smaller | |
| | .3 | Worm gear operator with handwheel for valves NPS 8 and larger | |
| | .1 | Crane | Fig 44 BXZ |
| | .2 | Keystone | Fig FH12-CBJ-2 |
| | .3 | Jenkins | Fig 2232Elj |
| | .4 | Nibco | LD-2000 |
| | .5 | Nibco | N-200 |
| | .6 | Centerline | Fig 200 Series |

- | | | | |
|----|--------------|--|-------------------------------|
| | .7 | De Zurik | Fig BGS, L1/632 |
| | .8 | Victaulic | 704Vic 300 MasterSeal and AGS |
| | .9 | Apollo | Fig Series 143 |
| | .10 | Bray | Fig 31H-375 |
| | .11 | Challenger | Fig 20-CS4E |
| | .12 | Kitz | Fig 6122EL/G |
| | .13 | Toyo | Fig 918BESL/G |
| | .14 | MAS | D-Series #LD4AE |
| .2 | BFV 2 | | |
| | .1 | 175 psi ULC and FM approved full lug, cast iron body, bronze disc, EPDM seat | |
| | .2 | Lever lock handle for valve sizes NPS 6 and smaller | |
| | .3 | Worm gear operator with handwheel for valves NPS 8 and larger | |
| | .4 | Indicator flag painted "safety yellow" and provision for mounting supervisory switch | |
| | .1 | MAS | W50-A-ED-LL |
| | .2 | Grinnell | |
| .6 | Plug Valves | | |
| | .1 | PV 1 | |
| | .1 | Class 175 WOG rating, lubricated plug valve, semi-steel body, tapered plug, screwed ends, wrench operated | |
| | .1 | Rockwell-Nordstrom | Fig 142 |
| | .2 | Newman-Milliken | Fig 170M |
| | .3 | Walworth | Fig 1796 |
| | .2 | PV 2 | |
| | .1 | Class 175 WOG rating, lubricated plug valve, semi-steel body, tapered pug, flat faced flanged ends drilled to 862 Pa (125 lb) ANSI | |
| | .2 | Valves NPS 6 and less: Manual lever operated | |
| | .3 | Valves NPS 8 and larger: Worm gear operated | |
| | .1 | Rockwell-Nordstrom | Fig 143 |
| | .2 | Newman-Milliken | Fig 172M |
| | .3 | Walworth | Fig 1797F |
| .7 | Check Valves | | |

.1 CV 1

.1 Class 125 horizontal swing check valve, bronze body, screwed ends, screwed cap and regrindable bronze disc

- | | | |
|----|----------------|-----------|
| .1 | Crane | Fig 37 |
| .2 | Jenkins | Fig 996AJ |
| .3 | Grinnell | Fig 3300 |
| .4 | Nibco | T-413 |
| .5 | Toyo Red-White | Fig 236 |
| .6 | Kitz | Fig 22 |
| .7 | Bray Rite | 12CBT |

.2 CV 2

.1 Class 125 horizontal check valve, iron body, bronze mounted, flat face flanged ends, renewable and regrindable bronze seat ring and disc

- | | | |
|----|----------------|-------------|
| .1 | Crane | Fig 373 |
| .2 | Jenkins | Fig 587J |
| .3 | Grinnell | Fig 6300A |
| .4 | Nibco | F-918 |
| .5 | Toyo Red-White | Fig 435JA |
| .6 | Victaulic | Series 715 |
| .7 | Gestra | "CB" Series |
| .8 | Kitz | Fig 78 |
| .9 | Bray Rite | 12CBT |

.3 CV 3

.1 Class 125 wafer type non-slam check valve, cast iron body, bronze plates and Buna-N seals

.2 Install between two flat faced flanges as specified for piping NPS 4 and larger

- | | | |
|----|---------------|--------------------|
| .1 | Mission Valve | "Duo-Chek" |
| .2 | Ritepro | "Check Rite" |
| .3 | Gestra | "RK" Series |
| .4 | Crane | Fig R-1-66-4-F-1-X |
| .5 | Centerline | 800 Series |
| .6 | Grinnell | Fig 300 |

- .7 Jenkins Fig R-1-66-4-F-1-X
 - .8 Nibco W-920-W
 - .9 Mueller Steam 71-AHH-3-H
 - .10 Bray Rite D15DBZ
 - .4 CV 4
 - .1 Class 125 horizontal swing check, bronze body, screwed ends, screwed cap and regrindable bronze disc
 - .1 Crane Fig 37
 - .2 Jenkins Fig 4092J
 - .3 Grinnell Fig 3300
 - .4 Nibco S-413
 - .5 Toyo Red-White Fig 236
 - .6 Victaulic Series 712
 - .7 Kitz Fig 22
 - .5 CV 5
 - .1 Class 125 ULC and FM approved for 1200 Pa (175 psig) WOG, iron body, bronze mounted, horizontal swing check, bolted cap, flanged ends
 - .2 For above ground or in valve pit
 - .1 Clow
 - .2 Bray Rite 212ULC/FM
 - .3 MAS W30 Series
 - .6 CV 19
 - .1 Class 450, 3100 kPa (450 psi) working pressure, 150°C (300°F) maximum temperature rating, floating piston, Teflon seat disc, bronze body, solder ends.
 - .1 Henry Valve Co. Fig 205.

3 Execution

3.1 TRENCHING, BEDDING AND BACKFILL

.1 General

.1 Extent:

- .1 For buried services inside building and to 1.5 m outside building wall.

.2 Trench depth:

- .1 To 75 mm(150 mm) below the correct elevation and slope established for the bottom of the pipe.

- .3 Bedding:
 - .1 Refill the bottom elevation of the trench with hand-placed bedding materials.
 - .2 Thoroughly compact to the approval of the Consultant.
 - .3 At pipe hubs or couplings, remove bedding in the bottom of the trench as necessary to provide for even and constant support for each length of pipe.
- .4 Shoring:
 - .1 Provide adequate shoring, bracing and sheeting in pipe trenches.
 - .2 Place barriers and temporary crossings as necessary to ensure support, safety and protection at all times.
- .5 Unstable soil conditions:
 - .1 When encountered, advise the Consultant.
 - .2 Excavate pipe trenches to a depth as directed by the Consultant and then backfill to the correct grade with bedding material.
- .6 Backfill:
 - .1 Where joints occur, do not backfill until joint testing is approved by Consultant.
 - .2 Hand place backfill to 300 mm above the top of the pipe in 100 mm layers taking particular care to place and compact the backfill simultaneously on both sides of the pipe.
 - .3 From 300 mm above the top of the pipe backfill in 150 mm layers and mechanically compact.
- .7 Keep excavations dry at all times.
- .8 Compaction:
 - .1 Mechanically tamp and thoroughly compact each layer of new granular bedding and backfill material to 95 percent Modified Proctor Density.
- .9 In fill areas, allow a minimum clearance of 100 mm on all sides of the pipe passing under or through building grade beams to prevent possible damage from settling of building. If a greater settlement can be expected, increase the clearance to prevent possible damage.
- .10 Remove and dispose of excess excavated material off-site.

3.2 **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 Do not use soldered joints in compressed air piping.

- .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 steam or 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, chilled water and condenser water 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, chilled water and condenser 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.
 - .3 Natural gas: Provide a drip pocket with capped end, drain valve and Provide riser to increase elevation of piping. Pocket depth to be the

greater of: 75 mm deep or equal to diameter of pipe. Pocket diameter to be the lesser of: NPS 2 or gas main pipe diameter.

.4 Immersion Wells and Sensing Bulbs

.1 Fitting size:

.1 Pipe size NPS 2½ size and less: Increase pipe length for 300 mm to minimum one pipe size larger to maintain equivalent unobstructed cross sectional area.

.2 Pack immersion wells in piping for liquids up to a temperature of 150°C (300°F) with a mineral type grease prior to installation of sensing bulb.

.5 Piping Connections to Mains

.1 Make branch connections to respective horizontal piping of larger diameter to the upper quadrant of the larger pipe.

.2 Water piping:

.1 Make down feed piping connections to horizontal supply and return mains to the bottom quadrant of the mains.

3.3 **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 Gas Piping - Buried - Cathodic Protection

.1 Isolate buried piping between two buildings at both ends with dielectric unions or flanges.

.2 Protect piping by at least one 1 kg magnesium sacrificial anode every 30 m of run, welded to the buried gas pipe, to manufacturer's installation instructions.

.3 Provide dielectric unions on piping NPS 2½ and less and dielectric flanges on piping NPS 3 and larger.

.3 Copper Pipe - Type L

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

.4 Copper Pipe - Buried

.1 Provide dielectric unions at connection between cast iron or ductile iron water main and copper tubing.

.2 When required by municipal authority, provide 900 mm long copper gooseneck after corporation stop at connection to water main. Connection at water main to be at forty-five degrees and gooseneck to have minimum 160 mm radius bend.

.5 Refrigerant Piping

- .1 Install piping to conform to applicable requirements of ANSI B31.5 Code for Pressure Piping Section 5 "Refrigeration Piping" and CSA B52-M "Mechanical Refrigeration Code" latest issue.
- .2 Make solder type joints with "sil-fos" silver solder or similar high melting point solder having a melting point of at least 538°C (1000°F). Remove all interior parts of refrigerant specialties and valves before applying heat to the joint.
- .3 Provide refrigerant hoses on refrigerant line connections to equipment with reciprocating or rotating elements.
- .4 Test procedure and evacuation procedures: Conform to ANSI B31.5.
- .5 Test pressure: In accordance with CSA Code B52-M.
- .6 Provide all refrigerant required for testing and charging of the system.
- .7 Purge refrigerant piping with anhydrous nitrogen prior to making connection to pre-evacuated equipment to ensure removal of all moisture and non-condensable gases.
- .8 Completely evacuate to 0.5 torr (500 micron), seal and leave for twenty-four hours, re-evacuate to 0.5 torr, and charge all components of refrigeration system not evacuated by manufacturer, in accordance with manufacturer's printed recommendations.
- .9 Do not use the refrigeration compressor to evacuate the system under any circumstances. Evacuation the system using a vacuum pump at an ambient temperature not less than 2°C (35°F) to ensure removal of all moisture and non-condensable gases.
- .10 After testing, evacuation and charging is completed, allow system to operate under normal conditions for a minimum period of twenty-four hours, at which time, moisture indicator should indicate a dry system. If it does not so indicate, change dryer and operate unit for another twenty-four hours. Repeat this procedure until moisture indicator indicates a thoroughly dry system.

.6 PVC - Buried - Pressure and Drainage Piping

- .1 Provide a tracer wire directly over PVC pipe.

.7 PVC Drainage, Waste and Vent Piping

- .1 Below grade: Install in accordance with CSA B182.11 and manufacturer's recommendations.
- .2 Above grade: Install in accordance with CSA B181.11 and B181.12 and manufacturer's recommendations.
- .3 Provide fire stop seals on all fire separation penetrations, except at connections through concrete floor slabs to non-combustible water closets.
- .4 Do not use combustible piping in return air ceiling plenums or vertical riser shafts.

.8 Polypropylene - Laboratory Drainage

- .1 Make heat fusion joints in accordance with manufacturer's written instructions.

- .9 Polyethylene - Laboratory Drainage
 - .1 Make heat fusion joints in accordance with manufacturer's written instructions.

- .10 Borosilicate Glass - Beaded End
 - .1 Install and support piping system to manufacturer's written instructions.
 - .2 Provide pipe hangers with padding material between hanger and glass pipe.

- .11 Borosilicate Glass - Plain End
 - .1 Install and support piping system to manufacturer's written instructions.
 - .2 Provide pipe hangers with padding material between hanger and glass pipe.

3.4 **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 gauge) 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 Foundation Sleeves
 - .1 For pipes entering structures from below grade, seal the annular space between sleeve and pipe with prefabricated seals.
- .3 Firestopping
 - .1 Provide firestopping on pipes passing through firewalls, fire separation walls or through walls, partitions or floors which are considered as serving as firestops.
 - .1 Provide at partitions around washrooms.

- .2 Seal the space around the pipe, in the sleeve, in accordance with Section 23 05 01 and Section 07 84 00.
- .4 Pipe Sleeves Through Roofs
 - .1 Supplied and installed under other Contracts or under roofing section, unless specifically shown otherwise on the Drawings.
- .5 Future Services
 - .1 Fill sleeves for future use with lime mortar.
- .6 Escutcheon Plates
 - .1 Place escutcheon plates on bare piping passing through finished walls or floors.
- 3.5 **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
---------	-------------

Domestic hot and cold water	95/5 with matching flux
Drainage, waste, vent	50/50 with matching flux
Compressed air service	"Sil-Fos" silver solder or brazed

- .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 Carbon steel welded joints:
 - .1 To ANSI B31.1 Section IX for welding.
 - .2 Fusion welded joints made by electric arc welding, gas metal arc welding, or oxy-acetylene gas welding.
 - .3 Ensure that supervisory staff, fitters and welders are fully conversant with the requirements laid down by that standard prior to the commencement of welding.
 - .4 Employ qualified welders holding a current up-to-date provincial certificate for the process and rating involved as required by the provincial regulations.
 - .5 Unless more stringent methods of inspections are specified the Consultant will visually inspect welded joints for fusion of metal, icicles, alignment, etc.
 - .1 Remove any defects and remake the joint to his satisfaction.
 - .6 For welding of materials other than carbon steel, conform to the requirements specified in the relevant section of the Specification.
- .8 Grooved end piping systems:
 - .1 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 connection to steam traps and in by-passes around traps.
 - .3 At connections to equipment. Locate between shut-off valve and equipment.
 - .4 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.
- .4 Flange joints
 - .1 Assemble joints with appropriate flanges, gaskets and bolting.
 - .2 Allow clearance between flange faces such that the connections can be gasketed and bolted tight without undue strain on the piping system, with flange faces parallel and bores concentric.
 - .3 Centre gaskets on the flange faces so as not to project into the bore.
 - .4 Lubricate bolts before assembly and provide two hardened steel washers under the head of each unit to assure uniform bolt stressing.
 - .5 Machine off raised face flanges when joining to a flat companion flange and use a full face gasket.
 - .6 Follow gasket manufacturer's instructions for correct bolting procedure.
 - .7 Use calibrated torque wrench and tighten bolts in recommended sequence in four equal steps to required final torque value.
- .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.
 - .4 NPS 2½ and larger: Welded joints.
 - .2 Fittings and ancillary items installed in systems operating at pressures in excess of 103 kPa (15 psig):
 - .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 butt weld 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.

3.6 **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.
- .4 Where required for sectionalizing a system or floor.
- .5 Check valves wherever required to ensure flow of liquid in one direction.

.3 Type

- .1 Shut-off service: Gate, butterfly type, and ball (quarter-turn).
- .2 Throttling service: Double regulating, globe or plug type for throttling purposes.

.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.

.5 Valve chains

- .1 Provide chain wheel operators and operating chain for valves located more than 2 m above floor or walkway.
- .2 Provide chain of sufficient length to extend to within 2 m of operating platform or floor for free hanging chains, or to within 1.5 m of floor in locations where chain can be secured to wall or column. Secure chain to wall or column with a wall hook.
- .3 Chain wheels using rustproof chain complete with guide and of size recommended by valve manufacturer for proper operation of valve.

3.7 **INSPECTION AND TESTING**

.1 Pressure Leak Testing

- .1 General Contractor through Subcontractor to conduct pressure tests on all piping included in this Contract. It shall include buried piping prior to backfill.
- .2 Furnish all pumps, compressors, gauges and connectors necessary for the tests.
- .3 Test sections as authorized by Consultant to accommodate construction schedule. However, test complete systems on completion of Work.
- .4 Conduct tests in the presence of:
 - .1 Consultant
 - .2 Personnel of governing authorities having jurisdiction
- .5 Notify above personnel in ample time to permit them to be present.
- .6 Conduct tests before piping is painted, covered or concealed.
- .7 Disconnect pumps or compressors used for applying the test pressure, during the test period.
- .8 Disconnect and/or remove equipment or specialties not designed to withstand the test pressure during the test and reconnect same after completion of test.
- .9 Promptly correct any defects that develop through tests and re-test to the complete satisfaction of the Consultant and other parties involved.
- .10 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.
- .11 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 two 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 one and one-half 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 (50 psig).
 - .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 Natural and Propane Gas Piping
 - .1 Conduct final tests in accordance with the requirements of the local utility or governing authority.
 - .2 If feasible, make tests when ambient air temperature is approximately constant.
 - .1 Corrections for pressure change due to temperature differential shall be allowed as approved by the Consultant.
- .5 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.
- .6 Specific Test Requirements
 - .1 Test the following services with compressed air or inert gas at one and one-half times the working pressure, but in no event less than 345 kPa (50 psig).
 - .1 Natural gas piping
 - .2 Vacuum piping
- 3.8 **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 fifteen 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.
 - .4 Flush stainless steel piping with water as described above, then immediately flush with design Product fluid. Do not leave city water or chlorinated water in piping.
 - .3 Chilled Water, Condenser Water, Glycol 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 seventy-two hours at room temperature then drain and refill with water 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.)

3.9 PIPING SYSTEMS STANDARDS

.1 Abbreviations

- .1 The Mechanical Pipe Standards (MPS) include the following abbreviations:

End Treatment		Material	
B&S	Bell and Spigot	ARCI	Acid Resisting Cast Iron
BDE	Beaded End	CB	Cast Bronze
BE	Beveled End	CBR	Cast Brass
BW	Butt Weld	CGI	Cast Grey Iron
CJ	Compression Joint	CI	Cast Iron
FE	Flange End	CK	Copper type "K" soft annealed
GE	Groove or Rolled End	CL	Copper Type "L" hard drawn
HFJ	Heat Fusion Joint	CS	Carbon Steel
LUG	Full Tapped Lug	CTSL	Cast Steel
MJ	Mechanical Joint	Cu	Copper
PE	Plain End	DWV	DWV Copper
SJ	Solder Joint	FS	Forged Steel
SO	Slip On	Galv	Galvanized
SW	Socket Weld	MI	Malleable Iron
SWJ	Solvent Weld Joint	PET	Polyethylene
TE	Threaded End	PPE	Polypropylene
WFR	Wafer	PVC	PVC
WN	Weld Neck	SMS	Semi-Steel
		SS	Stainless Steel
		TBS	Tempered Borosilicate Glass
		WC	Wrought Copper

.2 Mechanical Pipe Standards

- .1 The following piping system standards are bound at the end of this section.

2000	
2060	Industrial Vacuum - Copper
3000	
3010	Fire Protection - Buried - 4" and Larger - Ductile Iron
3011	Fire Protection - Carbon Steel - Threaded, Cut Groove
3012	Fire Protection - Galvanized Steel (FM - Note 4) - Threaded, Cut Groove
3021	Fire Protection - Industrial - Carbon Steel - Welded, Roll Groove
3022	Fire Protection - Commercial - Carbon Steel - Welded, Roll Groove
3023	Fire Protection - Galvanized Steel (FM - Note 4) - Welded, Roll Groove

3031	Fire Protection - Buried - Ductile Iron
4000	
4011	Drainage and Vent - Buried - Cast Iron
4012	Drainage and Vent - Buried - PVC
4020	Pumped Sanitary - Pumped Storm - Above Ground
4031	Sanitary Drainage and Vent - Above Ground - DWV and Cast Iron
4032	Sanitary Drainage and Vent - Above Ground - PVC
4041	Storm Drainage - Above Ground - Steel - Drainage Fittings
4042	Storm Drainage - Above Ground - Steel - Grooved
4043	Storm Drainage - Above Ground - Cast Iron
4044	Storm Drainage - Above Ground - PVC
4052	Process Drain and Vent - Buried - PVC
4053	Process Drain and Vent - Above Ground - Cast Iron
4054	Process Drain and Vent - Above Ground - PVC
4055	Process Drain and Vent - Above Ground - Acid Resistant
4056	Process Wastewater Piping - Above & Below Ground - FRP
4100	
4111	City Water - Buried - Copper
4112	City Water - Buried - Polyethylene
4113	City Water - Buried - Ductile Iron
4114	City Water - Buried - PVC
4130	Domestic Water - Above Ground - Copper
5000	
5011	Service Water - Carbon Steel - Threaded and Welded
5012	Service Water - Carbon Steel - Threaded and Grooved End
5013	Service Water - Carbon Steel - Socket Weld and Welded
5014	Service Water - Carbon Steel - Socket Weld and Grooved End
5015	Service Water - Copper
5021	Service Water - Carbon Steel - Buried
5022	Service Water - Copper - Buried
5200	
5211	Natural Gas - Buried - Carbon Steel
5212	Natural Gas - Buried - Polyethylene
5221	Natural Gas - Above Grade - Steel
5222	Natural Gas - Above Grade - Steel - Socket Weld
5240	Fuel Oil - Above Grade - Socket Weld and Welded
6000	
6020	Refrigerant

End of Section

Item	Size	End Treatment	Mat'l	ASTM		ANSI (CSA)	Schedule Class	Remarks
				Spec	Grade			
Pipe	8" & DN	PE	CI			B70-M		Note 1, 2
	10" & UP	PE	CI			B70-M		Note 3
Fittings	8" & DN	PE	CI			B70-M		Note 1, 2
	10" & UP	PE	CI			B70-M		Note 3
Unions								
Couplings								

Item	Size	End Treatment	Mat'l	Stem	Type	Approvals	Schedule Class	Remarks
Gate								
Globe								
Angle								
Butterfly								
Ball								
Check								
Strainers								

Line Reference	Service
SAN ST	Sanitary Storm

Notes	
1. Rubber ring gaskets integral with bell 2. Neoprene sleeve and stainless steel gear type clamp (MJ joint) 3. Lead and oakum joints 4. For buried piping within building, and up to 5' (1.5m) from building	ARCADIS PIPING SPECIFICATION Drainage and Vent Buried Cast Iron
	Maximum Temperature 140°F
	Maximum Pressure -
	<div> <div> Revised ##### Rev: 1 </div> <div> Checked PS Appr'd CD </div> </div> <div> MPS-4011 </div>

Item	Size	End Treatment	Mat'l	ASTM		ANSI (CSA)	Schedule Class	Remarks
				Spec	Grade			
Pipe	6" & DN	B&S	PVC			(B181.2-M)		Note 2, 3, 4
	8" & UP	B&S	PVC			(B181.2-M)		Note 2, 3, 4
Fittings	6" & DN	B&S	PVC			(B181.2-M)		Note 2, 3, 4
	8" & UP	B&S	PVC			(B181.2-M)		Note 2, 3, 4
Unions								
Couplings								

Item	Size	End Treatment	Mat'l	Stem	Type	Approvals	Schedule Class	Remarks
Gate								
Globe								
Angle								
Butterfly								
Ball								
Check								
Strainers								

Line Reference	Service
SAN ST	Sanitary Storm

Notes				ARCADIS			
1. For buried piping within building, and up to 5' (1.5m) from building 2. Rubber ring gaskets integral with bell 3. Install in accordance with CSA B182.11 and manufacturers literature 4. Alternate for storm drainage: CSA B182.1-M in PVC				PIPING SPECIFICATION		Maximum Temperature 140°F	
				Drainage and Vent Buried PVC		Maximum Pressure -	
						MPS-4012	
				Revised	2003-01-10	Checked	PS
				Rev:	2	Appr'd	CD

Item	Size	End Treatment	Mat'l	ASTM		ANSI (CSA)	Schedule Class	Remarks
				Spec	Grade			
Pipe	3" & DN	PE	Galv CS	A53	B		40	
Fittings	3" & DN	SE	Galv MI	A197		B16.3	150	
	3" & DN	FE	Galv CI	A126	A	B16.1	125	
Flanges	2" & DN	FE	Galv CI	A126	A	B16.1	125	
Unions	3" & DN	SE	Galv MI	A197		B2.1	150	Brass to Iron ground joint

Item	Size	End Treatment	Mat'l	ASTM	ANSI	Spec Type	Schedule Class	Remarks
Gate	3" & DN	SE	CB	Rising	GTV 1		125	
Globe								
Angle								
Butterfly								
Ball								
Check	3" & DN	SE	CI		CV 3		125	Non-slam
Strainers								

Line Reference	Service
PSW PST	Pumped Sanitary Pumped Storm

Notes	
1. Gaskets: 1/16" (1.6 mm) red rubber, full face type	ARCADIS
	PIPING SPECIFICATION
	Maximum Temperature 140°F
	Maximum Pressure -
	MPS-4020
	<div> <div> Revised Rev: </div> <div> ##### 1 </div> </div> <div> <div> Checked Appr'd </div> <div> PS CD </div> </div>

Item	Size	End Treatment	Mat'l	ASTM		ANSI (CSA)	Schedule Class	Remarks
				Spec	Grade			
Pipe	3" & DN	PE	DWV	B306				
	4" & UP	PE	CI			B70-M		Note 1
Fittings	3" & DN	SJ	WC/CBR	B16.29		B16.29 (B158.1)		
	4" & UP	MJ	CI			B70-M		Note 1
Unions								

Item	Size	End Treatment	Mat'l	ASTM	ANSI	Spec Type	Schedule Class	Remarks
Gate								
Globe								
Angle								
Butterfly								
Ball								
Check								
Strainers								

Line Reference	Service
SAN	Sanitary Sanitary Vent

Notes	
1. Neoprene sleeves with stainless steel gear type clamps (MJ joints),	ARCADIS
	PIPING SPECIFICATION
	Sanitary Drainage and Vent Above Ground DWV and Cast Iron
	Revised ##### Checked PS
	Rev: 1 Appr'd CD
<div> <div>Maximum Temperature 140°F</div> <div>Maximum Pressure -</div> <div>MPS-4031</div> </div>	

Item	Size	End Treatment	Mat'l	ASTM		ANSI (CSA)	Schedule Class	Remarks	Line Reference	Service
				Spec	Grade					
Pipe	6" & DN	PE	PVC			(B181.2-M)				
	8" & UP	PE	PVC			(B181.2-M)				
Fittings	6" & DN	SWJ	PVC			(B181.2-M)		Note 1		
	8" & UP	SWJ	PVC			(B181.2-M)				
Unions										
Item	Size	End Treatment	Mat'l	ASTM	ANSI	Spec Type	Schedule Class	Remarks		
Gate										
Globe										
Angle										
Butterfly										
Ball										
Check										
Strainers										

Notes					ARCADIS			
1. Solvent cement to CSA B181.11					PIPING SPECIFICATION			Maximum Temperature 140°F
					Sanitary Drainage and Vent Above Ground PVC			Maximum Pressure -
								MPS-4032
					Revised	2003-01-10	Checked PS	
					Rev:	2	Appr'd CD	

Item	Size	End Treatment	Mat'l	ASTM		ANSI (CSA)	Schedule Class	Remarks
				Spec	Grade			
Pipe	18" & DN	B&S	FRP	D2996				
Fittings	18" & DN	B&S	FRP					
Flanges						B16.5		
Unions								
Couplings								

Item	Size	End Treatment	Mat'l	ASTM	ANSI	Spec Type	Schedule Class	Remarks
Gate								
Globe								
Plug								
Butterfly	4" & UP	FE	DI			BFV 5	150	
Ball	3" & DN	FE	SS			BV 12	150	
Check	18" & DN	WFR	SS			CV 18	150	
Strainers								

Line Reference	Service
IW	Industrial Waste
EDW	Industrial Waste

Notes		ARCADIS	
		PIPING SPECIFICATION	Maximum Temperature 225°F
		Process Wastewater Piping Above & Below Ground FRP	Maximum Pressure 150°F
		Revised 2003-05-13	Checked
		Rev: 0	Appr'd
		MPS-4056	

Item	Size	End Treatment	Mat'l	ASTM		ANSI (CSA)	Schedule Class	Remarks
				Spec	Grade			
Pipe	3" & DN	PE	CL	B88				
	4" & UP	GE	Cu, CB	B42, B43				Seamless
Fittings	3" & DN	SJ	WC					
	4" to 8"	GE	Cu, CB					
Flanges								
	4" to 8"	GE	CB,CBR			16.24		
Unions	3" & DN	SJ, SE	CB					
Couplings	4" to 8"	GE	MI	A47	32510			Note 1
					35018			

Item	Size	End Treatment	Mat'l	Stem	Type	Approvals	Schedule Class	Remarks
Gate	3" & DN	SE	CB	Rising	GTV 1		125	
	3" & DN	SJ	CB		GTV 7		125	
	4" & UP	FE	CI	OS&Y	GTV 2		125	
Globe	2" & DN	SJ	SB	Rising	GLV 3		125	
	3" & UP	FE	CI		GLV 2		125	
Angle								
Butterfly								
	4" & UP	LUG	CI		BFV 1		150	
Ball	3" & DN	SJ	CB		BV 2		150	
Check	3" & DN	SE/SJ	CB		CV 1		125	
	4" & UP	FE	CI		CV 2		125	
Strainers								

Line Reference	Service
DCW	Domestic Cold Water
DHW	Domestic Hot Water
DHWR	Dom Hot Water Recirc

Notes				ARCADIS			
1. Copper plated malleable iron couplings				PIPING SPECIFICATION		Maximum Temperature 180°F	
				Domestic Water Above Ground Copper		Maximum Pressure 125	
						MPS-4130	
				Revised	2000-09-14	Checked	PS
				Rev:	2	Appr'd	CD

Item	Size	End Treatment	Mat'l	ASTM		ANSI (CSA)	Schedule Class	Remarks	Line Reference	Service
				Spec	Grade					
Pipe	3/4" & DN	CJ	ACR	B280		B31.5 (B52-M)		Note 1, 3		
	1" & UP	SJ	ACR	B280		B31.5 (B52-M)				
Fittings	3/4" & DN	CJ	CL or CK	B280		B31.5 (B52-M)				
	1" & UP	SJ	CL or CK	B280		B31.5 (B52-M)				
Flanges	All	SJ	FS							
Unions	All	SJ	CBR				500	Note 2		
Couplings										
Item	Size	End Treatment	Mat'l	Stem	Type	Approvals	Schedule Class	Remarks		
Gate										
Globe	All	SJ	CBR	B31.5	GLV 10					
Angle										
Butterfly										
Ball										
Check	All	SJ	CBR	B31.5	CV 19					
Strainers										

Notes					ARCADIS			
1. De-oxidize and dehydrate tubing, with ends factory sealed and identified by the manufacturer as being suitable for refrigeration service 2. Brass tail piece adaptor for copper tubing, forged steel flanges, steel bolts, bronze nuts and asbestos-free fibre basket 3. Can be soft annealed or hard drawn to ASTM B28C					PIPING SPECIFICATION		Maximum Temperature 300°F	
					Refrigerant		Maximum Pressure 400 PSIG	
					Issue	2002-12-18	Checked	PS
					Rev:	1	Appr'd	CD
					MPS-6020			

- 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 in accordance with Section 01 33 00.
 - .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data in accordance with Section 01 33 00.
- 2 Products
 - 2.1 **THERMOMETERS AND PRESSURE GAUGES**
 - .1 General
 - .1 To match existing thermometers and pressure gauges
 - .2 Scale Reading Units
 - .1 Thermometers to read (both Fahrenheit and Celsius) (Fahrenheit) (Celsius) scale.
 - .2 Pressure gauges to read (both psi and kPa) (psi) (kPa) scale.
 - .3 Gauge stems and separable sockets of sufficient length to provide for proper insertion in piping or equipment in which they are installed.
 - .3 Products are identified by model designations from H.O. Trerice Co. and to be used as a guide to establish standard of construction. Comparable Products are acceptable from the following manufacturers:
 - .1 H.O. Trerice Company
 - .2 Dresser Canada Inc. - Ashcroft
 - .3 Weiss
 - .4 Weksler - Baker Instruments
 - .5 Winter's Thermogauges Limited
 - .2 Direct Reading Thermometers
 - .1 Industrial 230 mm scale length, variable angle type, liquid filled, aluminum case
 - .1 H.O. Trerice Company - A400 series
 - .2 Bi-metal dial type, 125 mm diameter, variable angle, stainless shell type 300 series case and stem with calibration screw.

- .3 H.O. Trerice Company - B85600 series
- .3 Remote Reading Thermometers
 - .1 115 mm diameter, liquid filled or gas activated type, braided bronze armour over copper capillary, stainless steel bulb and cast aluminum case for surface mounting.
 - .1 H.O. Trerice Company - Series No. L80300 (liquid filled)
- .4 Thermometer Wells
 - .1 Provide wells in pipelines as follows:
 - .1 For copper pipe: Brass.
 - .2 For steel pipe: Brass or stainless steel.
- .5 Conversion Kit
 - .1 Retrofit kit for converting wells of straight liquid filled thermometers to accept bi-metal dial thermometers.
- .6 Direct Reading Pressure Measurement
 - .1 Dial type, 100 mm diameter, glycerine liquid filled
 - .1 Case: Stainless steel type 304
 - .2 Movement: Stainless steel
 - .3 Tube and socket: Stainless steel type 304
 - .4 Adjustable pointer
 - .5 Two-way gauge cock
 - .6 Operating temperature range, glycerine: -17°C to +115°C (0°F to 240°F)
 - .7 Operating temperature range, silicone: -34°C to +115°C (-30°F to 240°F)
 - .8 Accuracy: ASME B40.1 Grade 1A $\pm 1\%$ full scale
 - .9 H.O. Trerice Company - Series 700
- .7 Differential pressure measurement at pumps, refrigeration machines and where shown
 - .1 Same as for direct reading pressure measurement, and:
 - .1 Maximum registering pointer
 - .2 Impulse snubber
 - .3 Three way switching valve
- .8 Sanitary Direct Reading Pressure Measurement
 - .1 Dial type, 100 mm diameter, food grade glycerine liquid filled
 - .1 Case and ring: Polished stainless steel type 316
 - .2 Movement: Stainless steel type 316

- .3 Capsule and socket: Stainless steel type 316
- .4 Adjustable pointer
- .5 Operating temperature range, glycerine: -20°C to +100°C (-4°F to +212°F)
- .6 Accuracy: ASME B40.1 Grade 1A $\pm 1\%$ full scale
- .7 Approvals: 3A and USDA
- .8 H.O. Trerice Company - Series 700TALF
- .9 Test wells. For use with partial immersion laboratory type thermometers.
 - .1 Manufactured from bar stock or forged brass with cap and chain, compatible with thermometers used.
 - .2 Registered with Technical Standards and Safety Association, Boiler and Pressure Vessel Safety Branch, and have C.R.N. Registration number.
 - .1 H.O. Trerice Company

2.2 **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 NPS 3 and larger:
 - .1 "Y" pattern
 - .2 Class 125 (860 kPa) cast iron body
 - .3 Flanged ends and bolted cleanout cap
 - .4 Blow-off drain connection.
 - .3 Screen material: 20 mesh stainless steel unless otherwise noted
 - .4 Manufacturers:
 - .1 Erwel
 - .2 Spirax Sarco
 - .3 Streamflo
 - .4 Brooks – Hart
 - .5 Mueller
- .2 Basket Strainers
 - .1 NPS 2 to 12, WOG service

- .1 Single basket
- .2 Class 150 (1033 kPa) cast iron body with quick release cover
- .3 Bottom blow down valve
- .2 NPS 2 to 12, steam service
 - .1 Single basket
 - .2 Class 125 (860 kPa) cast iron body with bolted cover
 - .3 Bottom blow down valve
- .3 Basket Screens
 - .1 Stainless steel
 - .2 NPS 2 and 3: 1.15 mm perforation mesh
 - .3 NPS 4 and over: 3.2 mm perforation mesh
- .4 Manufacturers
 - .1 Erwel
 - .2 Spirax Sarco
 - .3 Streamflo
 - .4 Brooks – Hart
 - .5 Mueller

2.3 **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 (150 psi) working pressure and 93°C (200°F) working temperature.
 - .6 Designed to absorb 150 mm transverse movement.
 - .7 Flexible length not less than six times nominal size.
 - .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
- .2 Flexible Rubber Expansion Joints
 - .1 Size Application
 - .1 Steel piping: NPS 1½ to NPS 12
 - .2 Construction
 - .1 Double arch, sphere design bellows
 - .2 Composite three layer EPDM or neoprene with nylon reinforcement construction
 - .3 Floating flanges complete with control units.
 - .4 Operating pressure: Minimum 860 kPa (125 psig)
 - .5 Operating temperature: -10°C to +100°C (14°F to 212°F)
 - .3 Manufacturer
 - .1 Senior Flexonics (Canada) Ltd - Style 102
 - .2 SSI - model ATM
 - .3 UniRoyal Rubber - Style 4140
- .3 Expansion Compensators (bellows type)
 - .1 Size Application
 - .1 Steel piping: NPS ¾ to NPS 2
 - .2 Copper piping: NPS ¾ to NPS 3
 - .2 Construction
 - .1 Pressure external to bellows.
 - .2 Internal guides, limit stops and anti-torque device.
 - .3 Copper pipe installation: Bronze construction with female solder type ends.
 - .4 Steel pipe installation: Steel construction with stainless steel bellows and screwed ends.
 - .5 Selected for 1035 kPa (150 psi) (1380 kPa (200 psi)) working pressure.
 - .3 Manufacturers
 - .1 Senior Flexonics (Canada) Limited
 - .2 Badger

- .3 Hyspan
- .4 Uncontrolled Type Expansion Joints
 - .1 Size Application
 - .1 Steel piping: NPS 2 to NPS 24
 - .2 Construction
 - .1 Stainless steel bellows
 - .2 Flanged ends
 - .3 Suitable for axial extension and compression, lateral off-set, and angular rotation
 - .4 Temperature rating: -29°F to +426°C (-20°F to +800°F)
 - .5 Selected for 1035 kPa (150 psi) (1380 kPa (200 psi)) steam working pressure.
 - .3 Manufacturers
 - .1 Senior Flexonics (Canada) Limited
 - .2 Adscos Division - Yuba Industries Inc.
 - .3 Hyspan
- .5 Ring Controlled Type Expansion Joints
 - .1 Size Application
 - .1 Steel piping: NPS 3 to NPS 24
 - .2 Construction
 - .1 Stainless steel bellows, limit stops and guides
 - .2 Reinforcing control rings
 - .3 Flanged ends
 - .4 Anchor type bases where required
 - .5 Temperature rating: -29°F to +426°C (-20°F to +800°F)
 - .6 Selected for 1035 kPa (150 psi) (1380 kPa (200 psi) 2070 (300 psig)) steam working pressure.
 - .3 Manufacturers
 - .1 Senior Flexonics (Canada) Limited
 - .2 Adscos Division - Yuba Industries Inc.
 - .3 Hyspan
- .6 Slip Type Expansion Joints
 - .1 Size Application

- .1 Steel piping: NPS 1½ to NPS 24
- .2 Construction
 - .1 Packing chamber, limit stops, lubrication fittings, or lubricant impregnated packing rings
 - .2 Adjustable packing gland or fixed packing gland arrangement with a packing injection assembly
 - .3 Slip pipe of hard chrome plated carbon steel to ASTM A53-82
 - .4 Anchor base
- .3 Manufacturers
 - .1 Senior Flexonics (Canada) Ltd.
 - .2 Rockwell
 - .3 Yarway
 - .4 United Flexible Metallic Tubing (Canada) Limited
 - .5 Adsco
 - .6 Hyspan

2.4 **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

2.5 **VALVE CONTROL & GAUGE MONITORING SYSTEMS (FUTURE BAS INTEGRATION)**

- .1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:

- .1 Delta Controls
- .2 Reliable Controls
- .3 Schneider Electric SmartX Series
- .4 Distech Controls
- .5 Johnson Controls Facility Explorer
- .6 Honeywell CIPer series, Spyder Models 5 or 7
- .2 BAS System Integration:
 - .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
 - .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
 - .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.
- .3 Licensing Requirements
 - .1 Licenses shall be provided to and in the name of the City of Toronto
 - .2 Licenses shall be perpetual, transferrable, assignable and royalty free.
- 3 Execution
 - 3.1 **INSTALLATION - THERMOMETERS AND PRESSURE GAUGES**
 - .1 General
 - .1 Installation height: Not greater than 3 m from floor or platform.
 - .2 Installation heights exceeding 3 m from floor or platform: Install remote reading thermometers and gauges, with dial mounted at 1500 mm above floor or platform, on steel or aluminum plate.
 - .2 Thermometers
 - .1 Install thermometers in wells.
 - .2 Install wells with extension necks in piping or equipment that is to be insulated.
 - .3 Provide thermometers at inlet and outlet of:

- .1 Domestic hot water tanks
- .2 Water heating and cooling coils
- .3 Water boilers
- .4 and as shown

.4 Thermometer Ranges

SYSTEM	SCALE RANGE
City water	(-5° to 40°C) (25° to 100°F)
Domestic cold water	(-5 °to 40°C) (25°to 100°F)
Domestic hot water	(5° to 120°C) (40° to 180°F)
Hot water heating (scheduled & constant temperature)	(5° to 115°C) (40° to 240°F)

.3 Pressure Gauges

.1 Selection

- .1 Normal operating reading: Between one-half and two-thirds of full scale or range and expected maximum and minimum readings are within range.

.2 Provide pressure gauges at inlet and outlet of:

- .1 Domestic water heaters
- .2 Water heating and cooling coils
- .3 Water boilers
- .4 Water filters
- .5 Pressure reducing valves
- .6 Pumps (pressure differential)
- .7 and as shown

.3 For direct pressure measurement, provide for each gauge:

- .1 One-quarter turn bronze ball valve complete with lever handle
- .2 Pressure snubber
- .3 Syphons for gauges in steam service
- .4 Isolation diaphragms where shown for gauges in corrosive service

.4 For differential pressure measurement, provide for each gauge:

- .1 Three-way three position (left-off-right) switching valve with lever handle
- .2 Pressure snubber
- .3 Impulse dampener
- .4 Syphons for gauges in steam service

- .5 Isolation diaphragms where shown for gauges in corrosive service
- .4 Test Plugs
 - .1 Provide test plugs for temporary insertion of thermometers and pressure gauges at locations shown on Drawings.
- 3.2 **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.
 - .2 Basket Strainers
 - .1 Install basket strainers with minimum of 450 mm clearance above strainer.
 - .2 Provide pipe supports on piping immediately adjacent to strainer; do not directly support strainer, or have adjacent piping supported through the strainer.
 - .3 Remove baskets, clean and replace at time of building handover.
 - .3 Automatic Back-Wash Filters
 - .1 Install automatic backwash filters in accordance with manufacturer's recommendations.
 - .2 Provide drain to back-wash drain connection and pipe to floor drain. (Pipe-up domestic cold water connection).
- 3.3 **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 On suction and discharge connections of domestic water booster pumps.
 - .2 On suction and discharge connections of base mounted double suction pumps.
 - .3 On discharge connections of sump and sewage pumps.

- .4 In steam, hot water, chilled water, or glycol piping connections to coils and humidifiers 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.
- .5 On piping connections to domestic hot water tanks.
- .6 Cooling tower supply and return connections at tower.
- .2 Flexible Rubber Expansion Joint
 - .1 Cooling tower supply and return piping connections at pump.
 - .2 Above ground drainage piping where shown on Drawings.
- .3 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 Compressed air, maximum 860 kPa (125 psig).
- .4 Uncontrolled Type Expansion Joints
 - .1 Domestic hot water and recirculating water piping NPS 3½ size and larger.
 - .2 Heating system piping NPS 2½ size and larger.
- .5 Ring Controlled Type Expansion Joints Slip Type
 - .1 High pressure steam piping over 100 kPa (15 psig).
- .6 Slip Joints
 - .1 High temperature hot water over 100°C (212°F).
- .7 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 15060 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.
- .8 Flexible metal hose connection installation:
 - .1 Support or guide piping firmly adjacent to flexible connections and prevent pipes from swaying.
 - .2 At steam coils locate hoses between control valve and coil on steam supply side and on main condensate line leaving coil or bank of coils on return side.

- .3 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.

3.4 **INSTALLATION - MISCELLANEOUS**

.1 Pressure Relief Valves

- .1 Install relief valves downstream of pressure reducing valves, and on pressure vessels where shown.
- .2 Provide discharge elbow drain, and pipe drain with NPS ¾ pipe to nearest floor drain.
- .3 Terminate relief vent up through roof, at height as follows:
 - .1 900 mm for water systems below 92°C (200°F).
 - .2 1800 mm for water and steam systems above 92°C (200°F).

.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 Reheat coils where detailed on Drawings.
 - .4 Other locations as shown.

End of Section

- 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 in accordance with Section 01 33 00.
 - .2 Submit Layout Drawings showing each type and placement of manufactured, pre-fabricated roof piping support system. Submit details for fixing roofing pad to roof.
- 2 Products
 - 2.1 **MATERIALS**
 - .1 Acceptable Manufacturers
 - .1 Hangers:
 - .1 Anvil
 - .2 Myatt
 - .3 Carpenter & Paterson
 - .4 Hunt
 - .5 B-Line
 - .6 Taylor Pipe Supports
 - .2 Insulation shields:
 - .1 Anvil
 - .2 Myatt
 - .3 Pipe Shields Inc.
 - .4 Taylor Pipe Supports
 - .2 Lower Attachment
 - .1 Clevis hanger – steel pipe
 - .1 Standard weight black steel clevis hangers with level adjustment and 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 colored 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.
- .3 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 (gauge)
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.
- .4 Middle Attachment
 - .1 Machine threaded rods
 - .1 Black steel finish in concealed areas.
 - .2 Galvanized finish in mechanical rooms and exposed areas.
- .5 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 Malleable beam clamp FM approved: Anvil figure 218, NPS 2½ to NPS 8; maximum load: 540 kg.
- .3 For pipes NPS 10 and larger, Provide supplementary steel members supported from structural steel.
- .4 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.
- .6 Rooftop Pipe Supports
 - .1 Prefabricated pipe support system:
 - .1 Bases: (Injection moulded plastic or polycarbonate resin, with UV inhibiting additive) (Stainless steel) (Hot dipped galvanized steel).
 - .2 Framing: Channel strut system of size suitable for the load involved.
 - .3 Hangers: As specified above.
 - .4 Clamps, bolts, nuts and washers to suit installation, same material as framing members.
 - .5 Roof pads to suit roof construction.
 - .2 Acceptable Manufacturers:
 - .1 Portable Pipe Hangers
 - .2 Taylor Ecofoot
 - .3 Miro Industries Inc.
- .7 Riser Clamps
 - .1 Black steel double clamp: Anvil figure 261, supported at floors; Anvil figure 240, supported by hanger rods.
- .8 Pipe Guides
 - .1 Outer hinged housing with sliding spider clamp.
 - .1 Carbon steel, black steel finish.
 - .2 Anvil figure 256.

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.

.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 21°C (70°F)	Between 21°C (70°F) and 43°C (110°F)	Greater than 43°C (110°F)
	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

Pipe Size NPS	Operating Temperature		
	Less than 21°C (70°F)	Between 21°C (70°F) and 43°C (110°F)	Greater than 43°C (110°F)
	Insulated	Non-insulated	Insulated
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 "Galvafrid", 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 two @ 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	19	5.7	7.3
10	22	5.7	7.3
12	22	7.0	7.9
14	25	7.6	9.7
16	25	8.2	10.6
18	25	8.5	11.2
20	32	9.0	11.8
24	38	9.7	12.8
30	51	10.0	13.4
36	51	13.7	18.0

.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	10	1.2	1.2	1.2	1.2
¾	10	1.2	1.2	1.2	1.5

Pipe Size NPS	Rod Size mm	Pipe Schedule			
		PVC 40	CPVC 40	PVC 80	CPVC 80
1	10	1.2	1.5	1.5	1.8
1¼	10	1.2	1.5	1.5	1.8
1½	10	1.5	1.8	1.8	1.8
2	10	1.5	1.8	1.8	2.0
2½	12	1.8	2.0	1.8	2.4
3	12	1.8	2.0	2.0	2.4
4	16	1.8	2.0	2.0	2.7
6	19	2.0	2.4	2.7	3.0
8	19	2.4	2.4	2.7	3.0
10	22	2.7	-	3.3	-
12	22	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 Vertical Piping Supports

- .1 Vertical plumbing and drainage piping:
 - .1 To the Ontario Building Code, unless more stringent requirements are specified herein.
- .2 Vertical support spacing:
 - .1 Cast iron soil pipes: At every floor with riser clamps.
 - .2 Other piping: At every other floor with riser clamps, unless otherwise required by expansion conditions or otherwise specified.
- .3 Support bottom of riser with base fitting set on concrete pier or by hanger located at top of riser pipe as close to riser as possible.
- .4 Riser clamps:
 - .1 Bolted securely to pipes.
 - .2 Rest ends of clamp on the pipe sleeve or on the floor.
 - .3 Weld shear lugs to pipe to transfer load to riser clamp.
- .5 Stabilize vertical piping laterally by fabricated brackets or malleable iron, extension type split hangers.
- .6 Run vertical piping at columns in the column webs, on either or both sides of the column, unless otherwise directed by the Consultant.

.10 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 pipe guides on each side of an expansion joint and expansion compensator.
 - .1 1.2 m 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.
- .11 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 1.8 m intervals along route of piping.
 - .2 Provide a 200 mm length of rebar and wire through insert.
- .12 Upper Attachments - Structural Steel
 - .1 For pipe size NPS 10 and larger supported from structural steel:
 - .1 Provide supplementary structural steel and weld or bolt to structural steel.
 - .2 Submit Plan Drawings and details to the Structural Engineer for review.
- .13 Roof Mounted Piping
 - .1 Manufacturer site responsibilities:
 - .1 Provide on site assistance and inspection as required for installation.
 - .2 Provide Layout Drawing, located positions of each hanger.
 - .2 Hanger system installation:
 - .1 Remove roofing ballast and debris from areas of base.
 - .2 Adhere roofing pad to roof membrane with adhesion system as recommended by manufacturer.
 - .3 Adhere base to roofing pad with adhesion system as recommended by manufacturer.
 - .4 Set frame legs in to bases and assemble hangers.
 - .5 Remove excess adhesive from frame, bases and pads.

.6 Replace roof ballast up to edge of base.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **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, or 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
Offices	33-35
Service/Garage Areas	50

- .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.

.2 Vibration Limits of Mechanical Equipment

.1 Equipment classification:

- .1 One of three categories defined in ISO standard 2372.
- .2 Vibration severity limits corrected for hard and soft support as defined by ISO standard 3945.
- .3 Maximum vibration severity, as measured: Not to exceed category A (Good).

.2 Summary of the standards:

- .1 Hard support: The fundamental frequency of the machine on its support is higher than its main excitation frequency (in general, rigidly mounted machine).
- .2 Soft support: The fundamental frequency of the machine on its support is lower than its main excitation frequency (in general, machines on vibration isolators).
- .3 Vibration severity: The largest of all the rms values of vibration velocity of a machine measured at three perpendicular axes at main support bearings of the rotor.

.3 Vibration severity limits:

.1 For equipment on hard support.

Type of Machine	Class	Vibration Severity Limit mm/s
Small Equipment (up to 20 HP)	I	0.71
Medium Equipment (21-100 HP)	II	1.11
Large Equipment (over 100 HP)	III	1.80

.2 For soft support the limits are 1.6 times higher:

.4 These limits apply for all normal running conditions of the equipment.

.5 Measurement equipment: To ISO standard 2954.

.1 Carry out measurements by a technically competent person.

.3 Minimum Requirements

.1 Refer to Mechanical Drawings and schedules for the minimum requirements of vibration isolation and sound attenuation.

1.3 **SUBMITTALS**

.1 Shop Drawings

.1 Submit in accordance with Section 01 33 00.

2 Products

2.1 **MANUFACTURERS**

.1 Acceptable manufacturers of noise and vibration control hardware are:

.1 Vibron

.2 Vibro-Acoustics

.3 Korfund-Sampson

.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 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.

.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).

.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 ten 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.

.5 Structural Steel Fan Bases

- .1 Continuous integral box section structural steel base, reinforced as necessary to withstand the belt tension without drive misalignment or distortion.
- .2 Drill holes in the structural base to correspond with anchor bolt holes of fan base.
- .3 Provide built-in motor slide rails in each base.
- .4 Beams and brackets, flange and web thickness: Minimum of 5 mm.
- .5 Use height saving brackets in all mounting locations to provide a base clearance of 25 mm.
- .6 Minimum depth: 1/10th of the longer dimension, but not less than 125 mm.
- .7 Maximum depth: 300 mm unless specifically advised by the Consultant.
- .8 Beam stiffness: Maximum deflections in between the support points (at the isolators) do not exceed 1/8th of the deflection of the isolators.
- .9 Overall stiffness: Withstand the reaction torque of the drive without relative deflection at the corners of more than 1/8th the isolator deflection.

.6 Thrust Restraints

- .1 Design: Similar to open spring restricted mount for intake, and precompressed hanger for discharge.
- .2 Specified precompression complete with attachment rods and angle brackets.
- .3 Stiffness: Less than one-fifth of the horizontal stiffness of the main isolation system.
- .7 Concrete Inertia Bases
 - .1 Continuous integral box section structural steel base, reinforced as necessary to withstand the belt tension without drive misalignment or distortion.
 - .1 T-shaped base to support piping elbows for base mounted pumps.
 - .2 Drill holes in the structural base to correspond with anchor bolt holes of fan base.
 - .3 Provide built-in motor slide rails in each base.
 - .4 Beams and brackets, flange and web thickness: minimum of 5 mm.
 - .5 Form with full depth perimeter frames with flanges pointed to the centre of base.
 - .6 Base reinforcement: Reinforcing rods at maximum 250 mm centres in both directions and minimum 38 mm up from the bottom of the steel channels, or place additional steel as required by structural condition or by code.
 - .7 Metal pans: Minimum 1.6 mm (16 gauge) welded sheet metal.
 - .8 Use height saving gusseted brackets in all mounting locations to provide a base clearance of 25 mm from housekeeping pad.
 - .9 Minimum base depth: 1/12th of the longer dimension, but not less than 125 mm.
 - .10 Maximum base depth: 300 mm unless specifically advised by the Consultant.
 - .11 Stiffness: Deflection in between the support points (at the isolators) does not exceed 1/40th deflection of the isolators.
 - .12 Overall base stiffness: Sufficient to withstand the reaction torque of the drive without relative deflection of the corners of base of more than 1/40th isolator deflection.
 - .13 Concrete fill: 30 MPa concrete.
- .8 Isolated Rooftop Equipment Rail Support
 - .1 Continuous support roof rails.
 - .1 Upper aluminum channel frame construction: Minimum height 120 mm.
 - .2 Distributed open springs, designed to suit equipment load distribution.
 - .3 Lower aluminum channel plate, continuous contact to roof curb.
 - .4 Elastomeric air and weather seal on outside edge of frame (concealing springs).
 - .5 Aluminum weather seal flashing.
 - .6 Internal levelling system.

3 Execution

3.1 **INSTALLATION**

.1 General

- .1 Carry out the Work of this section in accordance with manufacturer's instructions (and supervision where required) and only by workers 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 one hundred 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 mechanical room walls or floor, as described above for pipes.

.3 Vibration Control

.1 Types of vibration isolation hardware:

.1 Isolation mount types (xx specifies static deflection)

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 precompressed 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.

.3 IS bases

.1 Use IS base type structural steel frame as required for the support rigidity of the installation of the isolators.

.2 Maximum isolation frequency: Not to exceed one-third of the lowest speed of the rotating equipment unless specified otherwise.

.4 Floor mounted equipment

.1 Install on a housekeeping concrete pad.

.2 Adjust and level the isolators for a 50 mm clearance unless otherwise noted.

.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 manufacturer's 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 floor mounted suspended slab	up to 30 HP	IS	OS	25
	over 30 HP	CI	OS	45
Centrifugal fans - suspended	-	None	S4	45
Base mounted pumps	Basement or slab-on-grade	None	R	6
	Suspended slab	CI	OS	25
Refrigeration machines	Basement or slab-on-grade	None	RSR	6
	Suspended slab	None	OSRI	25
Cooling towers		Supplemental Steel	OSR	64
Air compressors	Up to 10 HP	None	CS	25
	Over 10 HP	CI	CS	25
Boilers	Basement or slab-on-grade	None	R	-
	Suspended slab	None	R	-
Propeller fans and roof exhausters		None	R	-
Air handling units	Fans internally isolated as above	None	R	-
Packaged rooftop equipment	Fans internally isolated as above	None	R	-

.6 Thrust Restraints

.1 Required locations:

- .1 Fan intakes in excess of 1 kPa (4" W.G.) static vacuum.
- .2 Fan discharge other than vertical, in excess of 1 kPa (4" W.G.) static gauge pressure.
- .3 On hanger supported, horizontally mounted axial fans with more than 34 kg thrust due to static pressure.

.2 Unless specified otherwise, attach horizontal restraints at the centreline of thrust and symmetrically on either side of the unit.

.3 If horizontal thrust restraints are used, adjust same after installation for a maximum of 6 mm movement at start and stop.

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

- 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 in accordance with Section 01 33 00.
 - .2 Submit schedule of equipment identification nameplates for review.
 - .2 Samples
 - .1 Submit samples of piping, valve and ductwork identification markers.
- 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 fifteen characters (e.g. standby pump)
 - .3 This identification is in addition to manufacturer's nameplate data.
 - .2 Ductwork Identification
 - .1 Painted stencil lettering: 50 mm high.
 - .2 Paint colour:
 - .1 Black paint on canvas covered insulated ductwork
 - .2 Black paint on metal covered insulated ductwork
 - .3 Black 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 150 mm diameter: Coil wrap six rows of printing
 - .2 Over 150 mm diameter: Saddle type with two rows of printing, fastened with stainless steel springs
 - .3 Lettering Size:

Outside Diameter	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 Pipe label to include service pressure for, natural gas and vacuum.
 - .6 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
 - .3 Acceptable manufacturers
 - .1 S.M.S.
 - .2 Brady
 - .3 Safety Supply Co.
 - .4 Revere-Seton
- 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 Motor control centres
 - .4 Pushbutton stations
 - .5 Control panels
 - .6 Time switches
 - .7 Disconnect switches
 - .8 Contactors or relays in separate enclosures
 - .4 Equipment nameplates for building automation system components are specified under Section 25 05 00.
 - .5 Securely fasten nameplates to the equipment with round-head cadmium plated steel self-tapping screws.

.2 Ductwork Identification

- .1 Label ductwork installed under this 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 this division to indicate the content and direction of flow with Type 1 or Type 2 labeling system.
- .2 For piping carrying steam, compressed air and vacuum, show on label the pressure or vacuum, and working units as applicable.
- .3 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.
- .4 Labels to be visible from 1.5 m above the adjacent floor or platform.
- .5 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.
- .6 Natural gas piping: In addition to pipe labels specified above, paint all piping and tubing with one coat oil alkyd primer and one top coat of alkyd enamel, bright yellow.
- .7 Natural gas piping: As specified above except provide labels every 6 m.

.4 Valve Tags

.1 Provide valve tags on all valves, except as follows:

- .1 At plumbing fixtures.
- .2 On 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 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

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

.2 Section Excludes

- .1 The following items are not to be insulated, or are factory insulated.

.1 Ductwork:

- .1 Variable volume terminal boxes
- .2 Internal acoustically insulated ductwork, except overlap thermal insulation 300 mm over acoustic insulation section
- .3 Supply ductwork which is exposed to the occupied space, unless otherwise noted

1.2 **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.

.2 Reference Standards

- .1 Comply with the latest edition of:
- .1 NFPA 90-A, Standard for the Installation of Air-Conditioning and Ventilating Systems
- .2 NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials
- .3 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- .4 ASTM C-411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

1.3 **SUBMITTALS**

.1 Samples

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

- .2 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.
- .3 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.

1.4 **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.

1.5 **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".

2 Products

2.1 **DUCTWORK INSULATION**

.1 Type D1

- .1 Fiberglass: To ASTM C553
- .2 Flexible blanket
- .3 Laminated kraft-aluminum foil facing jacket
- .4 Operating temperatures: 4°C to 121°C (40°F to 250°F)
- .5 Density: 12 kg/m³
- .6 k value: 0.051 W/m°C @ 24°C (0.35 BTUH•in/ft²°F @ 75°F)
- .7 Acceptable Manufacturers
 - .1 Johns Manville - Microlite
 - .2 Knauf Fibreglass

.2 Type D2

- .1 Fiberglass: To ASTM C553

- .2 Semi-rigid board
- .3 Laminated kraft-aluminum foil facing jacket
- .4 Operating temperatures: 4°C to 121°C (°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
- .3 Type D3
 - .1 Inorganic mineral fibre: To ASTM C518
 - .2 Flexible blanket or rigid board
 - .3 ULC approved ductwork fire rating: To two hours
 - .4 Laminated kraft-aluminum foil facing jacket
 - .5 Maximum operating temperature: -173°C to +1260°C (°F)
 - .6 Acceptable manufacturers
 - .1 3M Ceramics Materials - Firemaster Duct Wrap
Firemaster Grease Duct
Firemaster Board

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

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- .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 - Thermaclad 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 Henry - 200-37
 - .2 Foster - 85-75
 - .2 Lap Seal Adhesive
 - .1 For joints and lap sealing of vapour barriers
 - .2 Acceptable manufacturers:
 - .1 Henry - 230-39
 - .2 Foster - 85-75
 - .3 Contact Adhesive
 - .1 Acceptable manufacturers:
 - .1 Foster - 85-20
 - .4 Lagging Adhesive
 - .1 Acceptable manufacturers:
 - .1 Henry - 120-18
 - .2 Foster - 30-36
 - 2.4 **MASTIC**
 - .1 Interior
 - .1 Acceptable manufacturers:
-

- .1 Henry - 120-19
 - .2 Foster - 30-35
 - .2 Exterior, With Vapour Barrier
 - .1 Acceptable manufacturers:
 - .1 Henry - 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 VentureClad 1579CW
 - .2 Alumaguard All-weather
 - .5 Cutback Asphalt
 - .1 Acceptable manufacturers:
 - .1 Henry - 700-01
 - .2 Foster - 60-25
- 2.5 **MISCELLANEOUS PRODUCTS**
 - .1 Sealants
 - .1 Acceptable manufacturers:
 - .1 Henry - 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 Henry - 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.
- 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 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 300 mm 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.
 - .4 Type D3
 - .1 Install fire rated insulation in strict accordance with manufacturer's recommendations and ULC listing requirements.
 - .2 Provide the services of the manufacturer's technical representative to inspect the installation prior to inspection by the Consultant. Submit inspection certificate from the manufacturer.

3.2 INSULATION SELECTION

- .1 HVAC Ductwork
 - .1 Insulate the following systems:

System	Size	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

System	Size	Max. Op. Temp °C (°F)	Insulation Type	Insulation Thickness mm
	Concealed		D1	38
Return air ducts (as noted)	Exposed Concealed	38 (100)	D2 D1	25 38
Exterior supply and return ductwork	All	65 (150)	D2	50
Exhaust duct behind registers in high humidity areas, minimum 3 m long	Concealed	38 (100)	D1	38
Exhaust air plenums and ducts, between outside wall and motorized damper	Exposed Concealed	38 (100)	D1 D1	38 38
Fabricated steam boiler breeching and hot water boiler stacks	Round Rectangular	454 (850)	E3 E4	50 Note 1
Fire rated ducts, two hour	All	-	D3	Note 2

Note 1: Two layers of 25 mm thickness, overlapped butt joints.

Note 2: Thickness and installation in strict accordance with ULC listing requirements.

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 Outdoor ductwork:

- .1 Non-winter application: Finish with one layer of glass fabric applied between two full mop coats of outdoor mastic with all laps completely sealed.
- .2 Winter application: Finish insulated ductwork with one layer of glass fibre fabric applied between two full mop coats of exterior mastic, aluminum

colour. Topcoat with aluminum coating in accordance with manufacturer's direction. Store materials in a heated space prior to application.

.3 Do not allow mastic materials to come in contact with single ply membrane roofs.

.1 Clean up accidental spills immediately.

.2 Provide temporary drop sheets to protect the roof.

End of Section

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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.

.2 Section Excludes

.1 The following items are not to be insulated, or are factory insulated:

.1 Piping:

.1 Compressed air piping

.2 Natural gas piping

.3 Fire protection piping (except where heat traced)

.4 Vertical sections of rainwater leaders (except where running exposed or concealed within high humidity areas including shower rooms, locker rooms, kitchens, etc.)

.5 Vertical sections of exposed sanitary drainage piping

.6 Condenser water supply and return piping inside of building

1.2 **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.

.2 Reference Standards

.1 Comply with the latest edition of:

.1 NFPA 90-A, Standard for the Installation of Air-Conditioning and Ventilating Systems

.2 NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials

.3 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

- .4 ASTM C-411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

1.3 **SUBMITTALS**

- .1 Samples
- .1 Submit in accordance with Section 01 33 00.
- .2 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.
- .3 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.

1.4 **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.

1.5 **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).

2 Products

2.1 **PIPE INSULATION**

- .1 Type P1
- .1 Fiberglass: To ASTM C547
- .2 Rigid, split formed with pressure sensitive longitudinal adhesion strip
- .3 Reinforced all service vapour retarder jacket:
- .4 Operating temperatures: -40°C to +454°C (-40°F 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 gauge) 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 (-290°F to +250°F)
 - .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 (-290°F to +250°F)
 - .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 - Thermoclad 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 Henry - 200-37
 - .2 Foster - 85-75
- .2 Lap Seal Adhesive
 - .1 For joints and lap sealing of vapour barriers
 - .2 Acceptable manufacturers:
 - .1 Henry - 230-39
 - .2 Foster - 85-75
- .3 Contact Adhesive
 - .1 Acceptable manufacturers:
 - .1 Foster - 85-20
- .4 Lagging Adhesive
 - .1 Acceptable manufacturers:
 - .1 Henry - 120-18
 - .2 Foster - 30-36
- .5 Mastic Interior
 - .1 Acceptable Manufacturers
 - .1 Henry - 120-19
 - .2 Foster - 30-35
- .6 Exterior, With Vapour Barrier
 - .1 Acceptable manufacturers:
 - .1 Henry - 130-11
 - .2 Foster - 65-07
- .7 Exterior, Breather Type
 - .1 Acceptable manufacturers:
 - .1 Childers - CP-10

- .8 Exterior - Aluminum Colour Finish
 - .1 Acceptable manufacturers:
 - .1 USE Hickson Hydrosshield Mastic 451 with "Stormking" aluminum coating
- .9 Cutback Asphalt
 - .1 Acceptable manufacturers:
 - .1 Henry - 700-01
 - .2 Foster - 60-25
- 2.4 **MISCELLANEOUS PRODUCTS**
 - .1 Sealants
 - .1 Acceptable manufacturers:
 - .1 Henry - 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 Henry - 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.
- 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.
- .5 At heat traced piping: Make allowance in sizing inside diameter of insulation for tracing cable which will be provided under Electrical Contract.
- .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 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 Apply insulation on roof drain bodies with 100% coverage of adhesive.
 - .2 Insulate above ground sanitary drainage systems (above finished ceiling areas).

- .3 Insulate above ground storm horizontal rainwater leaders, located beneath roofs.
- .7 Insulation termination points
 - .1 Terminate 75 mm from fittings.
 - .2 Bevel insulation at forty-five degree angle away from fitting.
 - .3 Finish exposed face with insulating and finishing cement.
- .8 Insulation protection inserts - cold piping systems under 15°C (60°F)
 - .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:
 - .1 Insulate the following systems:

System	Maximum 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
Dual temperature cooling/heating piping	93 (200)	All	P1, P4	38
Hot water heating piping	93 (200)	All	P1	38
Low temperature heating piping	60 (140)	Up to 4 5 and over	P1 P1	25 38
Refrigerant piping	60 (140)	All	P3, P4	19

System	Maximum Op. Temp °C (°F)	Pipe Size NPS	Insulation Type	Insulation Thickness mm
Condensate water piping (exterior)	40 (105)	All	P1, P4	38

Note 1: Two layers of 25 mm thickness, overlapped butt joints.

.2 Plumbing Piping

.1 Insulate the following systems:

System	Maximum Op. Temp °C (°F)	Pipe Size	Insulation Type	Insulation Thickness mm
City water piping	27 (80)	All	P1, P4	25
Domestic cold water piping, including piping downstream of backflow preventers	27 (80)	All	P1, P4	25
Domestic hot and recirculating water piping, including piping downstream of backflow preventers	82 (180)	Up to 2 2½ and over	P1 P1	25 38
Storm and 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	ASJ (Canvas) (PVC) (Metal)	(Canvas) (PVC) (Metal)
P2	(Canvas) (PVC) (Metal)	(Canvas) (PVC) (Metal)
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.
- .3 Outdoor piping:
 - .1 Finish insulated piping with a field or factory applied aluminum jacket. Fasten and caulk butt joints and secure with sheet metal screws. Locate longitudinal joints on bottom of pipe.
 - .2 Alternatively, finish with two coats of outdoor type mastic (outdoor mastic - aluminum colour finish).
- .4 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

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, and air conditioning systems
 - .2 Survey of installed automatic controls and verification of functional performance
 - .3 Measuring and reporting all specified space noise levels
 - .4 Test performance of all vibration isolation equipment
 - .5 Rechecking of testing and balancing during the alternate (heating/cooling) season
- .2 All Start-Up and Performance Testing shall be paid by the contractor in coordination with Client/Owner representatives for training, commissioning and handover.
- .3 Conform with all sections of Division 1, 21, 22, 23 and 25 as applicable.

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 **QUALIFICATIONS**

- .1 Performance testing and balancing shall be performed by an accredited firm who is a member of Associated Air Balancing Council (AABC).

1.4 **COORDINATION**

- .1 The Mechanical Contractor 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 Make available all equipment data (Shop Drawing performance data and operating instructions) to the testing and balancing firm.
- .7 Refrigeration machine manufacturer service representative for performance testing of the refrigeration equipment. Testing and balancing firm witnesses and records all test results.
- .8 Fuel fired heating equipment manufacturer service representative, or other qualified service company technical representative, for performance testing of heating equipment. Testing and balancing firm witnesses and records all test results.
- .2 As part of the coordination effort, the Mechanical Contractor 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.
- .3 Start up and Performance Testing shall be cross referenced with the Commissioning Procedures part of Commissioning Report requirements.

1.5 **SUBMITTALS**

- .1 Submit layout Drawings and report format a minimum fourteen 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

2 Products

2.1 **NOT APPLICABLE**

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 Air and water balancing report
 - .4 Acoustic survey report
 - .5 Vibration survey report
 - .6 Controls operation report
 - .7 Alternate season test 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 33 00.

3.2 **EQUIPMENT START-UP REPORT**

- .1 Provide a consolidated test report for all equipment, including but not limited to 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 insulation megger test - result and initialed by Contractor
 - .3 Motor rotation (bump test) - result and initialed by Contractor
 - .4 Equipment start-up report status - status and initialed by Contractor
 - .5 Manufacturer start-up report status - status and initialed by Contractor
 - .6 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, gas or vapor systems
 - .1 Equipment ID and name
 - .2 Isolation valves are in the open position - status and initialed by Contractor
 - .3 Steam traps are in service - status and initialed by Contractor
 - .4 Backflow preventers have been tested - status and initialed by Contractor
 - .5 Pressure relief valves installed - record setpoint 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 HVAC units
 - .2 Duct systems
 - .3 Pumps
 - .4 Air compressors
 - .5 Refrigeration equipment
 - .6 Sprinkler systems (to NFPA 13)
- .4 Manufacturer's Start-Up Test
 - .1 Provide a separate start-up report for each piece of the following equipment, utilizing the manufacturer's start-up check list. This report may be prepared by the manufacturer's service representative.
 - .1 AHUs and glycol heat recovery equipment
 - .2 Packaged AC equipment
 - .3 Split ACs

- .4 Domestic hot water heaters
- .5 Air compressors
- .6 Control systems - see Section 25 30 01

3.3 AUTHORITIES REVIEW

- .1 Submit copies of authorities-having-jurisdiction inspection and test reports, including:
 - .1 Plumbing and drainage municipal inspector reports
 - .2 TSSA pressure vessel and piping inspection reports
 - .3 ESA field certification reports

3.4 AIR AND WATER BALANCING

- .1 Provide air and water balancing report: To Section 23 08 16.

3.5 ACOUSTIC SURVEY

- .1 Provide acoustic survey test report: To Section 23 08 16.

3.6 VIBRATION SURVEY

- .1 Provide vibration survey test report: To Section 23 08 16.

3.7 CONTROLS SYSTEM

- .1 Provide controls test reports: To Section 25 30 01.

3.8 ALTERNATE SEASON TESTING

- .1 Provide alternate season test report for winter and for summer: To Section 23 08 16.

3.9 DEFICIENCIES

- .1 Immediately report to Consultant, any deficiencies in the systems or equipment performance resulting in design requirements being unobtainable.

3.10 DRAFT REPORT

- .1 On completion of the start-up, testing, adjusting and balancing of all systems, submit to the Consultant, two 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
 - .5 Air systems testing and balancing data
 - .6 Liquid systems testing and balancing data
 - .7 Acoustic survey report

- .8 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.
- 3.11 **INTERIM REPORT**
- .1 After completion of any retesting described above, submit three typewritten copies of the interim report, in a 3-hole "D" style binder, and two CD-R electronic copies in Adobe Acrobat ver.6 PDF format.
 - .2 This report is required to obtain Substantial Performance of the Contract.
- 3.12 **FINAL REPORT**
- .1 Submit to Consultant following completion of alternate season testing and balancing. Submit three typewritten copies and two CD-R Adobe PDF in the same formats as the initial report specified above.
- 3.13 **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.
- 3.14 **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.
- 3.15 **ADDITIONAL TESTING**
- .1 The Consultant may request such additional testing in connection with this Project as he deems necessary.
 - .2 Additional testing and balancing shall be performed at the rates quoted and costs shall be withdrawn from the Contractor's allowance for the testing and balancing Work as accepted by the Consultant.

End Of Section

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
- .2 Measuring and reporting all specified space noise levels
- .3 Measuring and reporting all specified vibration isolation levels
- .4 Rechecking of testing and balancing during the alternate (heating/cooling) season

.2 Section Excludes

.1 The following systems do not require air and water balancing:

- .1 Domestic cold water
- .2 Domestic hot water (except balancing valve on connections to hot water recirculation piping)
- .3 Steam and condensate systems (except steam flow meters at steam plant as part of heating equipment performance test)
- .4 Natural gas (except natural gas metering as part of heating equipment performance test)

.2 The following equipment does not require air and water balancing:

- .1 Hydronic and electric convection heaters (baseboards)
- .2 Hydronic and electric unit heaters
- .3 Hydronic radiant panel heating units

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 **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).
 - .1 Acoustic and vibration measurements may be performed by a specialist Sub-contractor to the testing and balancing firm.

1.4 **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.
- 1.5 **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 Contractor 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 Contractor and/or associated Subcontractors 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 Automation System technical representative to operate the BAS 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.
 - .8 Refrigeration machine manufacturer service representative for performance testing of the refrigeration equipment. Testing and balancing firm witnesses and records all test results.
 - .9 Fuel fired heating equipment manufacturer service representative, or other qualified service company technical representative, for performance testing of heating equipment. Testing and balancing firm witnesses and records all test results.

- .3 As part of the coordination effort, the Mechanical Contractor 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.

1.6 **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.

1.7 **SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00.
- .2 Submit layout drawings and report format a minimum fourteen 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 Work of 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

2 Products

2.1 **NOT APPLICABLE**

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
- .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, in accordance with Section 01 33 00.

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 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
------------------	------------
 - .3 Heat Flow Rates

Air Coils	5% of design capacity
Heat Exchangers	5% of design capacity
Water Heaters	5% of design capacity
- .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 Test relative barometric pressures in various building areas, as deemed necessary by the Consultant and at least in all areas served by different systems.

- .2 Operate, test and balance all air systems over their entire design range of operation including minimum and maximum fresh air, return air and supply air.
- .3 Simulate full heating and cooling conditions. Record sufficient data to verify compliance with design requirements.
- .4 Balance air systems within acceptable tolerances before water systems are balanced.
- .6 Hydronic Systems
 - .1 Operate, test and balance all water systems over their entire design range of operation.
 - .2 Simulate full heating and cooling conditions. Record sufficient data to verify compliance with design requirements.
 - .3 Balance water systems within acceptable tolerances before air systems are balanced.
- .7 Continuous Recording
 - .1 Set-up trend logs on the Building Automation System to record on a temperature and humidity levels on a twenty-four hour basis, in areas as directed by the Consultant.
- .8 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 Hydronic heating equipment (boilers, heaters, etc.)
 - .1 Manufacturer and model
 - .2 Gas and fuel oil input flow rating
 - .3 Gas and fuel oil input pressure rating
 - .4 Gas pressure regulator inlet and outlet pressure
 - .5 Entering and leaving water temperature - design and actual
 - .6 Entering and leaving water pressure - design and actual
 - .7 Water flow rate - design and actual
 - .8 Steam flow rate and pressure - design and actual
 - .9 Combustion efficiency test at maximum rated capacity; including flue gas analysis
 - .10 Combustion efficiency test - as per Ministry of Environment Guideline A-9, corrected to 3% O₂, for fuel input ratings exceeding 10 MMBtu/h (2932 kW)
 - .11 Thermal efficiency, based on ASME short form power test code, for fuel input ratings exceeding 10 MMBtu/h (2932 kW)

- .3 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
- .4 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
- .5 Pumps:
 - .1 Manufacturer
 - .2 Model or serial number
 - .3 Rated GPM (L/S)
 - .4 Rated Head
 - .5 Rated pressures
 - .6 Measured discharge pressure (full flow and no flow)
 - .7 Measured suction pressure (full flow and no flow)
 - .8 Measured gpm (L/s) at operating conditions
 - .9 Operating head

- .10 Operating RPM
- .6 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)
- .7 Heat transfer equipment:
 - .1 Manufacturer and type
 - .2 Design inlet and outlet temperatures
 - .3 Design pressure drop
 - .4 Design flow rate
 - .5 Measured inlet and outlet temperatures
 - .6 Measured pressure drop
 - .7 Measured flow rate

3.3 **ACOUSTIC SURVEY**

- .1 Test Locations
 - .1 Provide acoustic noise measurements in locations agreed with the Consultant. As a minimum, the following areas are to be tested:
 - .1 Service rooms: Electrical and mechanical - one location per room
 - .2 Open office areas: Minimum one test per 500 m²
 - .3 Enclosed office areas: Minimum 20% of all offices
 - .4 Boardrooms and meeting rooms: One location per room
 - .5 Kitchens, cafeterias and seating areas: One location per space
- .2 Test Methods
 - .1 Test noise levels on the dBA weighting scale over eight bandwidths.
 - .2 Report results in tabular and graphical plots, including NR curves for each space tested.
 - .3 Conduct two tests per test location:
 - .1 Background ambient: Building ventilation and air conditioning systems turned OFF.

- .2 Operating: Building ventilation and air conditioning systems turned ON, but building otherwise not occupied, and process equipment turned off.

- .4 Report any objectionable noise or vibration and be prepared to locate cause by instrumentation and analysis (including octave band and analysis)

3.4 **VIBRATION SURVEY**

- .1 Measure and record test results to Section 23 08 19.

3.5 **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.

3.6 **DEFICIENCIES**

- .1 Immediately report to Consultant, any deficiencies in the systems or equipment performance resulting in design requirements being unobtainable.

3.7 **DRAFT REPORT**

- .1 On completion of the start-up, testing, adjusting and balancing of all systems, submit to the Consultant, two 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 Acoustic survey report
 - .6 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.

3.8 **INTERIM REPORT**

- .1 After completion of any retesting described above, submit three typewritten copies of the interim report, in a three-hole "D" style binder, and two CD-R electronic copies in Adobe Acrobat ver.6 PDF format.
- .2 This report is required to obtain Substantial Performance of the Contract.

3.9 **FINAL REPORT**

- .1 Submit to Consultant following completion of alternate season testing and balancing. Submit three typewritten copies and two CD-R Adobe PDF in the same formats as the initial report specified above.

3.10 **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.

3.11 **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.

3.12 **ADDITIONAL TESTING**

- .1 The Consultant may request such additional testing in connection with this Project as he deems necessary.
- .2 Additional testing and balancing shall be performed at the rates quoted and costs shall be withdrawn from the Mechanical Subcontractor's (Contractor's) allowance for the testing and balancing Work as approved by the Consultant.

End of Section

- 1 General
 - 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
 - 1.2 **GENERAL**
 - .1 Provide Work of this section in accordance with the Contract Documents, and in accordance with Section 01 18 10 Commissioning General Requirements.
 - .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 and function correctly to meet the design intent, and to document system performance parameters for fine tuning of control sequences and operational procedures.
 - .1 Refer to Section 01 18 10 regarding roles and responsibilities of all parties involved in the commissioning process.
 - .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 Contractors, with the coordination of the commissioning process the responsibility of the Commissioning Authority in conjunction with the Construction Manager.
 - .6 The commissioning program is divided into four parts:
 - .1 Part 1: Verification testing
 - .2 Part 2: Performance testing
 - .3 Part 4: Operator training
 - 1.3 **SUBSTANTIAL COMPLETION**
 - .1 Substantial completion of the Division 23 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 months after Substantial Completion, based on seasonal conditions required to obtain test load conditions.

1.4 **WORK INCLUDED**

- .1 Commissioning Work of Division 23 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 labour as necessary to correct construction and/or equipment deficiencies found during the commissioning process.
 - .6 Providing Operation and Maintenance 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 (whichever is applicable):
 - .1 Automatic temperature control
 - .2 Air handling systems
 - .3 Cooling generation systems
 - .4 Heating generation systems
 - .5 Hydronic distribution systems
 - .6 Process cooling systems
 - .7 Compressed air systems
 - .8 Electric heating systems
 - .9 Air distribution and exhaust systems
 - .10 Domestic hot water systems
 - .11 Domestic cold water systems
 - .12 Fire protection systems/suppression systems
 - .13 Variable frequency drives
 - .14 Building Automation Systems
 - .15 Indoor air quality (IAQ) systems
 - .16 Smoke venting/control systems

- .17 IT/data AC and process cooling systems
 - .18 Kitchen HVAC systems, including fire suppression systems
 - .19 Fuel 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, 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 version 6 – 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 version 6 format. For original document chapters, provide Adobe chapter referencing.
 - .3 Digital File Naming Convention (whichever is applicable)
 - .1 Store documents with filenames which include the equipment type, ID number, and type of document.

- .2 Equipment type:
 - .1 PS – Process Systems, piping, compressed air
 - .2 FP – Fire Protection
 - .3 PD – Plumbing and Drainage
 - .4 HG – Heating Generation
 - .5 CG - Cooling Generation
 - .6 HV – HVAC
 - .7 BAS – Building Automation 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
 - .1 HV-AC1-VT.*
 - .4 Submit three copies of each verification and functional performance test report, 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 Automation Systems
 - .5 Provide three 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 / BAS
- 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
- 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, gas, fuel oil, 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.
- 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 Construction Manager. 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 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 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 number
 - .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 unsafe 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 Contractors

Testing conducted by:	Mechanical Contractors
Testing recorded by:	Mechanical Contractors
Tests witnessed by:	Commissioning Authority Design Consultant (optional) Owner (optional)
Reports reviewed by:	General Contractor/Construction Manager 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 assembles commissioning team members who are responsible for the implementation, witnessing and documentation of the tests.
- .2 Mechanical Contractor: 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, and interfaces with alarm and life-safety systems. 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 Contractor: "Submitted by"
 - .2 General Contractor/Construction Manager: "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 Gas and fuel fired equipment audit for CSA/CGA approvals, or TSSA field approvals
 - .7 Expansion tank installation and settings
 - .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
- .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 and standpipe systems)
 - .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 by area/floor
 - .3 TAB balancing report, by system
 - .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 Automation System:
 - .1 Operating check of each I/O and control loop
 - .2 Operating check of each control sequence
 - .3 Operating check of motorized control dampers for full open and full close stroke/spring return positions
 - .4 Operating check of motorized fire dampers for full open and full close stroke/spring return positions
 - .5 Temperature and humidity survey report, identifying date and time for each reading at each transmitter/sensor device
 - .6 Graphics display and report generation - provide display screen "snapshots"
 - .7 Operator training, including attendee names and dates, and details of manufacturers equipment demonstrations
 - .8 Status of as-built documentation, and Operating and Maintenance Manuals reviews
- .10 Specialty Systems
 - .1 Refrigeration system compliance check to CSA B52-99, Mechanical Refrigeration Code
- .5 Instrumentation
 - .1 Provide all measurement instrumentation for conducting the verification tests. Include hand-held "HART" instrument testing units or similar test equipment.
 - .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
 - .3 Smoke control and smoke venting interlocks
 - .4 Life safety systems
- .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 Automation System as follows:
 - .1 TAB airflow rates and calibrate terminal boxes in all modes of operation
 - .2 Equipment operation in both heating and cooling modes
 - .3 Minimum outdoor air intake positions, air-side economizer cycles, and multi-set outdoor air damper positions as required for each operating sequence and mode
 - .4 Building pressurization and other specialty programs
- .8 Verify the proper responses of instrumentation and control devices (actuators) as follows:
 - .1 For each controller or sensor, record the indicated monitoring and control system reading, and the test instrument reading
 - .2 If the initial test indicates that the test reading is outside of the control range of the installed device, check the calibration of the installed device and adjust as required. Re-test the deficient device and record the results on the checklist data sheets

- .9 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% 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 chilled water system to deliver the required flow rate, and water temperature at design conditions.
 - .2 Capability of the hydronic and domestic water heating systems to deliver the required flow rate, and temperature.
 - .3 Capacity of electric heating systems at design temperatures.
 - .4 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 Contractors
Testing conducted by:	Mechanical Contractors
Testing recorded by:	Mechanical Contractors
Tests witnessed by:	Commissioning Authority Design Consultant (optional) Owner (optional)
Reports reviewed by:	General Contractor/Construction Manager 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:
 - .1 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 Contractor: "Submitted by"
 - .2 General Contractor/Construction Manager: "Reviewed by"
 - .3 Design Consultant: "Reviewed by"
 - .4 Commissioning Authority: "Reviewed by"
 - .5 Owner: "Accepted by"
 - .2 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.

- .3 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 for each mode of operation under test.
 - .3 Special testing requirements:
 - .1 Test heating boiler and steam boiler performance in accordance with ASME Power Test Code 4.1 (short form), for thermal efficiency, and combustion efficiency.
 - .2 Test water chillers in accordance with ARI 590 and 591, at design conditions for full load ratings, and IPLV ratings.
- .7 Acceptance
 - .1 Any identified deficiencies will be reviewed by the Consultant in conjunction with the General Contractor/Construction Manager to determine if correction of the deficiency is part of the Contractor's or Subcontractor'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 **OPERATING AND MAINTENANCE TRAINING (PART 4)**

- .1 Scope of Work
 - .1 Provide systems training in addition to the requirements of Sections 21 05 00, 22 05 00 and 23 05 01.
 - .2 Roles and responsibilities:

Systems Operating Manuals	
Organized by:	Mechanical Contractor
Lecture material provided by:	Mechanical Contractor
Systems training provided by:	Mechanical Contractor

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 Sections 21 05 00, 22 05 00 and 23 05 01.
- .2 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 of each system.
- .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 systems
 - .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 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 (i.e. bullet points).
- .2 Collect training material and bind into separate binders in accordance with the requirements for the SOM manuals.

.5 Recording of Training Sessions

- .1 Record training sessions typical for each training topic. Provide one DVD for each training topic.
- .2 Provide three DVD copies of each training topic, appropriately labeled.

End of Section

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.

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:		

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 known 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

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- 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 in accordance with Section 01 33 00.
 - 1.3 **COORDINATION**
 - .1 Prepare coordination and fabrication drawings at a minimum scale of 1:50 $\frac{1}{4}"=1'-0"$ 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.
- 2 Products
 - 2.1 **DUCT WORK**
 - .1 Materials
 - .1 Galvanized steel sheet
 - .1 Z275 (G90) for unpainted duct work, indoor
 - .2 Z275 (G90) for outdoor duct work
 - .3 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 ULC approved, insulated double wall polymeric liner bonded to mechanical lock spiral joints
 - .1 Thermoflex M-KE
 - .2 Flexmaster
- .4 Metal duct sealant – high velocity duct sealer
 - .1 3M EC800
 - .2 Foster #30-02
 - .3 Hardcast Iron Grip #601
 - .4 Duro-Dyne S-2
 - .5 Transcontinental Equipment "MP".

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 fifteen 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	+3" (750 Pa)	A
Variable Volume Supply, upstream of VAV boxes	+3" (500 Pa)	A
Variable Volume Supply, downstream of VAV boxes	+1" (250 Pa)	A
Building Return Air	+/-2" (500 Pa)	A
Building Exhaust (washroom exhaust, general exhaust)	+/-2" (500 Pa)	A
Fire Rated (exhaust)	+/-3" (750 Pa)	A
Kitchen Exhaust	-4" (1000 Pa)	A
Other Process Exhaust Systems	-4" (1000 Pa)	A

- .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-flammable 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 Air Intakes and Exhausts
 - .1 Install removable galvanized screens securely fastened in place at air intakes, exhausts and open ends in duct work.
- .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.
 - .2 Install air terminal units (TU) and silencers (S) independent of duct work, with rods or angles of sizes adequate to support load.
- .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 1.5 m in width: Minimum 2.4 m centres.

- .2 Ducts 1.5 m in width and over: 1.2 m 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 diameter 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.)
860 mm to 1010 mm	1 mm (20 ga.)
1060 mm and up	1.3 mm (18 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 three 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 elbows: Smooth centre line radius of one and one-half times duct diameter. Alternatively, use elbows of five piece construction, subject to prior approval of Consultant.

- .2 Forty-five degree 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 as follows:

- .1 Between trunk supply duct and air terminal units, VAV boxes.

- .2 At connection to certain ceiling diffusers.

- .3 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.

.2 Fire Rated Duct Work

- .1 Construct and support fire rated duct work in strict conformance with the ULC listing requirements for two-hour fire rating.
- .2 Where duct construction or support is not covered by ULC listing requirements, construct and support duct work as for rectangular duct work, specified herein.

.3 Waterproof Duct Work

- .1 Slope fresh air intake ducts down at 1:100 to permit moisture induced by air intake to be drained. Install 38 mm drain flange in bottom of duct at low point. Continuously solder or seal joints in exterior air intake duct to prevent dripping of moisture through joints.
- .2 In areas having high humidity, fabricate exhaust duct work without seams in bottom of duct for at least 3 m of duct run behind register and slope duct up away from register.

.4 Kitchen Exhaust Hood Duct Work

- .1 Fabricate duct work, access door and cleanouts in accordance with NFPA 96.
- .2 Material: 1.6 mm (16 gauge) black steel (or stainless steel) with externally welded seams, and flanged and gasketted joints at hood and fan.

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 Balancing of Air Systems

- .1 Balance air handling systems in accordance with Section 23 08 16.

End of Section

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- 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 25: Integrated automation:
 - .1 Automatic control damper operators
 - .2 Automatic control dampers
 - 1.3 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Submit Shop Drawings in accordance with Section 01 33 00.
- 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 1.2 m 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 Automatic Control Dampers
 - .1 General:
 - .1 Modulating control dampers: Opposed blades.
 - .2 Two position control dampers: Parallel blades.
 - .2 Damper blades and frames:
 - .1 Extruded aluminum 6063-T5
 - .2 Maximum blade length: 1.2 m without internal frame support.
 - .3 Maximum blade length: 1.2 m without internal frame support.
 - .4 Blade edge seals: EPDM gaskets.
 - .5 Frame side seals: Extruded TPE or cambered stainless steel.
 - .6 Frame style: Flanged to duct.
 - .7 Jack shaft: Extendable, combination of aluminum, and zinc/nickel coated steel.
 - .8 Damper leakage: 50 L/s per m² damper face area at 1 kPa differential static pressure.
 - .3 Bearings:

- .1 Thermal plastic resin copolymer, nylon or oil impregnated bronze.
 - .2 At blade axles, linkage devices, etc.
 - .4 Damper blades and frame for outside exhaust and intake air applications:
 - .1 As above.
 - .2 Operating temperature: -40°C to +100°C (-40°F to +212°F).
 - .3 Thermally broken and insulated blades; expanded polyurethane foam insulation.
 - .4 Damper leakage: 21 L/s per m² damper face area at 1 kPa differential static pressure.
 - .5 Acceptable Manufacturer:
 - .1 Tamco - Series 1000
 - .2 Nailor Industries - Series 2000
 - .3 Tamco - Series 9000 (exhaust and air intake applications)
 - .4 Nailor - Series 2000IBF (exhaust and air intake applications)
 - .5 Ventex Alumavent
- .2 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 1.2 m.
 - .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 Ventex Alumavent
 - .2 Round duct work - medium pressure butterfly damper:
 - .1 Galvanized steel frame 0.9 mm (22 ga) with stiffening beads up to 300 mm diameter; 0.9 mm (20 ga) over 300 mm duct size.
 - .2 Blade: Laminated galvanized steel 0.9 mm (22 ga), or single layer of 1.6 mm (16 ga), open and closed end stops, Celcon bearings, polyethylene blade edge seal, 13 mm diameter drive shaft.

- .3 Locking quadrant: Galvanized steel locking quadrant with "Open – Closed" labels, 50 mm insulation stand-off.
- .4 Acceptable Manufacturers:
 - .1 Nailor – Series 1000 with HL2 quadrant
- .3 Round duct work - low pressure butterfly damper:
 - .1 Galvanized steel frame 0.9 mm (22 ga) with stiffening beads up to 300 mm diameter; 0.9 mm (20 ga) over 300 mm duct size.
 - .2 Blade: Galvanized steel 0.9 mm (22 ga) up to 300 mm diameter; 0.9 mm (20 ga) over 300 mm duct size, 6 mm diameter 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
- .4 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 one and one-half times width of smaller branch duct, but in no case less than 300 mm.
 - .4 Provide with locking type quadrant.
- .3 Volume Extractors in Duct Work:
 - .1 Use where noted on Drawings
 - .2 Acceptable Manufacturers
 - .1 Titus Model AG225 with #3 manual operator.

2.3 **FIRE AND SMOKE 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 Ventex Alumavent
- .2 Smoke Dampers
 - .1 ULC labelled fire dampers of airfoil parallel blade type, with extruded aluminum channel frames and sleeve housing and conforming to NFPA 90A and 92A, and UL555S, leakage class I rating at 176°C (350°F).
 - .2 Blades: Extruded aluminum airfoil blade with concealed linkage outside of airstream, with self lubricating bronze type bearings, stainless steel camber style jamb seals, and mechanically locked in extruded edge seals
 - .3 Dampers designed to operate while the system fans are operating.
 - .4 Operator: Externally mounted, factory installed 120 VAC electric actuator with spring return, fail close position. Built-in high limit thermostat switch opens at 73°C (163°F).
 - .5 Accessories: 120 VAC proof-of-closure and proof-of-open end-switch, with two SPDT switches.
 - .6 Acceptable Manufacturers: Damper
 - .1 Nailor – Series 1280
 - .2 Ruskin
 - .3 Ventex Alumavent
 - .7 Acceptable Manufacturers: Operator
 - .1 Belimo – Model FSNF-120 US
- .3 Combination Smoke and Fire Dampers
 - .1 ULC labelled fire dampers of airfoil parallel blade type, with extruded aluminum channel frames and sleeve housing and conforming to NFPA 90A and 92A, and UL 555 and UL555S, leakage Class I rating at 176°C (350°F).
 - .2 Blades: Extruded aluminum airfoil blade with concealed linkage outside of airstream, with self lubricating bronze type bearings, stainless steel camber style jamb seals, and mechanically locked in extruded edge seals
 - .3 Dampers designed to operate while the system fans are operating.
 - .4 Operator: Externally mounted, factory installed 120 VAC electric actuator with spring return, fail close position. Built-in high limit thermostat switch opens at 73°C (163°F).
 - .5 Accessories: 120 VAC proof-of-closure and proof-of-open end-switch, with two SPDT switches.
 - .6 Acceptable Manufacturers: Damper
 - .1 Nailor – Series 1220

.2 Ruskin

.7 Acceptable Manufacturers: Operator

.1 Belimo – Model FSNF-120 US

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. 81-99 or Henry No. 230-04 fire retardant adhesive. Seal all joints with Foster No. 30-36 or Henry No. 120-09 mastic sealant.

.3 Acceptable Manufacturers:

.1 Owens Corning

.2 Manson

.3 Knauf

.4 Manville

2.5 **ACOUSTIC SILENCERS (S)**

.1 Rectangular and Elbow Silencers

.1 Material:

.1 Housing: Hot dip galvanized steel sheet, one gauge heavier than adjacent duct work but not less than 0.9 mm (20 ga).

.2 Duct size: External silencer dimension to match adjacent duct dimensions, unless otherwise shown.

.3 Inner liner: Hot dip galvanized perforated steel sheet, 0.8 mm (22 ga).

.4 Insulation: Glass fibre or mineral wool to ASTM E-84, class 1.

.2 Performance

.1 Silencers have been selected on basis of sound power levels of first listed equipment. Ensure that equipment of any other named

manufacturer proposed for use has sound power levels equal to or lower than first listed equipment.

- .2 Be responsible for reducing noise levels to below acceptable maximum without additional cost to Owner.

.2 Circular Silencers

- .1 Same as for rectangular silencers and as follows:

- .1 Internal bullet: Spun head and tapered tail, with airflow straightening vanes.

- .2 Duct size: Duct flange connection same size as adjacent duct size.

.3 Acceptable Manufacturers

- .1 Vibron
- .2 Vibro-Acoustics
- .3 Woods

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.
- .4 For installation between sections of air handling units, install flexible connectors suitable for connecting to flanges of casings where so provided.

3.3 **TURNING VANES**

- .1 Provide hollow airfoil type turning vanes in duct work where shown on Drawings and in ninety 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 Smoke dampers
 - .4 Fire detectors
 - .5 Control elements
 - .6 Sprinkler heads mounted in duct work
 - .7 Motors
 - .8 Bearings
 - .9 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 Provide "Equipment and Man Doors" as follows:
- .1 In duct work with duct dimension over 1320 mm.
 - .2 In plenums.
 - .3 As shown.

3.5 **BALANCING DAMPERS**

- .1 Use rectangular opposed blade dampers at the following locations:
- .1 At floor connections to riser shafts/ducts.
 - .2 In supply and return duct work where main ducts are split into two more trunks.
 - .3 At rectangular branch duct connections to main or trunk ducts.
 - .4 As shown.
- .2 Use splitter dampers only where specifically shown on Drawings.
- .3 Use medium pressure butterfly dampers at the following locations:
- .1 At floor connections to supply air riser ducts.
 - .2 In supply and return duct work where main ducts are split into two more trunks.
 - .3 At branch duct connections to main or trunk ducts.
 - .4 At branch duct upstream of terminal box.
 - .5 As shown.
- .4 Use low pressure butterfly dampers at the following locations:
- .1 At branch connections on the downstream side of terminal boxes.
 - .2 At individual branch outlets serving grilles or diffusers.

- .5 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 **VOLUME EXTRACTORS IN DUCT WORK**

- .1 Use where noted on Drawings.

3.7 **FIRE AND SMOKE 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.
- .4 Provide static dampers on return air transfer openings.

3.8 **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.

3.9 **ACOUSTIC DUCT INSULATION AND SILENCERS**

- .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.
- .2 Use silencers in duct work where shown on Drawings, to attenuate airborne noise generated in air distribution systems.

.3 Fabricate cross talk silencers:

- .1 Housing: Galvanized steel, to SMACNA pressure class 1" standard.
- .2 Liner: Rigid coated duct liner.
- .3 Size: As shown on drawings.
- .4 Shape: As shown on drawings.
- .5 Provide a sheetmetal nosing at open ends of duct to close off cut edge of liner.

End of Section

1 General

1.1 **GENERAL REQUIREMENTS**

- .1 Curb mounted rooftop units shall be isolated on Vibro-Acoustics type NCC-VCR roof top spring isolated noise control curb consisting of galvanized curb sections with integral vertically and laterally restrained isolators formed to fit the contractor supplied rooftop equipment. The spring isolation curb and acoustic treatment package shall provide a space and adjacent space noise criteria as indicated on the schedule.
- .2 The silencing elements and the spring isolation elements shall be built and completed by the noise control manufacturer as an integral unit roof curb.
- .3 The noise control curb shall bear directly on the roof structure and shall be flashed and waterproofed into the roof's membrane waterproofing system by the installing contractor.
- .4 If products other than those of the basis of design noise control manufacturer are supplied on the project, the purchasing Contractor assumes full performance, project schedule and monetary responsibility for meeting the project noise criteria, including any retrofit work that may be required.

1.2 **SUBMITTALS**

- .1 The noise control manufacturer shall provide the following acoustic and pressure drop calculations, stamped by a professional engineer registered in the province of the project, as part of the submittal package to demonstrate that the resultant noise levels in the indoor occupied spaces served by the rooftop equipment meet the above noise criteria and maximum allowable pressure drop including system effects:
 - .1 Airborne noise through supply air ducts
 - .2 Airborne noise through return air ducts
 - .3 Breakout noise through all ducts
 - .4 Flanking noise through roof deck
 - .5 Structure-borne vibration noise
 - .6 Supply air pressure drop including system effects
 - .7 Return air pressure drop including system effects
- .2 Submittals shall include P.Eng stamped, IBC or NBC code compliant overturn calculations for site specific wind and seismic conditions.
- .3 Submittals shall include a written test report by a third-party organization showing airside silencing elements have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
- .4 Calculations shall be clearly typed or printed, not handwritten.

1.3 **PERFORMANCE**

- .1 The total noise contribution from other sources other than the AHU's must be at least 5 dB below the specified noise criteria. Sound power levels of actual equipment to be installed on project shall be used for the submitted analysis.

- .2 If the noise level in the occupied spaces exceeds the specified noise criteria level, it will be the financial responsibility of the noise control manufacturer to provide product and labour to achieve the specified criteria. The project schedule is based on the sound power levels of the "basis of design" air handling units. Additional noise control required as a result of the purchase of noisier air handling units will be the financial responsibility of the Purchasing Contractor.
- .3 Site performance verification will be conducted by an acoustic consultant commissioned by the Mechanical Engineer to ensure the specified performances have been attained.
 - .1 Onsite sound measurements shall be made using a Type 1 integrating sound level meter as defined in the latest versions of ANSI S1.4, ANSI S1.11, and ANSI 51.43. The meter shall utilize parallel octave or 1/3-octave band filters, where all frequency bands are processed simultaneously. Sound measurements shall be un-weighted, time averaged equivalent sound pressure levels (Leq).
 - .2 The measurements shall be conducted by an independent acoustical consulting firm that is a member of the National Council of Acoustical Consultants. The measurements shall be conducted in accordance with the Engineering Method of the Room Noise Measurement procedure outlined in the 2011 ASHRAE Handbook - HVAC Applications, page 48.32.

2 Products

2.1 NOISE CONTROL CURB CONSTRUCTION

- .1 Silencing elements shall be constructed of ASTM A 653/A 653M G90 galvanized steel, with fiberglass acoustic media fill protected from erosion by a perforated steel liner. Where indicated on the silencer schedule, media shall be encapsulated in glass fiber cloth or Vibar™ film to help prevent shedding, erosion and impregnation of the glass fiber.
- .2 The curb shall be constructed from a minimum of 16 ga G90 galvanized perimeter steel with a factory attached wood nailer. The perimeter steel seams shall be continuously welded. The galvanized perimeter curb steel shall be attached to a structural steel frame that incorporates a minimum of four restrained spring isolators that support the rooftop unit.
- .3 The curb shall have factory installed lifting points.
- .4 Curb sides and ends shall be capable of accepting 51 mm external insulation, factory installed.
- .5 The isolation springs shall be of the vertical and laterally restrained type. The springs shall be designed to be laterally stable and properly selected to provide minimum specified deflection with 50% additional travel to solid. Isolation springs shall be powder coated for corrosion resistance and have a minimum static spring deflection of 25 mm or 50 mm or 75 mm or greater as scheduled.
- .6 Overhung condensing unit sections shall be supported by a structural steel pedestal assembly with isolation springs that are vertically and laterally restrained and shall be installed as the main curb section.
- .7 A galvanized and insulated pan shall be provided under condensing sections that are located within the curb perimeter.
- .8 The curb section shall be complete with factory-installed duct supports.

- .9 The curb section shall be complete with factory installed supply air and return air neoprene flex connections.
- .10 Curb access doors or sections shall be installed as required for servicing curb components or accessories.
- .11 The curb shall be constructed to match the pitch of the roof.
- .12 The isolation shall allow 6 mm movement before resisting wind loads in any lateral direction.
- .13 Where required by the Project Specification the isolation curb shall be designed to meet all seismic loads and wind loading as defined by the building code having jurisdiction.
- .14 The perimeter of the curb shall have a flexible neoprene air and weather seal joining the upper and lower curb sections. There shall also be continuous closed cell sponge material between the top of the spring isolation curb and underside of the rooftop unit to provide a waterproof seal.
- .15 The spring isolation curb shall be shipped pre-assembled where possible. Where size prohibits one piece shipping, the isolation curb shall be split into a minimum number of sections and all connecting hardware shall be supplied by the manufacturer. Additional acoustic accessories shall be shipped loose for field installation.
- .16 The curb shall include a piping enclosure to match the rooftop unit.
- .17 Where required, the curb shall be equipped with a 914 mm wide service platform. That includes handrails, stairs and an open grating walkway.
- .18 All acoustic installation hardware shall be provided by the isolation curb manufacturer.

2.2 **ACCEPTABLE MANUFACTURER**

- .1 Vibro-Acoustics
- .2 Kinetics
- .3 Korfund-Dynamics

3 Execution

3.1 **INSTALLATION**

- .1 Install per manufacturer's guidelines.

End Of Section

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 in accordance with Section 01 33 00.
- .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.
 - .6 Proof of Canadian manufacturer or manufactured in Canada.

.2 Operation and Maintenance Data

- .1 Submit printed operating instructions and maintenance data in accordance with Section 01 33 00.

.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.

.4 Warranty

- .1 It shall be minimum of 5 years on fan housing, bearings, fan wheel.

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 to CGBS 1-GP-181M+ Amdt-Mar-78.
- .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.
 - .1 Explosion proof construction (non-sparking) where listed in schedules.

.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 diameter and larger: Shaft adapter sleeve type bearings utilizing horizontally split pillow blocks and mechanical flinger type grease valves.
- .4 Shafts smaller than 56 mm diameter, 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 Axial flow fans
 - .1 Conform to these Specifications except where inner cylinder mounting methods are used or dimensions do not permit it and special or flange mounted type bearings are required.
- .5 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.
- .6 Accessories
 - .1 Fans with variable inlet vanes
 - .1 Operating mechanisms to provide simultaneous adjustment of vanes.
 - .2 Motor operated mechanisms to be suitable for adaptation of motor operator provided under Division 25.
 - .3 Quick opening access doors in scroll casing.
 - .4 On DWDI fans interconnect vanes in each inlet to operate in unison.
 - .5 Provide locking device for manual operation.
 - .2 Casing drains
 - .1 Fans discharging vertically through roof: Fitted with 38 mm casing drains.
 - .3 Roof mounted fans
 - .1 Factory mounted unfused disconnect switches wired to motor terminals.

- .2 Conduit or wiring post running through fan housing so that wiring may be run to line side of disconnect switch from below roof without disturbing roof construction.
- .4 Roof curbs for roof mounted fans and ventilators
 - .1 Prefabricated insulated galvanized steel sheet curbs for mounting to roof deck.
 - .2 Prefabricated insulated galvanized steel sheet curbs for mounting to roof deck.
 - .3 Minimum curb height: 300 mm on every side, or as dimensioned on Drawings.

2.2 FAN TYPES

.1 Centrifugal Fans

.1 Arrangements

Fan Type	Arrangement
Belt driven single inlet single width (SWSI) fans up to and including 915 mm wheel diameter	#1 or #2
Belt driven single inlet single width (SWSI) fans with wheel diameter larger than 915 mm diameter	#3
Belt driven double width double inlet (DWDI) fans	#3
Belt drive plenum (plug) fans, single width single inlet (SWSI) fans	#3
Direct connected double width double inlet (DWDI) fans	#7
Direct connected single inlet single width (SWSI) fans	#8
Utility sets	#10
Tubular single width single inlet (SWSI) fans	#1 or #9

.2 Fan wheels

- .1 Backward curved or backward inclined for fan wheels less than 686 mm diameter.
- .2 Single or double thickness backward curved air foil blades for fan wheels 686 mm diameter and larger.

.3 Fan casing

- .1 Continuous seam welded.
- .2 Inlet mounting collar.
- .3 Outlet flanged collar.

.4 Plenum (plug) fans

- .1 Safety screen enclosure around fan and motor fabricated from steel angle and expanded metal mesh.
- .2 Access covers to fan and motor shaft ends for speed measurements.

.5 In-line cabinet fans

- .1 Single wheel SWSI centrifugal fans with motor and V-belt 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.
- .12 Variable inlet vanes and linkage where noted.
- .6 Ceiling cabinet fan / in-line cabinet fan
 - .1 Fan wheel
 - .1 Centrifugal direct drive type.
 - .2 High strength polymer material.
 - .3 Forward curved.
 - .2 Motor
 - .1 Continuous duty, permanently lubricated, thermally protected.
 - .2 Resilient motor mounts to eliminate vibration.
 - .3 Casing
 - .1 Heavy gauge steel.
 - .2 Acoustic lining.
 - .3 Painted for corrosion resistance.
 - .4 Built-in backdraft damper.
 - .5 Outlet connection for round duct.
 - .6 Integral mounting flanges to allow for ceiling installation.
- .7 Tubular centrifugal fans
 - .1 Characteristics and construction as for centrifugal fan wheels.
 - .2 (Direct drive motor) (Belt drive assembly).
 - .3 Smooth rounded inlet, and stationary guide vanes.

.2 Tube and Vane Axial Fans

.1 Fan

- .1 Fabricated of welded steel with welded motor support.
- .2 Quick-opening access door.
- .3 External grease and relief fittings to each bearing.
- .4 Streamlined inlet cone and discharge bell sections.
- .5 Integral silencer casing.
- .6 Reinforced legs for floor mounted units.
- .7 Hanger brackets.
- .8 Support bracket welded to side of casing for suspended units.

.2 Drives

- .1 Direct driven: (Adjustable pitch) (Fixed pitch) (Fan blade with totally enclosed "air-over" motors and diameter of wheel hub at least equal to that of motor frame.
- .2 Belt driven: (Fixed) (Adjustable) blade wheels with externally mounted open drip proof motors, internal belt fairing, external belt guards and adjustable motor mounts.

.3 Roof Top Fans and Ventilators

.1 Upblast exhaust and downward supply air fans

- .1 Suitable for mounting on curbed roof openings.
- .2 Heavy gauge galvanized steel housing and windband.
- .3 Finished inside and outside with sprayed asphalt.
- .4 Heavy gauge curb cap.
- .5 Gravity or spring assisted steel dampers as required, with magnetic catches to dampers to prevent rattling in closed position.
- .6 TEAO motor.
- .7 Weatherproof protective motor cover and belt-drive.
- .8 Supply fans complete with 25 mm throwaway filters.

.2 Spun aluminum dome type fans

- .1 Belt or direct driven as indicated in schedules.
- .2 Spun aluminum housing.
- .3 Hinged or completely removable hood for access to motor and fan.
- .4 Non-overloading centrifugal fan wheel.

- .5 Multi-blade gravity backdraft damper and aluminum 13 mm mesh birdscreen.
- .3 Gravity relief vents
 - .1 Spun aluminum cover.
 - .2 Welded aluminum curb cap.
 - .3 Galvanized bird screen.
 - .4 Exhaust air outlets complete with backdraft dampers.
- .4 Penthouse type intake and exhaust hoods
 - .1 Extruded aluminum fixed louvres with birdscreens on inside.
 - .2 Insulated metal roof.
 - .3 Welded base to suit curbed opening and prefinished to later colour selection.
- .4 Ceiling Fans
 - .1 Multi-bladed propellers of sheet or airfoil shape.
 - .2 Permanently lubricated ball bearings suited for operation in any position.
 - .3 Direct driven, variable speed, with EC motor complete with controllers.
 - .4 Acceptable manufacturers:
 - .1 Big Ass Fans
 - .2 Altra Air (Envira North)
 - .3 MacroAir
- .5 Propeller Fans
 - .1 Wall type belt or direct driven propeller fans
 - .1 Multi-bladed propellers of sheet or airfoil shape steel within bell mouth entrance.
 - .2 Grease lubricated ball bearings suited for operation in any position.
 - .3 (Direct) (or) (belt) driven, with motor as indicated.
 - .4 Bird screen (and automatic backdraft dampers with gasketed edges).
 - .5 Wire guard on motor side.
 - .6 Support motor with substantial brackets or frame. Motors supported integrally with wire guard will not be accepted.
- .6 Acceptable Manufacturers
 - .1 Industrial Type Construction (In-line, Propeller Utility Sets, Upblast, Fume)
 - .1 Twin City Fan

- .2 Chicago Blower
- .3 New York Blower
- .4 Northern Blower
- .5 Barry Blower
- .6 Carnes
- .7 Aeroflow
- .8 Aerovent
- .9 Howden Fan Co.
- .10 Wood Fans
- .11 Canada Blower
- .2 Ceiling Cabinet Fans
 - .1 Greenheck
 - .2 Twin City
 - .3 Carnes
 - .4 Aerovent
 - .5 PennBarry
 - .6 Loren Cook
- .3 Small Propeller Fans
 - .1 Howden Fan Co.
 - .2 Greenheck
 - .3 Carnes
 - .4 Wood Fans
- .4 Spun Aluminum Fans
 - .1 Greenheck
 - .2 Jenn Air
 - .3 Carnes
- .5 Intake and Exhaust Hoods, Penthouses, Relief Vents
 - .1 Greenheck
 - .2 Jenn Air
 - .3 Carnes
 - .4 Loren-Cook

2.3 **CONTROL AND MONITORING SYSTEMS (FUTURE BAS INTEGRATION)**

- .1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:
 - .1 Delta Controls
 - .2 Reliable Controls
 - .3 Schneider Electric SmartX Series
 - .4 Distech Controls
 - .5 Johnson Controls Facility Explorer
 - .6 Honeywell CIPer series, Spyder Models 5 or 7
- .2 BAS System Integration:
 - .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
 - .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
 - .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.
- .3 Licensing Requirements
 - .1 Licenses shall be provided to and in the name of the City of Toronto
 - .2 Licenses shall be perpetual, transferrable, assignable and royalty free.

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.
 - 3.2 **FABRICATED GOOSENECK TYPE FRESH AIR INTAKE AND EXHAUST AIR HOODS**
 - .1 Fabrication: Black steel construction.
 - .2 Size, shape and arrangement as shown on Drawings.
 - .3 Finish interior and exterior surfaces finished with rust inhibitive primer.
- End of Section

- 1 General
- 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- 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 Linear Diffusers and Grilles
 - .1 Extruded aluminum construction, unless otherwise shown on Drawings.
 - .2 Linear supply and return diffusers to have either natural anodized aluminum finish or baked enamel finish as listed on Drawings.
 - .3 Complete with engineered distribution plenum and internal opposed blade damper. Black finish on inside of plenums.
 - .4 Curved and custom shapes and finishes as detailed on Drawings.
 - .3 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.
 - .4 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.
 - .5 Door Grilles
 - .1 Door grilles will be supplied and installed by general trades.
 - .6 Acceptable Manufacturers:
 - .1 E.H. Price
 - .2 Nailor Industries Inc.

- .3 Titus
- .4 Carnes
- .5 Tuttle & Bailey

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 to specific light-air troffers in flat ceilings provide boots to connect flexible duct to lighting fixtures.
- .4 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

- 1 General
 - 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
 - .2 Conform with all sections of Division 1, 21, 22, 23 and 25 as applicable.
 - 1.2 **REFERENCE STANDARDS**
 - .1 Comply with the latest edition of the standards referenced herein:
 - .1 Air filter to be tested in accordance with ULC-S111 - "Standard Method of Fire Tests of Air Filter Units" and ASHRAE 52.2, latest edition, Methods of "Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter".
 - 1.3 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Submit Shop Drawings in accordance with Section 01 33 00.
 - .2 Submit manufacturer's catalogue literature showing:
 - .1 Pressure drop vs. air quantity
 - .2 Media area in each cell
 - .3 Dust holding capacity
 - .4 Maximum recommended pressure drop.
 - .2 Operation and Maintenance Data
 - .1 Submit printed operating instructions and maintenance data in accordance with Section 01 33 00.
 - .3 Maintenance Materials
 - .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .3 Spare filters: in addition to filters installed immediately prior to acceptance by Owner's Representative, supply one (1) complete set of filters for each filter unit or filter bank in accordance with section 01 78 00 - Closeout Submittals

2

Products

.1 General

- .1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50 °C.
- .2 Number of units, size as recommended by manufacturer and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

.2 PLEATED PANEL FILTERS – MERV 8

- .1 Air filters shall be medium efficiency ASHRAE pleated panels consisting of a cotton and synthetic media blend, media support grid, and enclosing frame. Filter depth shall be 1 or 2" depending on the application.
- .2 Sizes shall be coordinated with the manufacturer of air handling unit.
- .3 Filter media shall be a synthetic blend, lofted to a uniform depth, and formed into a uniform radial pleats. There shall be at least 15 or pleats per linear foot for 2" deep filters.
- .4 A welded wire grid, spot-welded on centers and treated for corrosion resistance, shall be bonded to the downstream side of the media to maintain the radial pleat and prevent media oscillation.
- .5 An enclosing frame, of high wet-strength beverage board shall provide a rigid and durable enclosure. The frame shall be bonded to the media to prevent air bypass, and include integral diagonal support members on the air entering and air existing side to maintain uniform pleat spacing in varying airflows.
- .6 The filter shall have a Minimum Efficiency Reporting Value of MERV 8 when evaluated under the guidelines of ASHRAE Standard 52.2.
- .7 Initial resistance to airflow shall not exceed 0.25" w.g. at an airflow of 500 fpm on 2" deep models.
- .8 The filter shall be classified by Underwriters Laboratories as UL Class 900.
- .9 Manufacturer shall provide evidence of facility certification to ISO 9001:2008.
- .10 Provide product test reports for each listed efficiency including all details as prescribed in ASHRAE Standards 52.2.
- .11 Standard of Acceptance: Camfil Farr, AAF Flanders, Dafco.

.3 CARTRIDGE FILTERS – MERV 11/13/14

- .1 Air filters shall be high efficiency ASHRAE supported media box-style 6" deep filters consisting of wet-laid micro fine glass mat media, safe-edge aluminum separators, frame to media pack adhesive bonding, and an aluminized steel enclosure.
- .2 Sizes shall be coordinated with the manufacturer of air handling unit.

- .3 Filter media shall be one continuous sheet of micro fine wet-laid glass mat media. The media shall be capable of withstanding a relative humidity level of 99%.
 - .4 Media separators of aluminum construction shall provide media separation and promote uniform airflow across the media surface. The edges of the separators shall incorporate a safe-edge on the air entering and air existing sides so the separators will not puncture the media.
 - .5 An enclosing frame of galvanized steel, with an aluminized finish, shall provide a rugged and durable filter pack. A peripheral header (s) shall be included for side access or built up bank frame installation.
 - .6 The filter shall have a Minimum Efficiency Reporting Value of MERV (11, 13, 14, 16) when evaluated under the guidelines of ASHRAE Standard 52.2-2012. It shall also have a MERV-A rating of (11, 13, 14, 16) when evaluated under ASHRAE Standard 52.2, Appendix J. It shall have an efficiency of (ePM10-70, ePM1-65, ePM1-70, ePM1-90) when evaluated per ISO filter testing standard 16890.
 - .7 Initial resistance to airflow shall not exceed (0.45", 0.60", 0.65")* w.g. at an airflow of 500 fpm.
 - .8 The filter shall be classified by Underwriters Laboratories as UL Class 900.
 - .9 Manufacturer shall provide evidence of facility certification to ISO 9001:2015.
 - .10 Provide product test reports for each listed efficiency including all details as prescribed in ASHRAE Standards 52.2 and ISO Standard 16890.
 - .11 Standard of Acceptance: Camfil Farr, AAF Flanders, Daeco
- .4 V-BANK CARTRIDGE FILTERS – MERV 11/13/14/16
- .1 Air filters shall be v-bank 12" deep mini-pleated fiberglass disposable type with pleat separators, polyurethane pack-to-frame sealant, polystyrene enclosing frame and have an ECI value of five stars.
 - .2 Sizes shall be coordinated with the manufacturer of air handling unit.
 - .3 Filter media shall be of microfine glass fibers formed into uniform pleats with a spacing of 10 pleats per inch and a uniform pleat height of 24mm. Pleats shall be separated at 25mm intervals to ensure uniform pleat distribution and even airflow through the filter pack.
 - .4 Pleats media packs shall be assembled into a v-bank configuration with sufficient total media area to meet airflow requirements. The filter outlet shall be radial in shape with a maximum of 60% open area to maintain low-pressure drop and uniform airflow (20" by 20" shall be straight v style design).
 - .5 The media packs shall be bonded to the inside periphery of a polystyrene enclosing frame with a polyurethane sealant. The enclosing frame shall include top and bottom molded tracks as an integral part of the frame to ensure a proper seal.
 - .6 Media packs shall be recessed at least one-inch from the headered side of the enclosing frame to allow uniform airflow when a prefilter is mounted directly to the enclosing frame. The header shall include a gasket on the vertical side to create a filter-to-filter seal in side-access housing applications.

- .7 Rigid plastic end caps shall be mechanically fastened to the top and bottom of the media pack enclosing structure to ensure a rigid and durable filter.
- .8 Carrying handles shall be an integral part of the filter frame and shall bridge from media pack to media pack providing additional filter support and filter rigidity. Handles shall include fastener connection locations for the application of spring mounting fasteners when the filter is applied in reverse flow applications.
- .9 The filter shall have a Minimum Efficiency Reporting Value of MERV (11, 13, 14, 16) when evaluated under the guidelines of ASHRAE Standard 52.2-2012. It shall also have a MERV-A rating of (11, 13, 14, 16) when evaluated under ASHRAE Standard 52.2, Appendix J. It shall have an efficiency of (ePM10-70, ePM1-65, ePM1-70, ePM1-90) when evaluated per ISO filter testing standard 16890.
- .10 Initial resistance to airflow shall not exceed (0.22, 0.27, 0.29, 0.64) inches w.g. at an airflow of 500 fpm for 24" x 24", 24" x 12" and 24" x 20" sizes. On 20" by 20" respective pressure drops shall be (0.27, 0.33, 0.37, 0.80) inches w.g. at an airflow of 1980 cfm.
- .11 Filter shall have a 5-Star rating when evaluated per Energy Cost Index.
- .12 Filter shall be listed by Underwriters Laboratories as UL Class 900.
- .13 The filter shall be capable of withstanding 10" w.g. without failure of the media pack.
- .14 Manufacturer shall provide evidence of facility certification to ISO 9001:2015.
- .15 The manufacturer shall provide a written Performance Guarantee ensuring the filter has the highest energy savings in its class of product, and will maintain its particle capture efficiency throughout its service life.
- .16 Provide product test reports for each listed efficiency including all details as prescribed in ASHRAE Standards 52.2 and ISO Standard 16890.
- .17 Standard of Acceptance: Camfil Farr, AAF Flanders, Dafco.

3 Execution

3.1 **MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 **INSTALLATION GENERAL**

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 **ACTIVATED CARBON TYPE FILTERS**

- .1 During testing, adjusting and balancing, install substitute media.
- .2 Install permanent media only after all painting is completed.

3.4 **REPLACEMENT MEDIA**

- .1 Replace all media with new upon acceptance.

- .2 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance.
- .3 Prior to the start of balancing install new prefilters and final filters.
- .4 Replace all prefilters and final filters at turnover to the owner. Used filters shall be inspected by the Owner. All filters in acceptable condition shall be retained by the Owner.
- .5 Provide a spare set of pre and final filters in additional to the set identified in item 3.1.4 above.
- .6 Spare HEPA filters are not required.

3.5 FILTER GAUGES

- .1 Install type as indicated across each filter bank (pre-filter, high efficiency filter and final filter) in approved and easily readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

- .3 Pleats media packs shall be assembled into a v-bank configuration with sufficient total media area to meet airflow requirements. The filter outlet shall be radial in shape with a maximum of 60% open area to maintain low-pressure drop and uniform airflow (20" by 20" shall be straight v style design).
- .4 The media packs shall be bonded to the inside periphery of a polystyrene enclosing frame with a polyurethane sealant. The enclosing frame shall include top and bottom molded tracks as an integral part of the frame to ensure a proper seal.
- .5 Media packs shall be recessed at least one-inch from the headered side of the enclosing frame to allow uniform airflow when a prefilter is mounted directly to the enclosing frame. The header shall include a gasket on the vertical side to create a filter-to-filter seal in side-access housing applications.
- .6 Rigid plastic end caps shall be mechanically fastened to the top and bottom of the media pack enclosing structure to ensure a rigid and durable filter.
- .7 Carrying handles shall be an integral part of the filter frame and shall bridge from media pack to media pack providing additional filter support and filter rigidity. Handles shall include fastener connection locations for the application of spring mounting fasteners when the filter is applied in reverse flow applications.
- .8 The filter shall have a Minimum Efficiency Reporting Value of MERV (11, 13, 14, 16) when evaluated under the guidelines of ASHRAE Standard 52.2-2012. It shall also have a MERV-A rating of (11, 13, 14, 16) when evaluated under ASHRAE Standard 52.2, Appendix J. It shall have an efficiency of (ePM10-70, ePM1-65, ePM1-70, ePM1-90) when evaluated per ISO filter testing standard 16890.
- .9 Initial resistance to airflow shall not exceed (0.22, 0.27, 0.29, 0.64) inches w.g. at an airflow of 500 fpm for 24" x 24", 24" x 12" and 24" x 20" sizes. On 20" by 20" respective pressure drops shall be (0.27, 0.33, 0.37, 0.80) inches w.g. at an airflow of 1980 cfm.
- .10 Filter shall have a 5-Star rating when evaluated per Energy Cost Index.
- .11 Filter shall be listed by Underwriters Laboratories as UL Class 900.
- .12 The filter shall be capable of withstanding 10" w.g. without failure of the media pack.
- .13 Manufacturer shall provide evidence of facility certification to ISO 9001:2015.
- .14 The manufacturer shall provide a written Performance Guarantee ensuring the filter has the highest energy savings in its class of product, and will maintain its particle capture efficiency throughout its service life.
- .15 Provide product test reports for each listed efficiency including all details as prescribed in ASHRAE Standards 52.2 and ISO Standard 16890.
- .16 Standard of Acceptance: Camfil Farr, AAF Flanders, Dafco.
- .17

.18

.1

.2 Filter Operating Conditions

.1 Panel and 30% MERV 7 filters: Continuous exposure to air at -25°C.

.2 All other filters: Continuous exposure to air at 12°C and 100% RH.

.3 Range: Operate satisfactorily between 3°C and 50°C.

.3 Efficiency Ratings

.1 To ASHRAE 52-76, atmospheric dust spot test, except where otherwise noted.

.2 Dust holding capacity to be determined from Air Filter Institute (AFI) test.

.19 Filter Racks

.1 Filter holding frames:

.1 1.6 mm thick "T" section construction supporting structure of (galvanized steel) (extruded aluminum).

.2 Gasketing between adjacent frames and between frames and plenum walls.

.2 Side access housings (for heat recovery coils on exhaust systems):

.1 1.6 mm galvanized steel construction.

.2 Gasketed slide track (with lever locking to full face of frame).

.3 Gasketed access door.

.20 Panel Filters

.1 Construction

Nominal Dimensions	600 mm x 600 mm x 50 mm
Maximum Initial Air Resistance	35 Pa at 1.5 m/s 50 Pa at 2.5 m/s
Maximum Face Velocity	2.5 m/s

.1 20% efficiency 85% arrestance.

.2 Disposable fibre media, to CAN2-115.10-M80, in permanent or disposable filter holding frames.

.3 Wire frame media supports in each cell

.2 Acceptable Manufacturers

.1 American Air Filter of Canada Limited - Renu frame with Frontline 4000 filter

.2 Farr Co. Limited

.3 Airguard Industries Service frame with PSF-31 media

.21 MERV 8 Efficiency Extended Surface Filters

.1 Construction

Nominal Dimensions	600 mm x 600 mm x 100 mm
Media area	2.5 m ²
Maximum Initial Air Resistance	50 Pa at 2.5 m/s
Maximum Face Velocity	(2.5 m/s) (2.0 m/s)
Dust Holding Capacity	1.8 kg/m ² at final resistance of 250 Pa

.1 Preformed disposable cartridges made from non-woven reinforced cotton fibre media supported on metal grid bonded to beverage board frame.

.2 Class II rated by ULC.

.2 Acceptable Manufacturers

.1 American Air Filter of Canada Limited - Perfect Pleat HC M8 (MERV 8)

.2 Varicell II (MERV 13)

.3 Farr Co. Limited

.4 Airguard Industries

3.7 **FILTER ACCESSORIES**

.1 Filter Gauges

.1 Construction

.1 0-250 Pa range for 35% efficiency cartridge filters

.2 0-750 Pa range for other filter banks

.2 Acceptable Manufacturers

.1 Dwyer 250AF Series inclined solid acrylic plastic manometer

.2 Magnehelic 2000 Series diaphragm actuated direct reading dial type

.3 Air Flow Developments Ltd. Type FL1BM

4 Execution

4.1 **INSTALLATION**

.1 Filter Racks

.1 Provide filter banks with racks and filters of size, type, number and arrangement as shown on equipment schedules and on Drawings.

.2 Filter Gauges

.1 Provide filter gauges as follows:

.1 One for each bank of filters over 2000 L/s capacity.

.2 Separate gauges for prefilter and final filter where roll filter or 35% cartridge filter is located ahead of another filter bank.

.3 One for each bank of "absolute" filters regardless of capacity.

4.2 **CONSTRUCTION**

.1 Filter Protection

- .1 Provide temporary roughing filters ahead of filter banks during initial operation of air handling systems.
- .2 Remove temporary filters and ensure that filter banks are fitted with full sets of cartridges and media when building is turned over to Owner.
- .3 Air filters used during construction and loaded to more than 125% of initial clean pressure drop to be replaced with new filters at completion.

End Of Section

1 General

1.1 **WORK INCLUDED**

.1 Furnish Work of this section in accordance with the Contract Documents including but not limited to, the following:

.1 Air cooled, pressure oil-lubricated duplex reciprocating air compressors package, 2-stage, 2 cylinder cast iron compressor pump unit with system pressure controller, one 120 gal horizontal air receiver, complete with automatic condensate drainage, and related compressed air piping, including design, shop drawings, fabrication, shop and field testing, delivery to Job Site, supervision and start-up of units.

.2 The constant speed compressor shall be capable of delivering 37 scfm at 150 psi in accordance with ISO 1217, Annex C scfm is actual cubic feet per minute at inlet conditions.

.3 Conform to all sections of Division 1, 21, 22, 23 and 25 as applicable.

2 Products

2.1 **GENERAL**

.1 Minimum expected useful life is twenty years.

.2 This specification is for NEW air compressors.

2.2 **ELECTRICAL RECIPROCATING COMPRESSORS**

.1 The reciprocating air compressor shall be capable of producing and delivering 100% of the required air demand as specified at Air Compressor Schedule.

.2 The compressor shall be designed and supplied as a complete package with all necessary equipment, including but not limited to the following components: inlet filter, air compressor system with drive motor, microprocessor regulation and control system. The package system shall be factory built, assembled and tested.

.3 The compressor package shall be rated to operate in ambient conditions from 32°F to 115°F.

.4 The units shall be manufactured by a qualified manufacturer who has been manufacturing air compressors for at least 10 years.

.5 The compressor manufacturer shall be certified under ISO 9001/9002 quality standards and ISO 14001 environmental standards.

.6 The manufacturer must participate in the Compressed Air & Gas Institute (CAGI) Performance Verification program.

2.3 **COMPRESSOR**

.1 The compressor shall be reciprocating type consisting of;

.1 High pressure: Heat treated and stress relieved connecting rod made from solid cast ductile iron.

.2 Low Pressure: Heat treated and stress relieved connecting rod made from aluminum alloy.

- .3 It shall have tin-plated compression rings designed to work with oil control rings and scraper.
- .4 It shall have babbit inserts.
- .5 Short stroke design to be a combination of large and short stroke and slow operating speeds.
- .6 Cylinder shall be made of cast iron. Walls shall be precision machined for friction reduction and minimal oil carryover. It shall have extra deep fins for cooling and assembly strength.
- .7 It shall have quick quiet-acting valves machined from carbon steel. Valve guide shall be of hardened carbon steel complimenting stainless steel valve discs and springs.
- .8 Bearings shall be designed for heavy load capacity. It shall be lubricated from the crankcase and shall be maintenance free.
- .9 Intercoolers shall be made of deep finned cast iron.
- .10 Flywheel shall be balanced fan type with airfoil-type spokes.
- .11 Crankshaft shall have integral counter weights and shall be balanced. Journals are precision ground and furnished with inserts. It shall be drilled and ported for carrying oil to bearing surfaces.

2.4 **NOISE LEVELS**

- .1 The compressor package shall not exceed 74 dB(A) when measured in the free field conditions at one meter in accordance with the CAGI-Pneurop Test Code.

2.5 **DRIVE MOTOR**

- .1 The drive motor must be a Open Drip Proof (ODP) type.
- .2 The full-load efficiency rating must meet or exceed NEMA premium standards.
- .3 The motor shall conform with NEMA MG 1 for 60 Hz applications and IEC 34-1, EN60034-1 for 50 Hz applications.
- .4 The complete motor shall be 100% maintenance free.
- .5 Approved manufacturers include:
 - .1 DV Systems
 - .2 Siemens
 - .3 Lincoln
 - .4 ABB
 - .5 TECO Westinghouse
 - .6 Reliance
 - .7 Leroy Somer
 - .8 Toshiba

.9 Baldor

2.6 **ELECTRONIC WATER DRAIN**

- .1 The compressor will have zero loss electronic water drain plumbed to the aftercooler.
- .2 These drains shall discharge no compressed air during removal of the condensate.
- .3 The zero loss drains shall be monitored by the microprocessor controller.
- .4 A manual condensate drain shall also be included.

2.7 **INLET AIR FILTER**

- .1 The filter shall be a paper cartridge type and be factory installed inside the compressor enclosure.
- .2 The filter shall have the following SAE fine efficiency ratings:
 - .1 1 micron: 98.0%
 - .2 2 microns: 99.5%
 - .3 3 microns: 99.9%
- .3 The filter shall be equipped with a differential pressure indicator for monitoring by the control system.
- .4 The service interval of the filter must be at least 4,000 hours.

2.8 **OIL SYSTEM**

- .1 The oil system shall include an ASME approved air/oil separator with oil level indicator. The service interval of the separator element must be at least 8,000 hours.
- .2 The oil filter shall be a spin-on type with an integrated bypass valve. The oil filter element will have a 12 micron beta 75 rating and the service interval must be at least 8,000 hours.
- .3 The oil temperature shall be regulated by means of a thermostatic bypass valve. Oil circulation is achieved through differential pressure.
- .4 The oil must be synthetic and rated for a change interval of 8,000 hours.
- .5 The oil system must use o-rings to provide a positive seal. No gaskets can be used.

2.9 **REGULATING AND CONTROL SYSTEM**

- .1 The compressor shall have a regulating system which is of the full load/no load design, controlled by an air compressor discharge pressure sensor which senses the pressure variations at the compressor discharge and maintains it within a pre-set adjustable range.
- .2 The full load/no load regulation shall be combined with a start/stop regulation to automatically stop the compressor as required.
- .3 The compressor shall be equipped with an onboard microprocessor controller which will control, monitor and protect the operation and condition of the air compressor.
- .4 The controller shall have a 3.5" colour display.
- .5 The controller shall allow programming of two pressure bands for loading and unloading.
- .6 Time based start/stop and changeover for net pressure band shall be programmable.

- .7 The control algorithm shall include a function to proactively stop the compressor during periods of low demand without having to wait for the stop timer to time out.
- .8 The controller must be capable of automatically restarting the compressor in the event of a voltage failure.
- .9 The controller must be capable of graphing any of the measured temperature or pressure inputs on the display. The time frame of the graph shall be adjustable from 4 minutes to 10 days.
- .10 The compressor shall be able to be controlled locally, remotely or via a local area network.
- .11 The controller must be equipped with auxiliary contacts for external indication of automatic or manual load control, general warning and general shutdown conditions.
- .12 The controller must be capable of providing remote monitoring by a PC through the local Ethernet system via an Ethernet port on the controller.
- .13 The controller must be capable of providing remote monitoring via an Apple or Android phone or tablet.
- .14 The controller shall monitor the hours of operation and output a message on the display to notify the operator to provide preventative maintenance in accordance with the factory approved service plan.
- .15 The control system shall have the capability to monitor the following items:
 - .1 Discharge air pressure
 - .2 Element outlet temperature
 - .3 Ambient temperature
 - .4 Compressor status
 - .5 Motor overload status
 - .6 Running hours
 - .7 Loaded hours
 - .8 Regulator hours
- .16 Compressor protective functions shall include:
 - .1 Emergency stop
 - .2 Element outlet temperature
 - .3 Service warnings
 - .4 Drive and cooling fan motor overload
- .17 Acceptable Manufacturers
 - .1 Atlas Copco
 - .2 Ingersoll Rand
 - .3 Quincy

.4 DV Systems

2.10 **MONITORING SYSTEMS (FUTURE BAS INTEGRATION)**

.1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:

- .1 Delta Controls
- .2 Reliable Controls
- .3 Schneider Electric SmartX Series
- .4 Distech Controls
- .5 Johnson Controls Facility Explorer
- .6 Honeywell CIPer series, Spyder Models 5 or 7

.2 BAS System Integration:

- .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
- .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
- .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.

.3 Licensing Requirements

- .1 Licenses shall be provided to and in the name of the City of Toronto
- .2 Licenses shall be perpetual, transferrable, assignable and royalty free.

3 Execution

3.1 **SUPERVISION**

- .1 Coordinate with Installing Contractor and provide supervision for:
 - .1 Unloading, transportation to final location, and installation of equipment.
 - .2 Connection of piping and electrical wiring to equipment.
- .2 Submit report of satisfactory completion of each phase of Work to Project Coordinator.

3.2 **TESTING AND COMMISSIONING**

- .1 Provide all supervision and engineering support necessary to assist Mechanical/Controls Subcontractor start-up, test and prove performance of equipment meets specified requirements, from minimum to full load conditions. Tests shall conform to manufacturer's standard using all purchased components.
- .2 In addition to machine performance tests, carry out noise tests to demonstrate compliance with noise specification for both indoor and outdoor noise levels.
- .3 Shop tests shall comprise following:
 - .1 Compressors
 - .1 Comply with manufacturer's standards/ISO 1217 Annex "C".

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- .2 Section includes, but is not necessarily limited to, the following:
 - .1 Thermal heat wheel, complete with variable frequency drive (where mentioned), rotation detection system, and temperature control system.
 - .2 Energy Recovery Core Heat Exchanger

1.2 **SUBMITTALS**

.1 Shop Drawings

- .1 Submit Shop Drawings in accordance with Section 01 33 00.
- .2 Submit the following Product specific information:
 - .1 Manufacturers certified data sheets for unit capacity and rating method.
 - .2 Manufacturer's piping and wiring diagrams.
 - .3 Written verification confirming internal pore diameter distribution in desiccant limits absorption to materials with critical diameters less than or equal to that of water molecule (2.8 angstroms).

.2 Operation and Maintenance Data.

- .1 Submit printed operating instructions and maintenance data in accordance with Section 01 33 00.

2 Products

2.1 **ENTHALPY CORE RECOVERY UNIT**

.1 General

- .1 Performance as shown on equipment schedules.
- .2 Ventilation Type: Static plate, heat and humidity transfer.
- .3 Unit shall be HVI Tested and Certified per CSA C439 Protocol.
- .4 It shall be fully assembled at the factory and consist of a fixed-plate cross-flow heat exchanger with no moving parts, an insulated single wall G90 galvanized painted 22-gauge steel cabinet, filter assemblies for both intake and exhaust air, enthalpy core, supply air blower assembly, exhaust air blower assembly and electrical control box with all specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection. Entire unit with the exception of field-installed components shall be assembled and test operated at the factory.

.2 Unit Cabinet

- .1 Materials: Formed single wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
- .2 The energy recovery component shall be of fixed-plate cross-flow construction, with no moving parts.
- .3 Enthalpy core: Energy recovery core shall be of the total enthalpy type, capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air. No condensate drains shall be allowed. The energy recovery core shall be designed and constructed to permit cleaning and removal for servicing.
- .4 Outside casing: Shall be constructed of 22-gauge steel, with lapped corners and zinc-plated screw fasteners. The case shall be finished with smooth pre-painted or powder coat white paint.
- .5 Case walls and doors shall be fully insulated with 1", expanded polystyrene foam insulation faced with a cleanable foil face on all exposed surfaces.
- .6 Access door shall provide easy access to blowers, ERV cores, and filters. Access door shall be hinged with airtight closed cell foam gaskets. Doors shall have an airtight compression seal using closed cell foam gaskets.
- .7 The ERV shall have locking door hinges so that the ERV can be installed in multiple orientations.
- .8 Door pressure taps, with captive plugs, shall be provided for cross-core pressure measurement allowing for accurate airflow measurement. Unit shall have (4) pressure ports allow for easy airflow balancing and verification.
- .9 No condensate drain pans or drains shall be allowed and unit shall be capable of operating in both winter and summer conditions without generating condensate.
- .10 Unit shall have factory-supplied 6"/8" duct collars for easy installation of ductwork to the unit.
- .11 Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

.3 Blower Section

- .1 The impeller type shall be backward-curved.
- .2 Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

.4 Motors

- .1 The supply and exhaust fans shall be electronically commutated (EC) motors with multispeed capability as standard offering.

.5 Unit Control

- .1 Unit shall have the capacity to operate continuously without the need for bypass, recirculation, pre-heaters, or defrost cycles under normal operating conditions.
- .2 The unit shall be capable of operating continuously or intermittently at the low airflow setting with the ability to go temporarily to the high airflow boost mode.
- .3 The unit shall have an internal 24VAC transformer and relay.
- .4 The ERV shall be capable of going into low or high airflow mode by any of the following methods.
- .1 Occupancy Sensor
 - .2 Carbon Dioxide Sensor
 - .3 Boost Mode push button switch
 - .4 Proportional Run Time Controller

.6 Filter Section

- .1 The ERV cores shall be protected by a MERV 8 rated, spun polyester, disposable filter in both airstreams.
- .2 ERV shall have the capability to incorporate an optional 1" thick MERV 13 disposable pleated filters located in the outdoor air airstream.
- .3 All filters shall be accessible from the exterior of the unit.

.2 Acceptable Manufacturers

- .1 Renewaire
- .2 Lifebreath
- .3 Or Approved Equal

2.2 CONTROL AND MONITORING SYSTEMS (FUTURE BAS INTEGRATION)

- .1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:
- .1 Delta Controls
 - .2 Reliable Controls
 - .3 Schneider Electric SmartX Series
 - .4 Distech Controls
 - .5 Johnson Controls Facility Explorer
 - .6 Honeywell CIPer series, Spyder Models 5 or 7

.2 BAS System Integration:

- .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
- .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
- .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.

.3 Licensing Requirements

- .1 Licenses shall be provided to and in the name of the City of Toronto
- .2 Licenses shall be perpetual, transferrable, assignable and royalty free.

3 Execution

3.1 **EXAMINATION**

- 1. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
- 2. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
- 3. Proceed with installation only after all unsatisfactory conditions have been corrected.

.1 Installation

- .1 Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, best practices and all applicable building codes.
- .2 Install unit with clearances for service and maintenance.
- .3 Locate, orient, and connect ductwork per AMCA, ASHRAE, and SMACNA guidelines. Provide service clearances as indicated on the plans. Locate units distant from sound critical occupancies.
- .4 Use factory supplied mounting flange to mount the unit per manufacturer's installation manuals to a structurally suitable surface. The units may be mounted in any orientation.
- .5 If vibration isolation is required, utilize factory provided springs as necessary to help provide vibration isolation for the unit.

- .6 Provide flexible duct connections at unit duct flanges.
- .7 To control sound radiated from the unit:
- .8 Provide acoustic treatment in mechanical room walls and ceilings.
- .9 To control sound associated with the two blower outlets:
- .10 Utilize insulated, flexible duct.
- .11 In sound critical applications provide increased duct sizing and consider the use of sound attenuator
- .2 Connections
 - .1 In all cases, industry best practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
 - .2 Duct installation and connection requirements are specified in Division 23 of this document.
 - .3 Electrical installation requirements are specified in Division 26 of this document.
 - .4 All ductwork shall be designed, constructed, supported and sealed in accordance with SMACNA HVAC Duct Construction Standards and pressure classifications.
 - .5 At a minimum all duct runs to the outdoors shall be thermally insulated at levels appropriate to the local climate. A continuous vapor barrier shall also be provided on both sides of the insulation.
- .3 Field Quality Control
 - .1 Contractor to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to Architect/Engineer in writing. Inspection must include a complete start up checklist to include (as a minimum) the following: Completed start up checklists as found in manufacturer's IOM.
- .4 Start-Up Service
 - .1 Contractor to perform start up service. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein. Refer to the manufacturer's installation, operation and maintenance IOM manual for start up procedure.
 - .2 Test and balancing may not begin until 100% of the installation is complete and fully functional.
 - .3 Follow National Environmental Balancing Bureau (NEBB) air test and balance procedures specific to energy recovery devices. Provide balancing reports to owner's representatives.
- .5 Demonstration and Training
 - .1 Contractor to train owners or owner's maintenance personnel to adjust, operate and maintain the ERV. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

End Of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- .2 This section includes units with integral Heating for indoor installation. Integral heat source shall be electric heater. Airflow arrangement shall be Outdoor Air only. Each unit shall be constructed in a horizontal configuration and shall incorporate additional product requirements as listed in Section 2 of this specification.

1.2 **SUBMITTALS**

.1 Shop Drawings

- .1 Submit Shop Drawings in accordance with Section 01 33 00.
- .2 Complete fan performance curves for Supply Air, with system operating conditions indicated, as tested on an AMCA Certified Chamber.
- .3 Sound performance data for Supply Air, as tested on an AMCA Certified chamber.
- .4 Motor ratings, electrical characteristics and motor and fan accessories.
- .5 Performance ratings for all coils.
- .6 Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
- .7 Estimated gross weight of each installed unit.
- .8 Installation, Operating and Maintenance manual (IOM) for each model.
- .9 Network interface Controller specifications to include available options and operating protocols. Include complete data on all factory-supplied input devices. It shall be verified with Client BAS's compatibility for its controls.
- .10 Remote Panel description to include all functions.
- .11 Coils shall be Recognized Components per UL 1995, CAN / CSA C22.2 No 236.05. Coil performance shall be calculated in accordance with AHRI 410

1.3 **QUALITY ASSURANCE**

- .1 Source Limitations: Obtain unit with Integral Heating with all appurtenant components or accessories from a single manufacturer.
- .2 Product Options: Drawings must indicate size, profiles and dimensional requirements of unit and are to be based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- .3 Certifications
 - .1 Entire unit shall be ETL Certified per UL1995 and bear an ETL mark.

- .2 Coils shall be Recognized Components per UL 1995, CAN / CSA C22.2 No 236.05. Coil performance shall be calculated in accordance with AHRI 410.

1.4 **COORDINATION**

- .1 Coordinate size and location of all building penetrations required for installation of each MAU and associated ducting, plumbing and electrical systems.
- .2 Coordinate sequencing of construction of associated plumbing, HVAC and electrical supply.

2 **Products**

.1 **General**

- .1 Unit with Integral Heating shall be fully assembled at the factory and consist of an insulated metal cabinet, outdoor air intake with aluminum mesh filter with bird screen with combination mesh filter and louver, condensate drain pan, P trap, electric coils, motorized intake damper, sensors, service receptacle, freeze protection, filter assembly for intake air, supply air blower assembly and an electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

.2 **Construction**

.1 **Casing:**

- .1 Materials: Formed, single wall metal cabinet with full fiberglass duct liner insulation, fabricated to permit access to internal components for maintenance. Underside of unit shall have formed metal panels covering base panel insulation.
- .2 Outside casing: 18 gauge, galvanized steel meeting ASTM A653 for components that do not receive a painted finish. Pre-painted components as supplied by the factory shall have polyester urethane paint on 18 gauge galvaneal steel. Base rail is 12 gauge, galvanized steel.
- .3 Internal assemblies: 24 gauge, galvanized steel except for motor supports which shall be minimum 14 gauge galvanized steel.
- .4 Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
- .5 Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
 - .1 Thickness: 1 inch (25 mm)
 - .2 Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
 - .3 Location and application: Floor of each unit shall be insulated with fiberglass insulation.
 - .4 Access panels: Unit shall be equipped with insulated removable or hinged/lift off access panels to provide easy access to all

major components. Access panels shall be fabricated of 18 gauge galvanized steel. Removable access panels shall incorporate a formed drip edge.

.2 Fans (Blower):

- .1 Blower section construction, Supply Air: Belt drive motor and blower shall be assembled onto a minimum 14 gauge galvanized steel platform and must have neoprene vibration isolation devices, minimum of 28.6 mm thick helical coil spring vibration devices.
- .2 Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
- .3 Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.
- .4 Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.
- .5 Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating." Forward curve blower:

.3 Control Center:

- .1 Control center / connections: unit shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections.

.4 Heating Coil:

- .1 Electric heat: Electric heater is to be UL listed with open coil elements. Heater control cabinet is to be installed within the units heating section. Electric heater is to be provided with SCR controls. Electric heater is to be controlled off of discharge temperature external 2-20. Units with electric heat are to be provided with a center that shall be constructed to permit single-point high voltage power supply connections.

.5 Motorized Inlet Air Damper: It shall be low leakage type and shall be factory installed.

.6 Unit sensors and device controllers are to be factory supplied and tested by the unit manufacturer.

.7 Motors:

- .1 General: Blower motors greater than 0.75 horsepower shall be "NEMA Premium™" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable.
- .2 Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.

- .3 Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts.
- .4 Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley. Comply with requirements in Division 23 05 13, matched with fan load.
- .8 Unit Controls:
 - .1 The unit shall be constructed so that it can function as a stand-alone heating system controlled by factory-supplied remote panel, thermostats and sensors or it can be operated as a heating system controlled by a remote panel complete with control switches. If Building Automation System (BAS) is available, this unit shall be provided and controlled by a factory-installed Network interface controller that is connected to various sensors (See Section 9).
 - .2 Unit shall incorporate a Network interface controller with integral LCD screen that provides text readouts of status, operating settings and alarm conditions. Network interface controller shall have a built-in keypad to permit operator to access read-out screens and change settings without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable.
 - .3 Sensors to be provided:
 - .1 Room / Space Temperature Sensors only applicable if room temp is selected
 - .2 Heating Inlet Air Sensor
 - .3 Dirty Filter Sensor
 - .4 Fire Stat Type III
 - .5 120V/24V Smoke Detector
- .9 Control and Monitoring System (Future BAS Integration)
 - .1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:
 - .1 Delta Controls
 - .2 Reliable Controls
 - .3 Schneider Electric SmartX Series
 - .4 Distech Controls
 - .5 Johnson Controls Facility Explorer
 - .6 Honeywell CIPer series, Spyder Models 5 or 7
 - .2 BAS System Integration:

- .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
- .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
- .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.
- .3 Licensing Requirements
 - .1 Licenses shall be provided to and in the name of the City of Toronto
 - .2 Licenses shall be perpetual, transferrable, assignable and royalty free.
- .10 Filters:
 - .1 Unit shall have 50mm thick MERV 13 disposable pleated filters following the outdoor air intake in a V-bank arrangement and shall be accessible from the exterior of the unit.
- .11 Acceptable Manufacturers
 - .1 Greenheck
 - .2 Johnson Controls
 - .3 Carrier
 - .4 Trane
 - .5 McQuay/Daikin
 - .6 Lennox

3 Execution

3.1 **EXAMINATION**

- .1 Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
- .2 Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.

- .3 Proceed with installation only after all unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- .1 Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

3.3 CONNECTIONS

- .1 In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
- .2 Piping installation requirements are specified in Division 22 (Plumbing). Drawings indicate general arrangement of piping, fittings and specialties.
- .3 Duct installation and connection requirements are specified in Division 23 of this document.
- .4 Electrical installation requirements are specified in Division 26 of this document.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to be submitted to the engineer in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

3.5 START-UP SERVICE

- .1 Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters. Verify water source for compliance with manufacturer's requirements for flow and temperature. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

3.6 DEMONSTRATION AND TRAINING

- .1 Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

End Of Section

- 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 following:
 - .1 ANSI/ASHRAE/IESNA 90.1
 - .2 ANSI/ARI Standard 390
 - .3 CSA C22.2
 - 1.3 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Submit Shop Drawings in accordance with Section 01 33 00.
 - .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data in accordance with Section 01 33 00.
- 2 Products
 - 2.1 **SPLIT-SYSTEM HEAT PUMP UNIT**
 - .1 Capacity, performance requirements, and configuration shall be as scheduled and specified.
 - .2 Provide fully packaged and factory tested indoor evaporator unit complete with control system, DX refrigeration system, supply air fan, filters.
 - .3 Provide fully packaged and factory tested remote outdoor condensing unit complete with built-in starter, contactors, controls, transformers, and weatherproof disconnect switch.
 - .4 Compressor to be inverter.
 - .5 Ship units fully charged with refrigerant R410A.
 - .6 Interconnect indoor evaporator unit and outdoor condensing unit with liquid and suction refrigerant lines. Refrigerant lines shall be insulated with cellular elastomer.
 - .7 Provide wired controller. Controller to be interlocked with electric heater where indicated on Drawings.
 - .8 Provide low (-20°C) ambient operation kit.
 - .9 Auto restart after power failure.

- .10 Acceptable Manufacturers
 - .1 Mitsubishi
 - .2 Daikin
- 2.2 **CONTROL AND MONITORING SYSTEMS (FUTURE BAS INTEGRATION)**
 - .1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:
 - .1 Delta Controls
 - .2 Reliable Controls
 - .3 Schneider Electric SmartX Series
 - .4 Distech Controls
 - .5 Johnson Controls Facility Explorer
 - .6 Honeywell CIPer series, Spyder Models 5 or 7
 - .2 BAS System Integration:
 - .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
 - .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid Integration (FIN).
 - .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.
 - .3 Licensing Requirements
 - .1 Licenses shall be provided to and in the name of the City of Toronto
 - .2 Licenses shall be perpetual, transferrable, assignable and royalty free.
- 3 Execution
 - 3.1 **GENERAL**
 - .1 Install unit and accessories as per manufacturer's instructions.
 - .2 Manufacturer to certify installation, and start-up and commission units.

- .3 Install miscellaneous steel framing, supports, braces, etc. as required to hang or support equipment and ductwork as specified herein, and as shown on Drawings.
- .4 Install and wire all accessories shipped loose with units for fully operating systems.

End of Section

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1 General

1.1 **REFERENCES**

- .1 CSA, Canadian Standards Association.
- .2 ULC, Underwriters' Laboratories of Canada.

1.2 **SUBMITTALS**

- .1 Submit the following Product data and Shop Drawings in one package.
 - .1 Product Data:
 - .1 Submit copies of manufacturer's product data in accordance with Section 01 33 00 Submittal Procedures, indicating:
 - .1 Product characteristics.
 - .2 Performance criteria, minimum operating air flow.
 - .3 Mounting methods, unit support.
 - .4 Physical size.
 - .5 KW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Limitations, clearance to combustibles.
 - .8 Colour and finish.
 - .2 Shop Drawings:
 - .1 Submit Shop Drawings in accordance with Section 01 33 00 Submittal Procedures, indicating:
 - .1 Equipment, capacity and piping connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
 - .3 Warranty on heavy duty units shall be minimum of 5 years, on lighter units shall be 2 years.
 - .4 Commissioning
 - .1 Submit Commissioning Plan, Commissioning Procedures, Certificate of Readiness, Deficiency Report and Commissioning Closeout Report, in accordance with Division 23.
 - .2 Submit design data and test reports.
 - .3 Submit inspection and test reports.

.5 Closeout Submittals

- .1 Submit the following for incorporation into Operation and Maintenance Manuals in accordance with Section 01 33 00 Submittal Procedures.
 - .1 Identification: Manufacturer name, type, year, serial number, number of units, and capacity.
 - .2 Functional description detailing operation and control.
 - .3 Performance criteria and maintenance data.
 - .4 Operating instructions and precautions.
 - .5 Component parts availability including names and addresses of spare part Suppliers.
 - .6 Lubrication schedule, maintenance and troubleshooting guidelines.
- .2 Manufacturer's installation instructions for the following items:
 - .1 Force flow heater.
- .3 Submit As-Built Drawings in accordance with Section 01 33 00 Submittal Procedures.

2 Products

2.1 **ELECTRIC FORCED AIR HEATER (FAH)**

- .1 Manufacturers:
 - .1 Ouellet
 - .2 Chromalox (Dimplex)
 - .3 Stelpro
- .2 Construction: 0.8 mm thick steel (20 ga) removable and tamperproof panel, glass fibre insulation and integral air outlet and inlet.
- .3 Finish: Polyester epoxy powder coat, white.
- .4 Electric coils: durable tubular heating element with fins.
- .5 Fans: statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted,
- .6 Motor: Totally enclosed type with permanently lubricated bearings, built-in thermal overload protection and resilient rubber isolation mounting.
- .7 Capacity: As per Drawing.
- .8 Built-in disconnect switch.
- .9 Controls
 - .1 On-off switch with integral overloads in cabinet.

- .2 Remote wall-mounted thermostat.
- .3 120 V control circuit with magnetic contactor and transformer.
- .4 High temperature limit switch.
- .10 Units must be UL and CSA approved.

2.2 **ELECTRIC UNIT HEATER**

- .1 Manufacturers:
 - .1 Ouellet Model OAS
 - .2 Chromalox (Dimplex)
 - .3 Stelpro
- .2 Construction: 18 gauge steel cabinet with threaded connections for hanger rods.
- .3 Finish: Epoxy powder coat, white.
- .4 Heating coil: Low surface temperature, seamless copper sheathed tubular elements, low-watt density.
- .5 Fan: Propeller type, dynamically and statically balanced, epoxy coated aluminum construction and fan guard.
- .6 Motor: Totally enclosed type with permanently lubricated bearings, built-in thermal overload protection and resilient rubber isolation mounting.
- .7 Air outlet: Two-way adjustable louvres.
- .8 Capacity: As per Drawing schedule.
- .9 Built-in disconnect switch.
- .10 Controls
 - .1 Remote wall-mounted thermostat.
 - .2 120 V control circuit with magnetic contactor and transformer.
 - .3 High temperature limit switch.
- .11 Units must be UL and CSA approved

2.3 **CONTROL AND MONITORING SYSTEMS (FUTURE BAS INTEGRATION)**

- .1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:
 - .1 Delta Controls
 - .2 Reliable Controls
 - .3 Schneider Electric SmartX Series
 - .4 Distech Controls
 - .5 Johnson Controls Facility Explorer

- .6 Honeywell CIPer series, Spyder Models 5 or 7
- .2 BAS System Integration:
 - .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
 - .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
 - .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.
- .3 Licensing Requirements
 - .1 Licenses shall be provided to and in the name of the City of Toronto
 - .2 Licenses shall be perpetual, transferrable, assignable and royalty free.
- 3 Execution
- 3.1 **EXAMINATION**
 - .1 Review proposed locations on-site and co-ordinate installation requirements with general trades, architectural finishes and power requirements.
- 3.2 **INSTALLATION**
 - .1 Install in accordance with manufacturer's instructions.
 - .2 Check final location with Consultant if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Consultant's direction.
 - .3 Clean finned tubes and comb straight.
 - .4 Provide supplementary suspension steel as required.
 - .5 Install thermostats in locations indicated.
 - .6 Before acceptance, set discharge patterns and fan speeds to suit requirements.
- 3.3 **COMMISSIONING**
 - .1 Perform Commissioning in accordance with Section 23 08 23 Mechanical Commissioning.
 - .2 Verify operational performance in general conformance with the following outline:

- .1 Operational performance outline:
 - .1 Thermostat operation.
 - .2 Element response.
 - .3 Fan operation.
 - .4 Disconnect.
 - .5 Other unit control features/devices.
- .2 Functional performance outline:
- .3 Interlocks with associated equipment.
- .4 Interface with adjacent building components.

3.4 **PROTECTION**

- .1 Protect from damage during construction. Do not operate during construction or until unit and area thoroughly cleaned and inspected.

End of Section

CS 852 HVAC for Garage

Control Diagram	Detail: Drawing: M0203
System Start	In case of emergency mode activation, gas detection control panel for both Bldg 8 and 9 enables normal ventilation exhaust fan (EF-01, 02) and the purge ventilation exhaust fan (EF-03, 04). Makeup Air Units (MAU-01, 02) will shut-off.
General	Operator, manually (or through BAS) could select: Temperature setting points and schedule: Occupied/unoccupied summer/winter.
Normal Operation	<p><i>Normal Operation</i></p> <p>All MAUs, 01 and 02 (both for building 8 and 9 respectively), continuously supply 100% outdoor air, while exhaust fans (EF-01, 02) 103% exhaust air as described above for winter / summer operation.</p> <p>Thermostat or gas sensors (or through BAS) enables the MAU 01 and 02 and EF 01 and 02, through OMS to satisfy their respective sensors. This includes enabling Unit Heaters (02 and 07 for Bldg 8, 08 and 13 for Bldg 9) during winter to supplement heating to the garage space.</p>
Emergency Operation	<p>All exhaust fans of units running at highest speed in emergency, all the supply fans stop.</p> <p>When the gas detection system indicates NO₂, CO levels in the garage are above the concentration level indicated or at operator's will, the control (or the BAS) will initiate purge ventilation fan EF 03 and 04 as required to satisfy sensors, and an alarm will start at the gas detection control panel.</p> <p>When the gas detection system indicates normal NO₂, CO levels in the storage garage, the control panel (or the BAS) will proceed with the selected schedule operation for the season. It will shut down the purge ventilation fan EF 03 and 04 and the continuous ventilation scheme will operate through thermostat.</p> <p>During Fire Detection, MAUs and other HVAC Equipment will shut off. Only Exhaust Fan 01, 02, 03 and 04 will run at full speed.</p>
System Stop	The system disables all equipment; equipment stops according to the respective control sequence.
Schedule	Continuous operation
Fire Alarm	System shuts down as for system stop.
Alarms	As per the individual equipment control sequences.
Monitor	N/A
Trend Logs	N/A
Emergency Power	All units – Exhaust fan 01, 02, 03 and 04 only

Remarks:

1.

End Of Section

CS 202 Compressed Air System

Control Diagram	Detail: Drawing: M0201
System Start	The operator starts the system manually from the OEM control panel or from BAS.
Normal Operation	<p><i>Normal Operation</i></p> <p>The compressed air master OEM control panel sequences the compressors as as duty/standby. Set delivery pressure at 150 psi (adjustable) after pressure regulator.</p> <p>On failure of one compressor, the control will automatically operate the other compressor and sound a silence-able audible alarm.</p> <p>After power failure, the lead compressor will start automatically by the master OEM control panel.</p>
System Stop	The system operates continuously until disabled manually by the operator.
Schedule	Continuous operation
Fire Alarm	N/A
Alarms	General fault to BAS (when connected)
	Local alarm
	Compressor failure
Monitor	Line air pressure
Trend Logs	OEM Control Panel
Emergency Power	<p>On power failure system (equivalent by compressor manufacturer) will automatically restart one able compressor.</p> <p>When the building is operating on emergency power, the compressed air master control will automatically limit operation for the compressed air system to only one compressor, regardless of the load. Emergency power will be signaled by dry contact closure.</p>

Remarks:

End of Section

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CS 203 Oil Interceptor Level Monitoring

Control Diagram	Detail: N/A Drawing: N/A
System Start	The system operates continuously.
Normal Operation	The OEM oil interceptors level monitoring system and display panels monitor and display the level of oil in the interceptor. When the oil level reaches 90% full, the level local control panel will display an alarm and emit a silence-able audible alarm.
System Stop	The system operates continuously.
Schedule	Continuous Operation
Fire Alarm	N/A
OEM Alarms	LLH - Oil Level 90%
Monitor	LL
Trend Logs	None
Emergency Power	Yes

Remarks:

End of Section

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CS 411

Sanitary Sump Pumps

Control Diagram	Detail: 7/M00006	Drawing: M0201
System Start	Continuous operation.	
Normal Operation	<i>Sump Level Control</i> Sump pumps operate under OEM float control.	
System Stop	Continuous operation.	
Schedule	Continuous operation.	
Fire Alarm	N/A	
Alarms	LLH	High sump level alarm.
Monitor	N/A	
Trend Logs	N/A	
Emergency Power	Yes	

Remarks

1.

End Of Section

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CS 751 Rooms Split AC (Heat Pump) Systems

Control Diagram	Detail: N/A Drawing: N/A
System Start	Thermostat Setpoint
Normal Operation	<i>Normal Operation</i> A/C system operates under OEM control to maintain space temperature and space humidity.
System Stop	Setpoints are achieved by Thermostat
Schedule	Continuous operation
Fire Alarm	Unit to shut down on fire alarm and isolating motor dampers on HVAC system to be closed.
Alarms to OEM	APD High filter pressure drop EST1 General unit fault
BAS Monitor	AT1 High space temperature AH1 High space humidity
Alarm	General unit fault
Trend Logs	Space temperature Space humidity Leak detection alarm General malfunction
BACNet / LonWorks	Provide BACNet network communications for the following: <ul style="list-style-type: none">• Diagnostics• Monitoring
Emergency Power	Yes (for system serving electrical and UPS rooms)

Remarks:

1. Provide serial communications to OEM controller. OEM controller is equipped with BACNet communications protocol.

End of Section

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CS 803 Compressor Room HVAC

Control Diagram	Detail: Drawing:
System Start	Manual by operator. Continuous operation in conjunction with related air handling/makeup air units and exhaust fans.
Normal Operation	<p>Compressor room is served by a ventilation system: System consists of mechanical supply (motorized damper) and exhaust.</p> <p>Compressor room is served by EF 08 in conjunction with the motorized damper for air intake and UH-01 heater for room temperature control. In summer when room temperature is close to 30°C the motorized damper shall be fully open for fresh air intake and the exhaust uses 100% exhaust. In winter when room temperature is close to 30°C, the system recirculates warm air from compressor heat dissipation and supplemented by the Unit Heater UH-01 controlled through a thermostat.</p>
System Stop	Continuous operation
Schedule	Continuous operation
Fire Alarm	Supply fan stops
Trend Logs	None
Emergency Power	N/A

Remarks:

1.

End Of Section

CS 810 Tail Pipe Process Exhaust Arms (Monoxivent)

Control Diagram	Detail: Drawing: M0202
System Start	Operator locally starts/stops exhaust fan from any of the two (per system) manual switches on the adjacent wall. The switches status shall be sent back to BAS.
Normal Operation	Continuous operation
System Stop	Continuous operation
Schedule	Continuous operation
Fire Alarm	N/A
Alarms	N/A
Monitor	N/A
Trend Logs	N/A
Emergency Power	N/A

Remarks:

1.

End of Section

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CS 852 HVAC for Garage

Control Diagram	Detail: Drawing: M0203
System Start	In case of emergency mode activation, gas detection control panel for both Bldg 8 and 9 enables normal ventilation exhaust fan (EF-01, 02) and the purge ventilation exhaust fan (EF-04, 04). Makeup Air Units (MAU-01, 02) will shut-off.
General	Operator, manually (or through BAS) could select: Temperature setting points and schedule: Occupied/unoccupied summer/winter.
Normal Operation	<p><i>Normal Operation</i></p> <p>All MAUs, 01 and 02 (both for building 8 and 9 respectively), continuously at 100% outdoor air, while exhaust fans (EF-01, 02) 103% exhaust air as described above for winter / summer operation.</p> <p>Step 1: In summer is natural ventilation.</p> <p>Step 2: Thermostat or gas sensors (or through BAS) enables the MAU 01 and 02 and EF 01 and 02, through OMS to satisfy their respective sensors.</p> <p>Step 3: All exhaust fans of units running at highest speed in emergency, all the supply fans stop.</p> <p>When the gas detection system indicates NO₂, CO levels in the garage are above the concentration level indicated or at operator's will, the control (or the BAS) will initiate purge ventilation fan EF 03 and 04 as required to satisfy sensors, and an alarm will start at the gas detection control panel.</p> <p>When the gas detection system indicates normal NO₂, CO levels in the storage garage, the control panel (or the BAS) will proceed with the selected schedule operation for the season. It will shut down the purge ventilation fan EF 03 and 04 and the continuous ventilation scheme will operate through thermostat.</p>
System Stop	The system disables all equipment; equipment stops according to the respective control sequence.
Schedule	Continuous operation
Fire Alarm	System shuts down as for system stop.
Alarms	As per the individual equipment control sequences.
Monitor	N/A
Trend Logs	N/A
Emergency Power	All units – Exhaust fans only

Remarks:

1.

End Of Section

CS 857 Gas Detection System

Control Diagram	Detail: Drawing:
System Start	The system operates continuously when powered.
Normal Operation	<i>Normal Operation</i> The OEM Gas detection system monitors CO and NO ₂ levels in the repair garage. The system will display an alarm and a strobe light at the control panel and provide dry contact closure to indicate alarm levels as indicated in the Specification, to allow air handling units to be activated to control ventilation systems in response to the detected gas levels.
System Stop	The system operates continuously when powered.
Schedule	Continuous operation
Fire Alarm	N/A
Alarms	General fault Sensor Fault
Monitor	N/A
Trend Logs	N/A
Emergency Power	YES

Remarks:

1.

End Of Section

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 Ontario Building Code
.3 Ontario Fire Code

- .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 cooperation 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 Refer to and comply with Section 01 10 00.

- .2 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.

- .3 Coordinate Work of this division such that items will properly interface with Work of other divisions.

- .4 Architectural Drawings, or in the absence of Architectural Drawings, Mechanical Drawings govern all locations.

- .5 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 **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.

1.9 **"AS BUILT" RECORD DRAWINGS**

- .1 (Refer to and comply with Section 01 33 00.) 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.

1.10 **SINGLE LINE DIAGRAM**

- .1 Reproduce this diagram in drawing form under glazed frame and mount in main switchgear room. Provide a copy of this diagram to the Consultant and include in the Maintenance Manuals.

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 Refer to and comply with Section 01 33 00.
- .2 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.
- .3 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.

1.13 **FACTORY WITNESS TESTS**

- .1 Prior to Consultant attendance at factory for witness testing, perform the following:
 - .1 Successfully conduct test to be witnessed.
 - .2 Following successful testing, inform the Consultant, in writing, that tests to be witnessed have been successfully performed.

1.14 **OPERATING AND MAINTENANCE MANUALS**

- .1 Refer to and comply with Section 01 33 00 and related sections.

1.15 **AREA CLASSIFICATION**

- .1 _____

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 **SPRINKLER PROOF EQUIPMENT**

- .1 Ensure that electrical equipment installed in electrical rooms and other areas containing sprinklers is constructed such that exposure to water from the sprinkler heads does not impair the effectiveness of the enclosed equipment.
- .2 Provide a separate cover or roof on all 2285 mm high equipment. Provide an overhang at the front, rear and sides to effectively prevent the entrance of water either at the top or through projecting faceplates, meters, etc.
- .3 Where penetrations are made in drip shields, flash and seal using manufacturer's approved caulking to maintain drip shield integrity.
- .4 Ensure that enclosure louvres are of outdoor design such that falling water or water running down the sides will not enter the enclosure.
- .5 Where enclosure openings in the top or sides are required for outgoing conduits, provide waterproof conduit fittings.
- .6 Provide panels and transformers with hoods.
- .7 Provide sprinkler proof busways.
- .8 In electrical rooms containing sprinklers provide wall mounted equipment such as pull boxes, junction boxes, splitter troughs, wireways, auxiliary gutters, cable troughs and disconnect switches located below the level of the sprinkler heads with the following accessories:
 - .1 Gaskets on doors and drip shields on equipment, panelboards, panels and enclosures.
 - .2 Louvres facing outward and downward where openings are required for heat dissipation. Expanded metal screening is not acceptable.

2.4 **HOUSEKEEPING PADS**

- .1 Provide 100 mm high concrete pads under floor mounted electrical equipment. Extend pads 50 mm outside the equipment perimeter.

2.5 **FIRE BARRIERS**

- .1 Where electrical material or devices pass through fire rated separations, make penetrations and provide fire barrier seals with a fire resistance rating equivalent to the rating of the separation.

- .2 Prior to installation, submit for review, proposed fire barrier seal materials, method of installation and ULC system number.
- .3 Acceptable Manufacturers:
 - .1 A/D Fire Protection Systems
 - .2 Dow Corning
 - .3 Fire Stop Systems
 - .4 IPC Flamesafe Firestop
 - .5 Nelson Electric
 - .6 3M
 - .7 Tremco
- 2.6 **MISCELLANEOUS METAL FABRICATIONS**
 - .1 Provide miscellaneous structural supports, platforms, braces, brackets and preformed channel struts necessary for suspension, attachment or support of electrical equipment in accordance with Section 05 50 00.
- 2.7 **SILICONE**
 - .1 Products and materials containing silicone are not permitted.
 - .2 Refer to and comply with Section 01 61 05.
- 2.8 **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
- 2.9 **PRODUCTS FURNISHED BY OWNER**
 - .1 Refer to Sections 00 21 00, 00 41 13, and 01 10 00.
 - .2 Carefully examine the Vendor or Manufacturers' Drawings and provide any incidental and miscellaneous materials, mounting hardware and supports required for complete systems.
- 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 **PAINTING**

- .1 Touch up finishes on electrical equipment found to be marred on completion of the Work using same colour and type of finish as originally used.
- .2 Prime paint field fabricated metalwork.
- .3 Other painting will be provided under Section 09 91 00.

3.4 **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 ten 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 and X-ray images. Prior to drilling submit the report to Consultant for approval.
 - .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

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **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"

1.3 **SUBMITTALS**

- .1 Consultant reserves the right to require Contractor to submit samples of any materials to be used in this Project.

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

- .3 600 V rated

- .4 For maximum 90°C (194°F) conductor temperature

- .5 For installation at minimum -40°C (-40°F) 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 1000 V rated

- .4 For maximum 90°C (194°F) conductor temperature

- .5 For installation at minimum -40°C (-40°F)

- .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

- .4 600 V rated

- .5 For maximum 90°C (194°F) conductor temperature dry and 75°C in wet locations
 - .6 For installation at minimum -10°C (14°F)
 - .7 To CSA C22.2 No. 75-M
 - .4 CSA type TEW:
 - .1 Heat resistant
 - .2 600 V rated
 - .3 For maximum 105°C (221°F) conductor temperature
 - .4 To CSA C22.2 No. 127
 - .5 CSA type SEW-2
 - .1 Heat resistant
 - .2 600 V rated
 - .3 For maximum 200°C (392°F) 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
 - .3 600 V rated for sizes #10 AWG and smaller
 - .4 1000 V rated for sizes #8 AWG and larger
 - .5 For maximum 90°C (194°F) conductor temperature
 - .6 For installation at minimum -40°C (-40°F) temperature

- .6 Control cables
 - .1 Two or more conductors
 - .2 Conductors 600 V rated
- .7 Composite cables
 - .1 Three power conductors
 - .2 Three #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 (-40°F) 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
 - .3 600 V rated
 - .4 For maximum 90°C (194°F) conductor temperature
 - .5 For installation at minimum -40°C (-40°F) 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 electrical 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 (-40°F) 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 TC, Tray Cable (-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
 - .3 600 V rated
 - .4 For maximum 90°C (194°F) conductor temperature
 - .5 For installation at minimum -40°C (-40°F) temperature
 - .6 CSA type RW90 XLPE to CSA C22.2 No. 38
 - .3 Construction
 - .1 Two or more insulated conductors
 - .2 Bare, stranded, copper ground conductor
 - .3 Fillers with binder tape to produce a circular cross-section
 - .4 Jacket

- .1 PVC
 - .2 FT4 flame test rated
 - .3 Low acid gas rated to CSA C22.2 No. 0.3
 - .4 Black colour
 - .5 To CSA C22.2 No. 230
 - .4 Acceptable Manufacturers
 - .1 Alcatel Canada Wire
 - .2 BICC Phillips
 - .3 Pirelli Cables
- .5 CSA Type MI
 - .1 Conductors
 - .1 ASTM Class B, soft drawn, electrolytic copper
 - .2 Solid
 - .2 Insulation
 - .1 Powdered magnesium oxide
 - .2 600 V 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 Extruded PVC overall jacket over sheath
 - .1 FT4 flame test rated
 - .2 Colour black unless otherwise indicated
 - .5 To CSA C22.1 No. 124-M
 - .4 Acceptable Manufacturer
 - .1 Pyrotenax
- .6 EMF-Free Power Cable
 - .1 Conductors
 - .1 ASTM Class B, soft drawn, electrolytic copper
 - .2 Stranded central conductor

- .3 Solid, served concentric return conductors, equivalent to central conductor
- .4 Conductor size and number of runs to suit feeder ratings as shown on drawings
- .2 Insulation
 - .1 Heat and moisture resistant
 - .2 Ethylene propylene rubber (EPR)
 - .3 Minimum 600 V rated
 - .4 For maximum 90°C (194°F) conductor temperature
 - .5 For installation at minimum -40°C (-40°F) temperature
 - .6 To CSA C22.2 No. 38
- .3 Construction
 - .1 Single conductor with served wire return conductor (coaxial)
 - .2 PVC inner-jacket over return conductor
 - .3 Interlocking aluminum over inner jacket
 - .4 Overall PVC jacket
- .4 Power filters
 - .1 Filter parameters to suit the feeder characteristics (rating, length, etc.)
 - .2 EEMAC type 1 enclosure
- .5 Engineered system
 - .1 Provide EMF-free power cables and power filters as a complete engineered system from the manufacturer
- .6 Acceptable Manufacturer
 - .1 United Wire & Cable (ZeroFlux® Power Cable)

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, five-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 600 V, 90°C (194°F) insulation

- .2 Modular connectors, five-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, three-wire, stranded copper conductors rated 600V, 105°C (221°F) 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 347 V, 20 A
 - .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 or malleable iron
 - .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 **MOTOR LEAD CONNECTION KITS, 5000 VOLT**

- .1 Connection kits for 4000 V motors.
- .2 Acceptable Manufacturers
 - .1 3M, motor lead splice kit, pigtail, 5320 series
 - .2 Raychem, motor connection kit, MCK-5, type V

2.9 **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
- 2.10 **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

2.11 **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 Aluminum (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 Aluminum (Steel, hot dip galvanized after fabrication)

.3 Side height, 100 mm(150 mm)

.4 Solid Type

.1 Class C1

.2 Aluminum (Steel, hot dip galvanized after fabrication)

.3 Side height, 100 mm(150 mm)

.5 Centre Rail Type

.1 Class C1

.2 Aluminum

.3 Rung spacing 150 mm, 225 mm, 300 mm

.4 Loading depth 75 mm, 100 mm, 150 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

2.12 **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

2.13 **SURFACE RACEWAY**

- .1 Surface metal raceway, snap-in divider to form two 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. 120 V 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

2.14 **CELLULAR FLOOR SYSTEM**

- .1 Standards
 - .1 Raceways and fittings to CSA C22.2 No. 79.
 - .2 Activation kits and components CSA approved.
- .2 Trench duct: Steel construction, intermittent bottom, adjustable compartment dividers, removable covers, external levelling screws, void closures, coupling mechanisms, end closures, elbows and coverplate lifting device.

- .3 Preset inserts: Steel construction, triple service access with grommetted openings for access to low tension and power cells.
- .4 Activation kits: Pedestal fitting, multiplex service, two duplex power convenience receptacles, two data receptacles, two telephone jack outlets, and fittings to connect to preset inserts.
- .5 Acceptable Manufacturer
 - .1 Walker: Trenchduct type VA, preset inserts NRG-Bloc series and activation kits M6 series

2.15 **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 outside diameter of conduit or cable passing through.
- .3 Strut
 - .1 Continuous slotted channel
 - .2 Twelve 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

2.16 **SPLITTER BOXES**

- .1 Code gauge (galvanized) sheet steel enclosure EEMAC Type (1) (4) (12) welded corners and formed hinged cover suitable for locking in closed position.
- .2 Cast steel enclosure EEMAC 7 (9) with gasketed bolt on cover for hazardous locations.
- .3 Copper (aluminum) main and branch lugs to match required size and number of incoming and outgoing conductors.
- .4 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.17 **JUNCTION BOXES**

- .1 Galvanized steel EEMAC Type 1 (4) (12) 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.

2.18 **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 (Termitrab SLKK5-F) (TT-SLKK5-S).

2.19 **PULL BOXES**

- .1 Galvanized sheet steel welded construction, EEMAC Type 1, (4) (12).
- .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.

2.20 **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

2.21 **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 one conduit enters one 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.

2.22 **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.

2.23 **CONCRETE BOXES**

- .1 Pressed steel concrete type boxes for flush mount in concrete with extension and plaster rings as required.

2.24 **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.

2.25 **WIRING DEVICES - SWITCHES**

- .1 Specification grade, general purpose AC switches, manual toggle operated, (white), (ivory) and (brown) colour, 15 A, 20 A, 120-277 V, 347 V, 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, (white), (ivory) colour, 15 A, 20 A, 120-277 V, 347 V, single pole, double pole, three-way, four-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

2.26 **WIRING DEVICES - DIMMER SWITCHES**

- .1 Dimmer switches: solid state, full range with slider type handle on-off switch, (white), (ivory) rated to suit circuit load, 1000 watts minimum, 120 volts.
- .2 Acceptable Manufacturers:
 - .1 P & S
 - .2 Lutron

2.27 **WIRING DEVICES - OCCUPANCY SENSORS**

- .1 W1 Automatic wall switch, passive infrared, (120V) (277V) (347V), adjustable time delay thirty seconds to thirty minutes, 180 degrees coverage, minimum 300 sq.ft. hand motion at desktop, adjustable light sensor (21-2150 lux), white.
 - .1 Wattstopper WS-250 Series
- .2 W2 Automatic wall switch, passive infrared, (120V) (277V) (347V), adjustable time delay five minutes to thirty minutes, manual or auto on, 180 degrees coverage, minimum 300 sq.ft. hand motion at desktop, white.
 - .1 Wattstopper PW-100 Series

- .3 W2B Automatic wall switch, passive infrared, (120V) (277V) (347V), adjustable time delay five minutes to thirty minutes, manual or auto on, dimmer, 180 degrees coverage, minimum 300 sq.ft. hand motion at desktop, white.
- .1 Wattstopper PW-100D-I-U
- .4 W3 Automatic wall switch, dual technology, (120V) (277V) (347V), adjustable time delay five minutes to thirty minutes, manual or auto on, 180 degrees coverage, minimum 300 sq.ft. hand motion at desktop, white.
- .1 Wattstopper DW-100
- .5 W4 Outdoor PIR Occupancy sensor lighting control to mount internal to task lighting fixtures. 360 degree High Bay lens (20'-40'), 7.5' wire lead length, 24VDC; IP65.
- .1 Leviton OSF20-ILW
- .6 DT1 Ceiling mounted dual technology, 2000 sq.ft. coverage at 180 degrees, corner mounting bracket, adjustable time delay, adjustable sensitivity, built-in light level sensor (20 to 2150 lux), (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
- .1 Wattstopper DT-200
- .7 DT2 Ceiling mounted dual technology, 1000 sq.ft. coverage at 360 degrees, adjustable time delay, adjustable sensitivity, built-in light level sensor (100 to 3200 lux), (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
- .1 Wattstopper DT-300
- .8 C1 Ceiling mounted ultrasonic, 2000 sq.ft. coverage at 360 degrees, temperature and humidity resistant receivers, logic key/on bypass, adjustable time delay fifteen seconds to fifteen minutes, (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
- .1 Wattstopper W-2000A
- .9 C2 Ceiling mounted ultrasonic, 1000 sq.ft. coverage at 360 degrees, temperature and humidity resistant receivers, logic key/on bypass, adjustable time delay fifteen seconds to fifteen minutes, (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
- .1 Wattstopper W-1000A
- .10 C3 Ceiling mounted ultrasonic, 500 sq.ft. coverage at 360 degrees, temperature and humidity resistant receivers, logic key/on bypass, adjustable time delay fifteen seconds to fifteen minutes, (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
- .1 Wattstopper W-500A
- .11 C4 Ceiling mounted passive infrared, 300 sq.ft coverage, corner mounted, optional ON override through logic key/ON bypass, adjustable time delay thirty seconds to thirty minutes, (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
- .1 Wattstopper WPIR

- .12 CH Ceiling mounted ultrasonic, 90 lin.ft. hallway coverage, temperature and humidity resistant receivers, logic key/on bypass, adjustable time delay fifteen seconds to fifteen minutes, (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.

- .1 Wattstopper W-2000H

2.28 **WIRING DEVICES – TIME SWITCHES**

- .1 T1 (120V) (277V) digital time switch, zero crossing, pushbutton programming, adjustable time-out setting five minutes to twelve hours, flash and beep warnings, time scroll for temporary override of pre-set time-out, reset feature to return to pre-set timeout setting, electroluminescent, white.

- .1 Wattstopper TS-400

- .2 T2 24 V low voltage digital time switch, local power packs as required to suit load, zero crossing, pushbutton programming, adjustable time-out setting five minutes to twelve hours, flash and beep warnings, time scroll for temporary override of pre-set time-out, reset feature to return to pre-set timeout setting, electroluminescent, white

- .1 Wattstopper TS-400-24.

2.29 **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 | - Arrow Hart 5261
- Leviton 5261
- Hubbell 5261
- Pass & Seymour 5261 |
| .2 | 15A, 125V, (5-15R) Duplex
Straight Blade | - Arrow Hart 5262
- Leviton 5262
- Hubbell 5262
- Pass & Seymour 5262 |
| .3 | 20A, 125V, (5-20R) Single
Straight Blade | - Arrow Hart 5361
- Leviton 5361
- Hubbell 6331
- Pass & Seymour 5361 |
| .4 | 20A, 125V, (5-20R) Duplex
Straight Blade | - Arrow Hart 5392
- Leviton 5362
- Hubbell 5392
- Pass & Seymour 5362 |
| .5 | 15A, 125V, (5-15R) Duplex
GFCI, Straight Blade | - Arrow Hart GF5242AH
- Leviton 6599-W
- Hubbell GF-5252
- Pass & Seymour 1591 |

.6	15A, 125V, (5-15R) Duplex Isolated Ground, Straight Blade	- - - -	Arrow Hart IG5262AH Leviton 5262-IG Hubbell IG-5262 Pass & Seymour IG6200
.7	20A, 125V, (L5-20R) Single locking, 2 pole, 3 wire, grounding	- - - -	Arrow Hart 6200 Leviton 2310 Hubbell 2310ACN Pass & Seymour L520-RCN
.8	20A, 250V, (L6-20R) Single locking, 2 pole, 3 wire, grounding	- - - -	Arrow Hart 6210 Leviton 2320 Hubbell 2320ACN Pass & Seymour L620-RCN
.9	30A, 250V, (L6-30R) Single locking, 2 pole, 3 wire, grounding	- - - -	Arrow Hart 6340 Leviton 70630-FR Hubbell 2620CAN Pass & Seymour L630RCN
.10	30A, 250V, (L15-30R) Single locking, 3 pole, 4 wire, 3 phase, grounding	- - - -	Arrow Hart 6520 Leviton 2720 Hubbell 2720ACN Pass & Seymour L1530-RCN
.11	20A, 277V, (L7-20R) Single locking, 2 pole, 3 wire, grounding	- - - -	Arrow Hart 6220 Leviton 2331 Hubbell 2330ACN Pass & Seymour L720R
.12	20A, 347V (L24-20R) Single locking, 2 pole, 3 wire, grounding	- -	Leviton 3721 Pass & Seymour L3720-RCN
.13	15A, 125V (5-15R) Quad straight blade, 2 pole, 3 wire grounding	- - -	Bryant 1254 Hubbell 415 series Pass & Seymour 1254
.14	15A, 347V, (24-15R) Quad straight blade, 2 pole, 3 wire grounding	- - -	Bryant 3474W Hubbell 415347WC Pass & Seymour 3474W
.15	15A, 125V, (5-15R) Duplex straight blade	- - - -	Arrow Hart 26262 Leviton Decora Plus Hubbell 2152 series Pass & Seymour 885
.16	15A, 125V (5-15R) Duplex straight blade, 2 pole, 3 wire grounding, surge suppression, indicator light, blue (ivory) colour	- -	Arrow Hart 5250 Hubbell 5260
.17	15A, 125V (5-15R) Duplex straight blade, 2 pole, 3 wire grounding, isolated ground, surge suppression, indicator light, blue (ivory) colour	- -	Arrow Hart IG5250 Hubbell IG5262

- .1 Stainless steel Type 302 alloy, vertically brushed, 0.8 mm thick cover plates.
- .2 Nylon, smooth, high impact strength.
- .3 Pressed steel, galvanized.
- .4 Cast covers for cast boxes with gaskets.
- .5 Cover plates of same manufacture as devices.

2.31 **WELDING RECEPTACLES**

- .1 Circuit Breaking Receptacle
 - .1 Receptacle and back box assembly, 600 volt, 60 amp, three-wire, four-pole, weatherproof, aluminum housing.
 - .2 Acceptable Manufacturers
 - .1 Appleton Powertite, AJA mounting box and spring door
 - .2 Crouse-Hinds, Arktite AREA 6000 series, AJ back box, angle adaptor and spring door
 - .3 Russellstoll, type JRFA, twenty degree angle adaptor and spring door
 - .2 Interlocked Receptacle and Switch
 - .1 Receptacle interlocked with unfused disconnect switch, 600 volt, 60 amp, three-wire, four-pole. Receptacle with aluminum housing and spring door. Disconnect switch with NEMA 12 sheet steel enclosure.
 - .2 Acceptable Manufacturers
 - .1 Appleton WSRD interlocked receptacle
 - .2 Crouse-Hinds Arktite receptacle with WSRD disconnect switch
 - .3 Schneider Square D with Crouse-Hinds Arktite receptacle and class 3110 disconnect switch
 - .3 Compact Interlocked Receptacle and Switch
 - .1 Compact unit, receptacle interlocked with unfused disconnect switch, 600 volt, 60 amp, three-wire, four-pole, watertight, NEMA 4X non-metallic enclosure.
 - .2 Acceptable Manufacturers
 - .1 Bryant, 460SM series
 - .2 Crouse-Hinds, Arktite CSR Series
 - .3 Hubbell, Circuit-Lock

2.32 **SNOW MELTING SYSTEM (SELF-REGULATING CABLE)**

- .1 Copper heating cables with semi-conductive core fluoropolymer jacket, copper shield and polyolefin outer jacket. Cold leads of adequate length for each cable set so entire heated length is in concrete section to be heated. Raychem Electromelt EM2-XR.

- .2 Automatic snow detector, controller, and contactors to switch cable sets, also air temperature thermostat, and "test/off/auto" switch to control each system. Complete with kits of same manufacture for splices, seals and power connections.
- .3 Cast junction boxes for connection of heating cables to power supply from panel. Heat shrink sleeves for watertight connections.
- .4 Thermostat: Rated 20 A, 120 V, suitable for outdoor ambient monitoring. Enclosure die-cast aluminum EEMAC 4, watertight and dusttight with threaded conduit hub. Set point +3°C with a minimum adjustment of 6°C above and 3°C below setpoint.
- .5 Snow sensor, 20 A, 120 V with EEMAC 4 enclosure for electrical wiring and relay, arranged for mounting on vertical conduit.
- .6 Acceptable Manufacturer:
 - .1 Raychem, Electromelt System

2.33 **SNOW MELTING SYSTEM (MI CABLE)**

- .1 Heating cables type MI with polyethylene jacket. Cold leads, jacketed, of adequate length for each cable set so entire heated length is in concrete section to be heated.
- .2 Control panel: 120 V AC supply, two-pole contactor, hold-on timer, bypass switch for manual control and status indicators.
- .3 Heat shrink sleeves for watertight connections.
- .4 Slab sensing thermostat.
- .5 Snow sensor arranged for mounting on vertical conduit with integral ambient thermostat.
- .6 Acceptable Manufacturer
 - .1 Pyrotenax: Slab sensing thermostat model 4688-WP, control panel model APS-3 and slab sensing thermostat model 4688-WP.

2.34 **ICE MELTING CABLE SYSTEM**

- .1 System comprises ice melting cable, junction boxes, downspout hangers, heat shrinkable tubes, end seals and thermostat.
- .2 Ice melting cable: Self regulating cable rated ten watts per foot when it contacts ice and five watts per foot in air, 120 volt power supply.
- .3 Junction boxes: Steel, EEMAC type 4 or cast steel fittings.
- .4 Thermostat: 4.5°F (40°F) setpoint, rated 120V, 22A, EEMAC 4x enclosure, three foot capillary tube.
- .5 Acceptable Manufacturers
 - .1 Ice melting cable: Raychem type GM-1X
 - .2 Downspout hangers: Raychem type GMK-DH
 - .3 Thermostat: Raychem type AMC-F5

2.35 **HEAT TRACING CABLE**

- .1 120 volt copper heat tracing cables for installation (inside) (and) (on exterior of) pipes complete with line voltage thermostat with remote sensor and capillary.

- .2 Acceptable Manufacturers:

- .1 Thermon
- .2 Raychem
- .3 Pyrotenax

2.36 **PLYWOOD BACKBOARDS**

- .1 Plywood backboards, good one side, 1220 mm x 2440 mm x 19 mm 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.

2.37 **FINISH**

- .1 Equipment enclosure finish: Baked grey enamel, ANSI 49 or ANSI 61.

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
.1 Lighting branch circuit where connection to luminaire is AC90 cable	T90 nylon
.2 Receptacle branch circuit	T90 nylon
.3 Ceiling boxes to luminaires in suspended ceiling	T90 nylon or AC90 cable
.4 Wiring under raised floor used as plenum	AC90 cable or wire in flexible metal conduit
.5 Wiring inside high temperature equipment	TEW or SEW-2
.6 Branch circuits other than those covered above	RW90
.7 Equipment feeders, circuits	RW90
.8 Underground and under slab raceways, duct banks, direct burial	RWU90

- .4 Type AC90 cable length limitations:

- .1 Ceiling box to luminaire: 1.2 m maximum in non-accessible ceilings;
1.8 m in accessible ceilings
- .2 Junction box to outlet: 3.6 m maximum
- .5 Load current limitations:
 - .1 Conductors rated for more than 90°C: 90°C (194°F) code ampacity rating
 - .2 Motor connection: 75°C (167°F) 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 three 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 **MOTOR LEAD CONNECTION KITS, 5000 VOLT**

- .1 Install motor lead connection kits for 4000 V motors.

3.6 **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 1.5 m 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 (167°F) 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.

3.7 **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 |
|----|---|--|
| .1 | Corrosive areas | rigid steel corrosion resistant coated |
| .2 | Hazardous areas | rigid steel |
| .3 | Outdoor areas | rigid steel |
| .4 | Embedded in concrete,
other than grade slab | rigid steel (PVC) |
| .5 | In or below grade slab | PVC |
| .6 | Exposed in unfinished areas up to
3 m above finished floor. Use
EMT above 3 m | rigid steel |

- .7 Connection to motors and equipment subject to vibration liquid tight flexible steel conduit
- .8 Final connection to dry type transformer flexible steel conduit
- .9 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 ninety degree 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.

3.8 **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.

3.9 **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 1.5 m 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.

3.10 **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.

3.11 **SURFACE RACEWAYS**

.1 Install per manufacturer's recommendations.

3.12 **CELLULAR FLOOR SYSTEM**

.1 Install trench duct, preset inserts and activation kits including activation power and data receptacles and telephone jack outlets.

.2 Tack weld trench duct to non-cellular decking, and tack weld trench duct void closures.

.3 Seal voids at preset inserts, cellular raceway butt joints and void closures with sealing compound.

3.13 **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 two-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.

3.14 **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.

3.15 **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.

3.16 **TERMINAL BLOCKS - SURGE SUPPRESSION**

- .1 Install surge suppression terminal blocks.

3.17 **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.

3.18 **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.

3.19 **MASONRY BOXES**

- .1 In block walls use deep boxes to provide clear space around knockout for AC90 cable entry.

3.20 **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
.1	Gypsum board, plaster or panelled	(white) (ivory) (brown)
.2	Office	(white) (ivory) (brown)
.3	Factory, service	brown (ivory)

3.21 **WIRING DEVICES - DIMMER SWITCHES**

- .1 Install each dimmer switch in outlet box at locations indicated.
- .2 Mount dimmer switches at height indicated.

3.22 **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
.1	Gypsum board, plaster or panelled	(white) (ivory) (brown)
.2	Office	(white) (ivory) (brown)

.3 Factory, service, exterior brown

3.23 **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
.1 Gypsum board, plaster or panelled	stainless steel (nylon) (white) (ivory)
.2 Factory, service	galvanized steel
.3 Exterior	cast cover

3.24 **WELDING RECEPTACLES**

- .1 Install welding receptacles.
- .2 Ensure that phase rotation is similar for all receptacles.

3.25 **CONTROL DEVICES**

- .1 Install as indicated.

3.26 **SNOW MELTING SYSTEM (SELF-REGULATING CABLE OR MI CABLE)**

- .1 Install cables.
- .2 Where not embedded in concrete, waterproof in-line splices may be used for connections to cold leads. Use heat shrink sleeves or other appropriate method to waterproof splices. Where cables are embedded in concrete, extend heating cables from slab to junction box. Splice to cold leads in junction boxes.
- .3 Secure cables in place with cable straps supplied by cable manufacturer. Maintain indicated spacing.
- .4 Install thermostat sensor, clear of cable, to sense slab temperature.
- .5 Install snow sensor in exposed location on roof well clear of any projection which could obstruct deposit of snow in collector. Mount sensor 600 mm above roof deck.

3.27 **ICE MELTING CABLE SYSTEM**

- .1 Install junction boxes, in suitable protected location, adjacent to start of each ice melting cable installation. Install ice melting cables along complete length of roof drains and downspouts. Install cable end seals at cable terminations at bottom of downspouts. Install downspout hangers where cable enters downspouts and roof drains.
- .2 Install thermostat in electrical room. Extend capillary through exterior wall, provide clamp on outside wall surface to hold coiled capillary with probe clear of wall. Seal wall penetration.

3.28 **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.

3.29 **PLYWOOD BACKBOARDS**

- .1 Install plywood backboards.

3.30 **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 one 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 one coat of CAN/CGSB-1.40-M zinc chromate primer.

End of Section

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- 1 General
 - 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
 - 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 cover plates.
 - .5 Make safe all circuit wiring left for future use.
 - 1.5 **INTERRUPTION OF SERVICES**
 - .1 Obtain Consultant'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.
- 2 Products
 - 2.1 **USE OF EXISTING MATERIAL AND EQUIPMENT**
 - .1 Unless noted otherwise, existing panels, boxes and wiring materials may be reused if acceptable to inspection authority.
 - .2 Unless noted otherwise, provide additional equipment of same type and manufacture to supplement existing equipment.
 - .3 Reused luminaires: Furnish new lamps.

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 Consultant'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 Consultant'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 ten 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, to Consultant, prior to drilling.
- .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.

End of Section

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- 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.
- 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

	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 **BUSWAY 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 Laminated plastic, black letters on white background, 75 mm character height.
 - .3 Suspended sign, rigid vinyl, black on yellow, 75 mm character height.
 - .1 Acceptable Manufacturers
 - .1 Panduit
 - .2 Safety Supply Canada
 - .4 Typical identification: "12-1-1, 600A, 3P, 4W".

2.5 **PANELBOARD IDENTIFICATION**

- .1 Engraved laminated plastic, black lettering on white background, 6 mm character height.
- .2 Typical two-line identification for lighting panel:
 - "Lighting Panel C, 120/208V, 3 ph, 4W"
 - "Supplied from panel BB"
- .3 Directories: Typewritten identification of breaker number, ampere rating and connected equipment.

2.6 **SWITCHBOARD IDENTIFICATION**

- .1 Engraved laminated plastic, black lettering on white background, 15 mm minimum character height.
- .2 Typical identification: "Switchboard AAA, 347/600V, 3 ph, 4 w"; for branch feeders "Power Panel B.

2.7 **MOTOR STARTER, CONTACTOR AND DISCONNECT SWITCH IDENTIFICATION**

- .1 Engraved laminated plastic, black lettering on white background, 6 mm character height.

- .2 Typical identification: "Pump S4, 208V, 3 ph".

2.8 **MAGLOCK/FIRE ALARM PULL STATIONS IDENTIFICATION**

- .1 Engraved laminated plastic, red lettering on white background, 25 mm character height.
- .2 Identification: "EMERGENCY EXIT UNLOCKED BY FIRE ALARM OR BY SECURITY SYSTEM".

2.9 **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

2.10 **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.

3 Execution

3.1 **SYSTEMS IDENTIFICATION**

- .1 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 **POWER COMPANY SERVICE IDENTIFICATION**

- .1 Identify service conductors with coloured marker tape as follows:
- .1 Phase A - red
- .2 Phase B - black
- .3 Phase C - blue
- .4 Neutral - white
- .5 Ground - green

3.3 **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.

3.4 **WIRE AND CABLE IDENTIFICATION**

- .1 Cables Bearing Identification Numbers on the Drawings
 - .1 Install identification markers at each end of cable run.
- .2 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.
- .3 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.
- .4 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.
- .5 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 (i.e. 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.

.6 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.

3.5 **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.

3.6 **CABLE TRAY IDENTIFICATION**

- .1 Install markers indicating system, voltage, or voltages for trays with barriers, and identification number at intervals of 20 m maximum, at branches and termination locations.

3.7 **BUSWAY IDENTIFICATION**

- .1 Install stick-on markers indicating busway identification number and rating at cable tap boxes and thereafter at intervals of 30 m maximum.
- .2 Install suspended identification signs at start of run and at intervals of 30 m maximum.

3.8 **PANELBOARD IDENTIFICATION**

- .1 Install identification plates, using adhesive, on outside of panel.
- .2 Install directory.

.3 Identify main bus as follows:

- .1 Phase A - red
- .2 Phase B - black
- .3 Phase C - blue
- .4 Neutral - white
- .5 Ground - green

3.9 **SWITCHBOARD IDENTIFICATION**

.1 Install identification plates for panel and branch feeders.

3.10 **MOTOR STARTER, CONTACTOR AND DISCONNECT SWITCH IDENTIFICATION**

.1 Install identification plates using self-tapping screws.

3.11 **IDENTIFICATION AFTER FINISH PAINTING**

.1 Behind access doors at shaft plenums: identify busways, feeder cables and feeder conduits.

3.12 **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.

3.13 **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

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Canadian Standards Association: CSA

- .1 C22.3 No. 1
.2 C22.2 No. 0.3-M
.3 C22.3 No. 2
.4 C22.2 No. 04-M
.5 C22.2. No. 41

.2 American Society for Testing and Materials: ASTM

.3 National Electric Testing Association Inc.: NETA

1.3 **SUBMITTALS**

- .1 Submit certified test reports in accordance with Section 26 05 01.

2 Products

2.1 **MATERIALS**

- .1 Furnish all materials, instrumentation, etc. required to execute testing and commissioning as specified, including manufacturers testing and commissioning.
- .2 Calibrate test instruments and for each instrument record identifying numbers, date of calibration and percentage of error (if any) on appropriate test reports.
- .3 Furnish megger test instruments as follows:
- | | |
|----------------|-------------------------------|
| Megger Voltage | System Voltage |
| 500 V | up to 250 V (low voltage) |
| 1000 V | 277 V to 1000 V (low voltage) |

3 Execution

3.1 **CO-ORDINATION OF ELECTRICAL PROTECTIVE DEVICES**

- .1 Following receipt of Shop Drawings, obtain from manufacturers time-current curves of all protective devices.
- .2 Coordinate 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 and establish selective coordination throughout the system.

- .3 Prepare a complete set of curves showing time current characteristics for all breakers and fuses from main switchboard main circuit down to 208/120 V panels.

3.2 **PRE-TEST INSPECTION AND CLEANING**

- .1 Check that all dust, debris, surplus materials and tools, have been removed from equipment.
- .2 Inspect all parts of the power distribution systems at each voltage level for completeness, check and set circuit protective devices, fuses, breaker relays, trips, and all ancillary devices in accordance with the reviewed coordination studies, approved drawings and manufacturer's instructions.
- .3 Check phase sequence throughout the systems and application of colour codes to equipment and cables.
- .4 Verify all cable sizes, equipment ratings, trip settings conform to Specifications and coordination study.

3.3 **TESTING GENERAL**

- .1 Test the electrical installation including all safety devices as the Work progresses and on completion.
- .2 Without adjustment to the Contract Price:
 - .1 Repair, rework or replace any equipment, material or workmanship which fails specified tests.
 - .2 Perform such additional tests and re-tests as may be directed by the Consultant and/or Owner's Representative.
- .3 Energize each voltage level of the system immediately after testing is complete.
- .4 In case this is not feasible verify all fuse sizes and trip settings and repeat megger tests of each feeder and equipment with circuit breakers and switches open, immediately before energization.
- .5 Distribution Panels and Panelboards
 - .1 Check bolted connections bus to bus, and bus to cable lug with torque wrench, to manufacturer's values. Mark with adhesive tape or label when satisfactory.
 - .2 Measure contact resistance on low voltage fusible and non fusible switches, circuit breakers, contactors and auxiliary equipment. Acceptable values:

	Microhms
Low voltage - up to 250 V	500
Low voltage - 277V to 1000V	500
 - .3 Megger test insulation resistance phase to phase and phase to ground of fusible switches, circuit breakers, contactors, buswork, auxiliary equipment. Acceptable values:

	Megohms
Low voltage, up to 250V	1
Low voltage, 277V to 1000 V	50
Duration of each test: one (1) minute	

- .4 Check ground bus and ground path for continuity, and connection to all non-current carrying metalwork. Maximum acceptable reading 0.1 ohms.
- .5 Check for physical faults: Damaged or dirty insulators, alignment of contacts, switchblades, operating mechanism, clearances, barriers, mounting.
- .6 Operate circuit breakers, switches, contactors, three times.
- .7 Operate equipment through design functions, including remote control operation, actuation of alarm and indication devices, mechanical and electrical operation and operation from protective relays.
- .8 Check 600V circuit breakers for trip and target operation. Test long time, short time, instantaneous and ground fault trips. Trip settings shall conform to values selected in the coordination study. Verify pickup and time values. Compare actual trip time with manufacturer's specifications and present in tabular form.
- .9 Balance loads on all panelboards. Use Shop Drawing information for all equipment loads.

3.4 **LOW VOLTAGE SWITCHBOARDS UP TO 1000 VOLT SERVICE**

- .1 Visually inspect components and complete assembly, check wiring and interconnections.

3.5 **LOW VOLTAGE STARTERS, CONTACTORS UP TO 1000 VOLT SERVICE**

- .1 Visually inspect components and the complete assembly.
- .2 Check each contactor and starter for switch or breaker operation, fuse or breaker rating, contactor size and operation, auxiliary contact operation.
- .3 Check starter overloads with motor nameplate ratings.
- .4 Check controls and starters and contactors operation on load.
- .5 Check motor rotation.

3.6 **DISTRIBUTION TRANSFORMERS UP TO 1000 VOLT SERVICE**

- .1 Set taps for nominal voltage output from secondary with initial loads applied.
- .2 Check for clear airflow through enclosure.
- .3 Check that connections are not stressed.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to latest issues, amendments and supplements of following standards:

- .1 CAN3-C155-M - Shunt Capacitors for AC Power Systems
- .2 CSA C9-M - Dry-Type Transformers
- .3 CSA C22.2 No. 4-M - Enclosed Switches
- .4 CSA C22.2 No. 5.1M - Moulded Case Circuit Breakers
- .5 CSA C22.2 No. 27 - Busways
- .6 CSA C22.2 No. 31-M - Switchgear Assemblies
- .7 CSA C22.2 No. 39 - Fuseholder Assemblies
- .8 CSA C22.2 No. 47 - Air-Cooled Transformers (Dry Type)
- .9 CSA C22.2 No. 106-M - HRC Fuses
- .10 NEMA BU1.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less
- .11 ANSI/UL 1449 4th edition - Surge Protective Devices
- .12 ANSI/UL 1283 5th edition - Electromagnetic Interference Filters
- .13 ANSI/IEEE C62.41 - Surge Voltages in Low Voltage AC Power Circuits

2 Products

2.1 **DISTRIBUTION PANELS**

.1 Description

- .1 Distribution panel comprising two basic units: Main circuit breaker and distribution circuit breakers.

.2 Construction

- .1 Steel, indoor, sprinkler proof enclosure, type as specified in Section 26 05 02, dead front, free standing. Suitable for mounting against a wall. Facilities for lifting into position and bolting to floor.
- .2 Provisions for addition of future sections at both ends.

.3 Bus

- .1 All bus, copper.

- .2 Neutral bus, full capacity where indicated.
- .3 Bus short circuit rating: 65 kA, 3 phase, rms, symmetrical, unless indicated on Drawings.
- .4 Ground bus, 6 mm x 25 mm extending full length of switchboard, solderless connector at each end suitable for No. 2/0 AWG copper grounding cable.
- .4 Main Circuit Breaker
 - .1 Circuit breaker, electronic trip, molded case, full function 100% rated where indicated, three-pole, quick make, quick break, trip free, provision for padlocking in off position.
- .5 Distribution Unit
 - .1 Circuit breakers, molded case, standard function 80% rated, three-pole, quick make, quick break, trip free, thermal magnetic or solid state trip elements. Provision for padlocking in "off" position.
 - .2 Spaces to be fully bussed for addition of future breakers.
- .6 Cable Entry
 - .1 Top cable entry through removable aluminum plates.
- .7 Surge protective Device (SPD)
 - .1 SPD with connection to switchboard bus via circuit breaker with features as follows:
 - .1 Hybrid filter consisting of thermally protected metal oxide varistors and a parallel filter circuit.
 - .2 High energy transient voltage suppression, surge current diversion and high frequency attenuation of wave shapes in Category C environment as defined in ANSI/IEEE C62.41.
 - .3 Surge current rating, based on 8 x 20µs wave shape, as follows:
 - .1 Per mode: 125 kA minimum
 - .2 Per phase: 250 kA minimum
 - .4 Filter noise attenuation: 50 dB minimum, normal mode, from 10 kHz to 100 MHz.
 - .5 Normal protection modes: line to line (and line to neutral for four-wire systems). Common protection modes: line to ground (and neutral to ground for four-wire systems).
 - .6 Fusing for each protection mode.
 - .7 Status LED indication of each phase.
 - .8 Trouble light.
 - .9 Auxiliary contact for remote annunciation of system integrity.
 - .10 Transient surge counter.

- .11 UL1449 4th edition and UL1283 5th edition listed, CSA or CUL approved.
- .12 Acceptable manufacturers for SPD
 - .1 Eaton
 - .2 Schneider
 - .3 Siemens
- .13 Electrical parameter monitoring system
- .8 Sub-metering system
- .9 Nameplate
 - .1 Nameplate, engraved laminated plastic, black lettering on white background as follows:
 - .1 Switchboard identification, 15 mm minimum character height
- .10 Finish
 - .1 ANSI 49 light grey enamel finish.
- .11 Acceptable Manufacturers
 - .1 Schneider
 - .2 Siemens
 - .3 Eaton
- 2.2 **PANELBOARDS - CIRCUIT BREAKER TYPE**
 - .1 Panelboards to be product of one manufacturer.
 - .2 Enclosures: Steel, type as specified in Section 26 05 01.
 - .3 Bus: Copper, half capacity ground bar and full or double capacity neutral bar as indicated, braced for interrupting capacity as indicated.
 - .4 Circuit breakers: Bolt-on, quick-make, quick-break, thermal and magnetic trips, trip indicating, trip free handle. Common operating handle on multipole breaker.
 - .5 Integral surge protective device, where indicated, with features as follows:
 - .1 Connection to panelboard bus via circuit breaker.
 - .2 Hybrid filter consisting of thermally protected metal oxide varistors and a parallel filter circuit.
 - .3 High energy transient voltage suppression, surge current diversion and high frequency attenuation of wave shapes in Category B environment as defined in ANSI/IEEE C62.41.
 - .4 Surge current rating, based on 8 x 20µs wave shape, as follows:
 - .1 Per mode: 80 kA minimum
 - .2 Per phase: 160 kA minimum

- .5 Filter noise attenuation: 50 dB minimum, normal mode, from 10 kHz to 100 MHz.
- .6 Normal protection modes: Line to line (and line to neutral for four-wire system).
Common protection modes: Line to ground (and neutral to ground for four-wire system)
- .7 Fusing for each protection mode.
- .8 Status LED indication of each phase.
- .9 UL1449 4th edition and UL1283 5th edition listed, CSA or CUL approved.
- .6 Door: Hinged lockable door.
- .7 Keys: Two keys per panelboard; key panelboards alike.
- .8 In addition to CSA requirements, manufacturer's nameplate to indicate panel withstand fault current.
- .9 Lock-on devices: For circuits supplying continuously operating equipment. Minimum quantity 10% of 15A, 20A and 30A rated breakers.
- .10 Spaces: Fully bussed for future breakers with removable filler plates.
- .11 Breaker arrangement: Locate breakers at specific circuit number locations shown on panelboard schedule sheet.
- .12 Acceptable Manufacturers
 - .1 Schneider
 - .2 Eaton
 - .3 Siemens

2.3 **DRY TYPE TRANSFORMERS - UP TO 600V**

- .1 Dry-type transformers: Type ANN, copper windings, insulation Class H, 150°C rise.
- .2 Enclosure: Steel, sprinkler proof enclosure type as specified in Section 26 05 01.
- .3 Taps: Full capacity four - 2½%, two above and two below normal.
- .4 Impedance: Minimum 3% and maximum 6%.
- .5 Vibration isolators: Internal noise and vibration isolating pads.
- .6 Mounting brackets: Floor and wall standard.
- .7 Acceptable Manufacturers:
 - .1 Eaton
 - .2 Hammond
 - .3 Schneider

2.4 **MANUAL MOTOR STARTERS**

- .1 Enclosure: Steel, sprinkler proof enclosure type as specified in Section 26 05 01.
- .2 Overload relay and heater element in each phase, manual reset.

- .3 Heavy duty type single phase toggle switch, and three phase pushbutton type, quick-make quick-break switching mechanism.
- .4 Pilot light: Heavy duty, transformer, push to test, red.
- .5 Provision for padlocking in OFF position.
- .6 Acceptable Manufacturers:
 - .1 Allen-Bradley
 - .2 Eaton
 - .3 Schneider
 - .4 Siemens

2.5 **MAGNETIC MOTOR STARTERS**

- .1 Enclosure: Steel, sprinkler proof enclosure type as specified in Section 26 05 01.
- .2 NEMA type combination magnetic motor starters, fusible disconnect type with overload relay and heater element in each phase.
- .3 Rating: Minimum size-1.
- .4 Door mounted accessories:
 - .1 Pushbuttons or three-position HOA selector switches, heavy duty oil tight type.
 - .2 Pilot lights: Heavy duty, transformer, press to test, red.
 - .3 Lens colour: Running - red; stopped - green; alarm/malfunction - amber.
- .5 Control transformer: 120V secondary, fused, sized to suit control circuit load plus 50VA.
- .6 Auxiliary contacts: Minimum one spare N/C, one spare N/O interchangeable, in addition to seal-in contact.
- .7 For control voltage from an external source:
 - .1 Provide terminals, covered with hard insulating guard.
 - .2 Apply a lamacoid warning plate on the outside of the starter cover describing the source of outside control power.
- .8 Acceptable Manufacturers:
 - .1 Allen-Bradley
 - .2 Eaton
 - .3 Schneider
 - .4 Siemens

2.6 **CONTACTORS**

- .1 Enclosure: Steel, sprinkler proof enclosure type as specified in Section 26 05 01.
- .2 NEMA type, heavy duty, designed for the application, e.g. lighting contactors for lighting circuits.

- .3 Auxiliary contacts, minimum two N/O and two N/C.
- .4 Control transformer, fused primary and secondary, 120 volt output.
- .5 Hand/Off/Auto (HOA) control selector switch and red pilot light, "press to test" type.
- .6 Acceptable Manufacturers:
 - .1 Allen-Bradley
 - .2 Eaton
 - .3 Schneider
 - .4 Siemens

2.7 **CONTROL STATIONS**

- .1 Pushbutton and selector switches: heavy duty, oiltight.

2.8 **FUSIBLE AND NON FUSIBLE DISCONNECT SWITCHES**

- .1 Enclosure: Steel, sprinkler proof enclosure type as specified in Section 26 05 01.
- .2 Switches: Quick-make, quick-break, heavy duty, short circuit rating 100,000A rms sym. Provision for locking in off position with up to three padlocks.
- .3 Viewing window: For viewing blades.
- .4 Electrical interlock: Mechanically operated from switch mechanism, rated 120 VAC, 15A, one N/O and one N/C contact at non-fusible switches local to motors
- .5 Except as noted otherwise, furnish and install non-fusible safety switches on all electrically powered equipment to isolate equipment from power supply.
- .6 Acceptable Manufacturers:
 - .1 Schneider
 - .2 Eaton
 - .3 Siemens

2.9 **FUSES**

- .1 HRC fuses to CSA C22.2 No. 106-M.
- .2 Time delay fuses as follows:
 - .1 Fuses up to 600V, up to 600A HRCI-J, Form I: Class J Bussman JHC, Gould Shawmut AJT.
 - .2 Fuses above 600A HRC-L, Form I: Class L Bussman KLU, Gould Shawmut A4BT.
- .3 Provide spare fuses of each type and size in use as follows:
 - .1 600A and below: Six.
 - .2 Above 600A: Three.
- .4 Submit a list of spare fuses to Consultant for approval.

2.10 **METERING CABINET**

- .1 Steel enclosure NEMA 1, sprinkler proof, sized 900 mm x 900 mm x 300 mm deep. Code gauge steel complete with hinged door, lock and latch and removable back plate to meet utility requirements.
- .2 Acceptable Manufacturers:
 - .1 Hammond

2.11 **RELAYS**

- .1 Totally enclosed plug-in type relay with four form-C contacts, operating coil to suit required voltage. Complete with mounting socket.
- .2 Acceptable Manufacturers
 - .1 Allen-Bradley
 - .2 Schneider
 - .3 Eaton

2.12 **AC INVERTER SYSTEM**

- .1 Description: Inverter, batteries, battery charger, contactors and controls for supply of emergency AC power to a normally energized load of circuit breaker controls.
- .2 References
 - .1 Comply with:
 - .1 CSA C22.2 No. 107.1-M – Commercial and Industrial Power Supplies
 - .2 ANSI/UL924 – Emergency Lighting and Power Equipment
- .3 Enclosure
 - .1 Steel enclosure type to comply with Section 26 05 01, floor mounting, front lockable doors. Common enclosure for inverter, battery, charger and controls.
 - .2 Finish ASA 61 grey.
- .4 Rating
 - .1 Input: 120 V, single phase, 60 Hz
 - .2 Normal output: 120 V, single phase, 60 Hz
 - .3 Load: facility for normally on loads, size to suit circuit breaker control transformer in main switchboard.
 - .4 Operating time: Thirty minutes with full nameplate capacity rating at end of thirty minutes continuous operation up to end of ten year battery design life expectancy.
- .5 Features
 - .1 Input failure sensing
 - .2 Auto test

- .3 Contactors to transfer from normal to inverter power
- .4 Automatic battery disconnection at low battery voltage
- .5 AC output circuit breaker
- .6 Output voltmeter
- .7 Inverter on/off control switch
- .8 Inverter trip LED
- .9 Manual bypass pushbutton
- .6 Inverter
 - .1 Frequency regulation: $\pm 1\%$
 - .2 Voltage regulation: $\pm 10\%$ for 10-100% load
 - .3 Output: sinusoidal wave form with total harmonic distortion of less than 10%.
- .7 Battery: Sealed, lead calcium gas recombination type, ten year design life expectancy
- .8 Battery charger:
 - .1 Capable of full battery recharge within twenty-four hours of full discharge.
 - .2 Automatic equalize cycle, constant trickle charge
 - .3 Regulation: $\pm 0.5\%$ output for $\pm 10\%$ input variation
 - .4 DC voltmeter and charge rate ammeter.
 - .5 LED indicators for "ON" float and high charge modes.
 - .6 LED indicators common alarm with cut-off switch for AC failure, high battery voltage, low battery voltage and charger failure
- .9 System Diagnostics
 - .1 Diagnostics to provide report to satisfy Ontario Building Code test requirements.
 - .2 Communication port RS485 and interface to provide monthly diagnostic report to Owner's computer.
- .10 Acceptable Manufacturers
 - .1 Lumacell
 - .2 Or accepted equal
- 3 Execution
- 3.1 **GENERAL**
 - .1 Protect equipment from dust, debris, moisture, and physical damage, with sealed envelope of plastic or other impervious material until building is enclosed and cleaned and equipment is energized.

- .2 Protect from condensation by maintaining at suitable temperature above 0°C.
- .3 Finish equipment enclosures to ANSI 49 or ANSI 61, baked grey enamel.

3.2 **PANELBOARDS**

- .1 Locate panelboards, secure, plumb true and square to structure.
- .2 Mounting Methods
 - .1 Exterior walls and interior combustible walls: mount on continuous slotted channel strut with 41 mm clear between back of panel and wall. Where practical, group panelboards on common frame.
 - .2 Interior non-combustible walls: mount against wall.
- .3 Where panelboards are flush mounted, provide three 25 mm empty conduits from each panelboard into ceiling space above.
- .4 Identify load circuits on panel directory complete with name and location.
- .5 Where panelboards are equipped with fused switches, install fuses immediately prior to energization. Record fuse rating on breaker or switch cover.

3.3 **DISTRIBUTION TRANSFORMERS**

- .1 Support from building structure on trapezes or L brackets. Locate to provide free flow of cooling air.
- .2 Loosen isolation pads until no compression is visible.
- .3 Make final connection with flexible metal conduit.
- .4 Leave slack in cables and flexible conduit, to avoid stress on connections.

3.4 **MOTOR CONTROL EQUIPMENT**

- .1 Secure equipment plumb true and square to structure.
- .2 Check nameplate rating of motor to select overload relay heater elements; install heater elements.
- .3 Check operation of starters and correct motor rotation. Coordinate with Mechanical Division.
- .4 Provide plastic covers to exclude dirt and dust until starters are energized.

3.5 **DISCONNECT SWITCHES**

- .1 Install local to equipment on adjacent wall, column, or other suitable mounting surface. Where necessary provide free standing rigid continuous slotted channel strut frame.
- .2 Where mounted on masonry walls, allow minimum of 6 mm clear space between enclosure and masonry wall.

3.6 **FUSES**

- .1 Store fuses in a moisture free location until ready to energize.
- .2 Install fuses immediately prior to energization.

- .3 Prior to acceptance of the Work, clearly mark manufacturer's labels on inside cover of each fusible unit, with ampere rating and catalogue symbol of replacement fuses to be used.

3.7 **METERING CABINET**

- .1 Install cabinet in accordance with utility requirements.

3.8 **AC INVERTER SYSTEM**

- .1 Install AC inverter system
- .2 Commission inverter system under supervision of inverter system and battery system manufacturer's representatives.

End of Section

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 **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.

.3 Submit samples as directed by Consultant for the following luminaire types:

1.3 **REFERENCES**

.1 Refer to the latest issue of the following standards:

.1 CSA C22.2 No. 9-M - General Requirements for Luminaires

.2 CSA C22.2 No. 34-M - Electrode Receptacles, Fittings, and Connectors for Gas Tubes

.3 CSA C22.2 No. 43-M - Lampholders

.4 CSA C22.2 No. 66 - Specialty Transformers

.5 CSA C22.2 No. 74 - Equipment for Use with Electric Discharge Lamps

.6 CSA C22.2 No. 141-M - Unit Equipment for Emergency Lighting

.7 ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

.8 CSA C860 - Performance of Internally Lighted Exit Signs

1.4 **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.

2 Products

2.1 **LUMINAIRES**

- .1 General
 - .1 Furnish luminaires in accordance with CSA C22.2 No. 9.
 - .2 Furnish medium screw base lampholders of nickel or brass in accordance with CSA C22.2 No. 43.
 - .3 Furnish mogul screw base lampholders of porcelain and nickel in accordance with CSA C22.2 No. 43.
 - .4 Furnish lamp bases for gas tube lamps in accordance with CSA C22.2 No. 34.
 - .5 Luminaire finishes shall resist chipping, crazing, discolouration.
 - .6 Luminaires to contain no asbestos.
 - .7 Furnish luminaires with flanges and gaskets to eliminate light leaks.
- .2 Incandescent Luminaires
 - .1 Furnish luminaires with all mounting and installation hardware.
 - .2 Furnish accessories (guards, shields, reflectors, etc.) of the same manufacture as the luminaire.
- .3 Fluorescent Luminaires
 - .1 Fabricate steel luminaires from minimum 22 gauge mild sheet steel with joints securely fastened.
 - .2 Do not use pre-painted steel.
 - .3 Remove sharp edges.
 - .4 Phosphate dip, prime and paint luminaire body, hardware and accessories with two coats of baked enamel, or other finish where indicated, after fabrication.
 - .5 Interior baked enamel finish to have a minimum 88% reflectance and a minimum thickness of 1.2 mils.
 - .6 Where two-level switching is indicated, furnish two ballasts, separately switched, with one ballast connected to the outer lamps and the other ballast connected to the inner lamp(s).
 - .7 Acrylic lens, 100% virgin acrylic, 0.125" nominal thickness, extruded aluminum hinged frame.
- .4 HID Luminaires
 - .1 Rated for operation over a -30°C to +40°C (-22°F to +104°F) ambient temperature range unless otherwise noted in luminaire schedule.
- .5 Exit Light Luminaires
 - .1 Aluminum housing, stencil face, knock-out chevrons, unless otherwise noted in luminaire schedule.
 - .2 150 mm high red letters.
 - .3 Universal ceiling, end-to-wall, surface back-to-wall mounting or recessed mounting if indicated.

- .4 Connection for emergency 12 V source where indicated.
- .5 LED type with diffusing lens.

2.2 **BALLASTS**

.1 Fluorescent

- .1 To CSA C22.2 No. 74.
- .2 Electronic, to operate one or two lamps, integrally mounted in luminaire unless otherwise indicated.
- .3 Rapid start type for normal output lamps unless otherwise indicated.
- .4 Instant start type for high output lamps.
- .5 Totally enclosed containing no polychlorinated biphenyls.
- .6 Rated 60 Hz, voltage as indicated.
- .7 Rated for operation over an ambient temperature range of 10°C to 40°C (50°F to 104°F).
- .8 Maximum case temperature not greater than 25°C (77°F) above ambient temperature.
- .9 Operate at in a frequency range of 25 kHz to 40 kHz.
- .10 Produce no visible flicker.
- .11 Minimum sound rating of Class A.
- .12 Minimum ballast factor of 0.9 unless otherwise noted in luminaire schedule.
- .13 Minimum power factor of 0.95.
- .14 Maximum crest factor of 1.5.
- .15 Maximum input current total harmonic distortion of 15% measured at rated output.
- .16 To withstand line transients as defined by ANSI/IEEE C62.41, Category A.
- .17 Acceptable manufacturers (unless otherwise specified in luminaire schedule):
 - .1 Advance
 - .2 Osram Sylvania
 - .3 Universal

.2 Metal Halide

- .1 To CSA C22.2 No. 66 and CSA C22.2 No. 74.
- .2 Integrally mounted in luminaire unless otherwise indicated.
- .3 Rated 60 Hz, voltage as indicated.

- .4 Two-winding constant wattage isolated winding (CWI) or three-winding magnetic regulator (Mag Reg) type ballast unless otherwise specified in luminaire schedule.
- .5 Lamp wattage regulation to be $\pm 10\%$ maximum for a line voltage variation of $\pm 10\%$ from rated voltage.
- .6 Totally enclosed containing no polychlorinated biphenyls.
- .7 Class 180 insulation.
- .8 Minimum ballast factor of 0.95.
- .9 Minimum power factor of 0.95.
- .10 Maximum crest factor of 1.65 for metal halide and 1.80 for mercury.
- .11 Maximum input current total harmonic distortion of 20% measured at rated output.
- .12 Ballast UL bench top rise temperature code to be suitable for the luminaire in which it is installed.
- .13 Minimum -30°C (-22°F) starting temperature.
- .14 Acceptable manufacturers:
 - .1 General Electric
 - .2 Holophane
 - .3 Universal
 - .4 Advance
- .3 High Pressure Sodium
 - .1 To CSA C22.2 No. 66 and CSA C22.2 No. 74.
 - .2 Integrally mounted in luminaire unless otherwise indicated.
 - .3 Rated 60 Hz, voltage as indicated.
 - .4 Two-winding constant wattage isolated winding (CWI) or three-winding magnetic regulator (Mag Reg) type ballast unless otherwise specified in luminaire schedule.
 - .5 Lamp wattage regulation to be $\pm 10\%$ maximum for a line voltage variation of $\pm 10\%$ from rated voltage.
 - .6 Totally enclosed containing no polychlorinated biphenyls.
 - .7 Class 180 insulation.
 - .8 Minimum ballast factor of 0.95.
 - .9 Minimum power factor of 0.95.
 - .10 Maximum crest factor of 1.65.

- .11 Maximum input current total harmonic distortion of 20% measured at rated output.
- .12 Ballast UL bench top rise temperature code to be suitable for the luminaire in which it is installed.
- .13 Minimum -40°C (-40°F) starting temperature.
- .14 Igniter with an automatic shutdown circuit to de-energize the high voltage pulses when an inoperative or missing lamp is detected.
- .15 Acceptable manufacturers:
 - .1 General Electric
 - .2 Holophane
 - .3 Universal
 - .4 Advance

2.3 LAMPS

.1 Compact Fluorescent

watts	type	base	colour temp (K)	hrs life @ 3hrs per start	initial lumens	CRI
9	twin	single end 2-pin	2700/3500/4100	10,000	580	82
13	twin	single end 2-pin	2700/3500/4100	10,000	800	82
13	twin	single end 2-pin	5000	10,000	785	80
9	dbt twin	single end 2-pin	2700/4100	10,000	525	82
13	dbt twin	single end 2-pin	2700/3000/3500/4100	10,000	810	82
13	dbt twin	single end 4-pin	2700/3000/3500/4100	12,000	900	82
18	dbt twin	single end 2-pin	2700/3000/3500/4100	10,000	1150	82
18	dbt twin	single end 4-pin	2700/3000/3500/4100	12,000	1150	82
26	dbt twin	single end 2-pin	2700/3000/3500/4100	10,000	1710	82
26	dbt twin	single end 4-pin	2700/3000/3500/4100	12,000	1710	82
13	triple	single end 4-pin	2700/3000/3500/4100	12,000	900	82
18	triple	single end 4-pin	2700/3000/3500/4100	12,000	1200	82
26	triple	single end 4-pin	2700/3000/3500/4100	12,000	1710	82
32	triple	single end 4-pin	2700/3000/3500/4100	12,000	2200	82
42	triple	single end 4-pin	2700/3000/3500/4100	12,000	3200	82
57	triple	single end 4-pin	2700/3000/3500/4100/5000	12,000	4300	82
70	triple	single end 4-pin	2700/3000/3500/4100	12,000	5200	82

.2 Fluorescent

watts	type	base	colour temp (K)	hrs life @ 3hrs per start	initial lumens	CRI	length (ins.)	length (mm)
14	T5	Miniature bi-pin	3000/3500/4100/6500	20,000	1350	85	21.6	548
21	T5	Miniature bi-pin	3000/3500/4100/6500	20,000	2100	85	33.4	848
28	T5	Miniature bi-pin	3000/3500/4100/6500	20,000	2900	85	45.2	1148
35	T5	Miniature bi-pin	3000/3500/4100/6500	20,000	3650	85	57.1	1450

24	T5HO	Miniature bi-pin	3000/3500/4100/6500	20,000	2000	85	21.6	548
39	T5HO	Miniature bi-pin	3000/3500/4100/6500	20,000	3500	85	33.4	848
54	T5HO	Miniature bi-pin	3000/3500/4100/6500	25,000	5000	85	45.2	1148
80	T5HO	Miniature bi-pin	3000/3500/4100/6500	20,000	7000	85	57.1	1450
17	T8	medium bi-pin	3000/3500/4100	20,000	1300	75	24	610
17	T8	medium bi-pin	3000/3500/4100	24,000	1350	85	24	610
25	T8	medium bi-pin	3000/3500/4100	20,000	1950	75	36	915
25	T8	medium bi-pin	3000/3500/4100	20,000	2150	85	36	915
28	T8/ES	medium bi-pin	3000/3500	24,000	2725	85	48	1219
28	T8/ES	medium bi-pin	4100/5000	24,000	2750	82	48	1219
32	T8	medium bi-pin	3000/3500/4100	20,000	2800	78	48	1219
32	T8	medium bi-pin	3000/3500/4100	20,000	2950	85	48	1219
32	T8	medium bi-pin	5000	20,000	2650	78	48	1219
32	T8	medium bi-pin	5000	20,000	2800	85	48	1219
32	T8	medium bi-pin	6500	20,000	2700	78	48	1219

.3 Incandescent

watts	type	base	Volts	hrs life	initial lumens
250	T4	Mini-can	130	2,000	5000

.4 Metal Halide Pulse Start

watts	type*	base/burn pos.	clear/coated colour temp.	hrs life @ 10hrs per start	initial lumen s	CRI	protected*
32	ED17-P.S.	Medium base down	coated-3200K	10,000	2400	70	yes
32	ED17-P.S.	Medium base up	coated-3200K	10,000	2400	70	yes
50	BD17-P.S.	Medium universal	clear-3200K	5,000	3900	70	no
50	BD17-P.S.	Medium universal	coated-3200K	5,000	3500	70	no
50	BD17-P.S.	Medium universal	clear-4000K	5,000	3100	75	no
50	BD17-P.S.	Medium universal	coated-4000K	5,000	2900	75	no
50	ED17-P.S.	Medium universal	clear-3500K	10,000	3400	70	yes
50	ED17-P.S.	Medium universal	coated-3500K	10,000	3200	70	yes
70	BD17-P.S.	Medium universal	clear-3200K	12,000	5500	70	no
70	BD17-P.S.	Medium universal	coated-3200K	12,000	5300	70	no
70	BD17-P.S.	Medium universal	clear-4000K	12,000	4700	75	no
70	BD17-P.S.	Medium universal	coated-4000K	12,000	4500	75	no
70	ED17-P.S.	Medium universal	clear-3200K	12,000	5500	70	yes
70	ED17-P.S.	Medium universal	coated-3200K	12,000	5300	70	yes

watts	type*	base/burn pos.	clear/coated colour temp.	hrs life @ 10hrs per start	initial lumen s	CRI	protected*
100	BD17-P.S.	Medium universal	clear-3200K	15,000	9000	70	no
100	BD17-P.S.	Medium universal	coated-3200K	15,000	8500	70	no
100	BD17-P.S.	Medium universal	clear-4000K	15,000	8100	75	no
100	BD17-P.S.	Medium universal	coated-4000K	15,000	7600	75	no
100	ED17-P.S.	Medium universal	clear-3200K	15,000	9000	70	yes
100	ED17-P.S.	Medium universal	coated-3200K	15,000	8500	70	yes
150	BD17-P.S.	Medium universal	clear-3200K	15,000	12500	70	no
150	BD17-P.S.	Medium universal	coated-3200K	15,000	12000	70	no
150	BD17-P.S.	Medium universal	clear-4000K	15,000	11700	75	no
150	BD17-P.S.	Medium universal	coated-4000K	15,000	11200	75	no
150	ED17-P.S.	Medium universal	clear-3500K	15,000	12500	70	yes
150	ED17-P.S.	Medium universal	coated-3500K	15,000	12000	70	yes
175	BD17-P.S.	Medium base up	clear-4000K	15,000	17500	75	no
175	BD17-P.S.	Medium base up	coated-4000K	15,000	16500	75	no
175	BT28-P.S.	EX39 (keyed) base up	clear-4000K	10,000	14400	65	yes
175	ED23.5-P.S.	Mogul base up	clear-3200K	15,000	17000	65	no
175	ED23.5-P.S.	Mogul base up	coated-3200K	15,000	16,000	65	no
175	ED23.5-P.S.	Mogul base up	clear-4000K	15,000	17500	75	no
175	ED23.5-P.S.	Mogul base up	coated-4000K	15,000	16500	75	no
250	BT28-P.S.	EX39 (keyed) base up	clear-4000K	10,000	23000	65	yes
250	ED28-P.S.	Mogul base up	clear-4200K	15,000	23000	65	no
250	ED28-P.S.	Mogul base up	coated-3900K	15,000	21500	65	no
320	ED28-P.S.	Mogul base up	clear-4000K	20,000	31000	65	no
320	ED28-P.S.	Mogul base up	coated-3700K	20,000	30000	70	no
320	ED28-P.S.	Mogul base up	clear-4000K	20,000	34000	65	no
320	ED28-P.S.	Mogul base up	coated-3700K	20,000	33000	70	no
320	ED28-P.S.	EX39 (keyed) base up	coated-3700K	20,000	30600	70	yes
320	ED37-P.S.	EX39 (keyed) base up	clear-4000K	20,000	32000	65	yes
320	ED37-P.S.	EX39 (keyed) base up	coated-3700K	20,000	30500	70	yes
400	ED28-P.S.	Mogul base up	clear-4200K	20,000	44000	65	no
400	ED28-P.S.	Mogul base up	coated-3700K	20,000	42000	70	no
400	ED37-P.S.	Mogul base up	clear-4000K	20,000	41000	65	no
400	ED37-P.S.	Mogul base up	coated-3700K	20,000	40000	70	no

watts	type*	base/burn pos.	clear/coated colour temp.	hrs life @ 10hrs per start	initial lumens	CRI	protected*
400	ED37-P.S.	Mogul base up	clear-4000K	20,000	44000	65	no
400	ED37-P.S.	Mogul base up	coated-3700K	20,000	42000	70	no
400	ED37-P.S.	Mogul base down	clear-4000K	20,000	44000	65	no
400	ED37-P.S.	EX39 (keyed) base up	clear-4000K	20,000	42000	65	yes
400	ED37-P.S.	EX39 (keyed) base up	coated-3700K	20,000	40000	70	yes
750	BT37-P.S.	Mogul base up	clear-4000K	16,000	82000	65	no
750	BT37-P.S.	Mogul base up	coated-3700K	16,000	72000	70	no
1000	BT37-P.S.	Mogul universal-vert.	clear-3900K	12,000	115000	65	no
1000	BT37-P.S.	Mogul universal-horiz.	clear-3900K	9,000	105000	65	no

.5 Metal Halide MR16 Ceramic Lamps

watts	type	base/burn pos.	clear/coated colour temp.	hrs life	initial lumens	CRI	protected
20	MR16	GX10	3000K	12,000	1000	83	yes
35	MR16	GX10	3000K/4000K	10,000/12,000	2200	83/93	yes

.6 Metal Halide "T" Shape Ceramic Lamps

watts	type	base/burn pos.	clear/coated colour temp.	hrs life	initial lumens	CRI	protected
39	T4.5	Bi-Pin G12	3000K	10,000	3400	82	no
70	T6	Bi-Pin G12	3000K	15,000	6200	83	no
70	T6	Bi-Pin G12	4200K	15,000	6400	93	no
150	T6	Bi-Pin G12	3000K	12,000	14000	82	no
150	T6	Bi-Pin G12	4200K	12,000	13000	94	no

.7 High Pressure Sodium Lamps

watts	type	base/burn pos.	clear/coated colour temp.	hrs life	initial lumens	CRI
35	B17	Medium universal	clear-1900K	16,000	2250	22
35	B17	Medium universal	diffuse-1900K	16,000	2150	22
50	B17	Medium universal	clear-1900K	24,000	4000	22
50	B17	Medium universal	diffuse-1900K	24,000	3800	22
50	ED23.5	Mogul universal	clear-1900K	24,000	4000	22
50	ED23.5	Mogul universal	diffuse-1900K	24,000	3800	22
70	B17	Medium universal	clear-1900K	24,000	6400	22
70	B17	Medium universal	diffuse-1900K	24,000	5950	22
70	ED23.5	Mogul universal	clear-1900K	24,000	6400	22
70	ED23.5	Mogul universal	diffuse-1900K	24,000	5950	22
100	B17	Medium universal	clear-2000K	24,000	9500	22
100	B17	Medium universal	diffuse-2000K	24,000	8800	22
100	ED23.5	Mogul universal	clear-2000K	24,000	9500	22
100	ED23.5	Mogul universal	diffuse-2000K	24,000	8800	22

.8 Acceptable lamp manufacturers unless otherwise specified in luminaire schedule:

- .1 General Electric
- .2 Osram Sylvania
- .3 Philips

2.4 **LIGHTING POLES**

- .1 Design poles and arms to withstand wind loading of 160 km/h and gusts of 1.3, without deformation, with designated luminaires installed.
- .2 Furnish poles (square) (round) (octagonal), (tapered) (straight), (steel) (aluminum), finish and colour as shown, designed for mounting on concrete base, height as indicated, complete with base bolt covers, grounding lug, handhole and flush weatherproof cover at base housing fuses and terminal strip.
- .3 Fuseholder, in-line, waterproof, breakaway type with 10 A fuse.
 - .1 Acceptable fuseholder manufacturers:
 - .1 Bussman, Tron fuseholder, HEB series with insulation boot
 - .2 Buchanan/Elastimold, Style 65
 - .3 Gould Shawmut, GEB series with insulating boots

2.5 **EMERGENCY BATTERY UNITS**

- .1 Supply voltage 120 (277) (347) V ac.
- .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 thirty minutes unless otherwise specified in luminaire schedule.
- .4 Battery charger: Solid state, multi-rate, voltage/current regulated, sized to restore battery to full charge in twelve hours.
- .5 Low voltage disconnect: Solid state, modular, operates at 80% battery voltage.
- .6 EEMAC 1 code gauge steel housing unless otherwise specified in luminaire schedule.
- .7 Auxiliary equipment:
 - .1 "AC power ON"
 - .2 "Fast charge" pilot light
 - .3 Voltmeter
 - .4 Test switch
 - .5 Five minute time delay relay
 - .6 Cord and plug (120 V only)
- .8 Lamp heads: Mounted as indicated, 360 degree horizontal and 180 degree vertical adjustment, type and wattage as specified in luminaire schedule.
- .9 Acceptable manufacturers: As specified in luminaire schedule.

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 1220 mm surface or suspended fluorescent luminaires occur in tandem, an 2440 mm 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.

3.2 **INSTALLATION - INDUSTRIAL**

- .1 For industrial luminaires suspended from ceiling outlet boxes, provide 13 mm 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 9.5 mm, no-bolt luminaire studs. Provide special hangers for support of any luminaire which weighs more than 23 kg.

- .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, Ontario Building Code, Electrical Safety Authority (ESA) 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 1.8 m 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.

3.5 **INSTALLATION - POLES**

- .1 Wire down inside of lighting poles with No. 10 AWG RW90 plus No. 10 AWG insulated ground wire and secure to clips. Provide strain relief at the top of the pole so that the weight of the wiring down to the bottom of the pole does not place a strain on the wiring terminations. Install fuse holders and fuses.
- .2 Assemble arms and luminaires securely to pole. Provide lamps in lampholders.
- .3 Erect pole plumb and true on base. Along roadways, orient pole handhole on the side opposite the roadway unless otherwise indicated.
- .4 Connect underground ground wire and pole ground wire at ground lug in pole.
- .5 Leave slack in wires to allow connector and ground wire to be pulled out of handhole 150 mm clear of pole without disconnecting.

3.6 **FLOODLIGHTS**

- .1 Aim floodlights at night to satisfaction of Consultant.
- .2 Provide support from the building structure where floodlights are supported from buildings. Make support and wiring penetrations of the building envelope waterproof.

End of Section

265000_LUMINAIRE SCHEDULE

TYPE	VOLTS	LAMP (QTY)	DESCRIPTION	MFR.TYPE/SERIES
L01	120	LED 3500K, MINIMUM 80 CRI	ROUND LED HIGH BAY LUMINAIRE, SURFACE MOUNT TO UNDERSIDE OF JOIST/TRUSS, 12,000 LUMEN	METALUX UHB LED HIGH BAY or equivalent
L02	120	LED 3500K, MINIMUM 80 CRI	4' LED Wall mount strip light, 160w/lm, 4000lm	Metalux SNLED or equivalent
L03	120	LED 3500K, MINIMUM 80 CRI	2' x 4' LED Recessed Ceiling Panel, 4000lm	Peer Lux PNLV Lithonia CPX Metalux 22FP
L04	120	LED 3500K, MINIMUM 80 CRI	2' x 2' LED Recessed Ceiling Panel, 2000lm	Peer Lux PNLV Lithonia CPX Metalux 22FP
L05	120	LED 2700K, MINIMUM 80 CRI	LED Pendant Mount Architectural, Round 2000lm	
X01	120	LED	Exit Sign, Aluminum Housing, LED, Single Or Double Face, Back-to-Wall, End-to-Wall, pendant or Ceiling Mounted As Shown on Drawings, Green	Lumacell LA Series Beghelli Micra RM Series
X02	120	LED	Exit Sign, Aluminum Housing, LED, Single Or Double Face, Back-to-Wall, End-to-Wall, pendant or Ceiling Mounted As Shown on Drawings, Green Running Man Pictogram, White Housing, C/W battery pack and remote heads	Lumacell LA Series Beghelli Micra RM Series Aimlite RPALW Series
B01	120	6W LED MR16	Emergency Battery Unit, 120 Volt Input, 12 Volt Output, Minimum 100 Watt Capacity For 30 minute for connected load, Enclosed In EEMAC 1 Code Gauge Steel Housing, 10 Year Life, Time Delay Relay, Voltmeter, Two Integral 6 Watt LED MR16 Heads	Lumacell Signature Series LD10 Heads, Lumacell RG12S Series or approved equal

1 General

1.1 **SUMMARY**

.1 Labour, Products, equipment and services necessary to complete the Work of this section including, but not limited to, the following:

.1 Control Devices

.1 Distributed dimming control systems

.2 Central dimming control system

.2 Input Devices

.1 Occupancy, vacancy sensors

.2 Sensor power packs

.3 Daylight sensors

.4 Multi Sensors

.5 Touchscreens

.6 Wallstations

.3 End Devices

.1 Relays

.2 Digital to Analog converters

.3 0-10V to Reverse phase converters

.4 LED drivers

.4 Software and Integration

.1 BMS integration

.2 LAN/VLAN integration

.3 Partition controls

.4 DMX integration

.5 ASCII integration

.6 Programming software

.7 Emergency lighting control (if applicable)

1.2 **REFERENCES**

.1 American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)

.1 C62.41-1991 - Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

.2 ASTM International (ASTM)

- .1 D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.
- .3 Canadian Standards Association (CSA).
 - .1 CSA C22.2 # 14 Industrial Control Equipment
 - .2 CSA C22.2 # 184 Solid-State Lighting Controls
 - .3 CSA C22.2 # 156 Solid-State Speed Controls
- .4 International Electrotechnical Commission.
 - .1 (IEC) 801-2 Electrostatic Discharge Testing Standard.
 - .2 IEC/EN 60669-2-1 Switches for household and similar fixed electrical installations - electronic switches.
- .5 International Organization for Standardization (ISO)
 - .1 9001:2000 – Quality Management Systems.
- .6 National Electrical Manufacturers Association (NEMA)
 - .1 WD1 (R2005) - General Color Requirements for Wiring Devices.
- .7 Underwriters Laboratories, Inc. (UL):
 - .1 489 (2002) - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - .2 508 (1999) - Standard for Industrial Control Equipment.
 - .3 1472 (1996) - Solid-State Dimming Controls.
 - .4 924 (2003) - Emergency Lighting and Power Equipment.
- .8 National Fire Protection Association (NFPA)
 - .1 701 (2004) Standard Methods of Fire Tests for Flame Propagation

1.3 **COORDINATION REQUIREMENTS**

- .1 Coordination
 - .1 Coordinate the placement of lighting control panels
 - .2 Coordinate the placement of sensors, wallstations and other user input devices
 - .3 Coordinate the placement of daylight sensors to achieve optimal daylight dimming
- .2 Prewire meeting: Conducted on-site with lighting control system manufacturers or designated representative prior to commencing work as part of the manufacturer's standard practice and startup services. Manufacturer to review with the installer:
 - .1 Installation of lighting control panels and locations
 - .2 Lighting control network wiring
 - .3 Network IT requirements

- .4 Low voltage wiring requirements
- .5 Lighting control integration requirements
- .6 Lighting control system integration network wiring and connectivity
- .7 Installer responsibilities
- .8 Startup and training schedule and actions

1.4 **SUBMITTALS**

- .1 Submit under provisions of Section 01 33 00.
- .2 Specification Conformance Document: Indicate whether the submitted equipment:
 - .1 Meets specification exactly as stated.
 - .2 Meets specification via an alternate means and indicate the specific methodology used.
- .3 Shop Drawings; include:
 - .1 Load schedule indicating actual connected load, load type, and voltage per circuit, circuits and their respective control zones, circuits that are on emergency, and capacity, phase, and corresponding circuit numbers.
 - .2 Schematic of system.
- .4 Product Data: Catalog specification sheets with performance specifications demonstrating compliance with specified requirements.
- .5 Project Record Documents: Installer to record actual installation location and settings of lighting control panels and components.

1.5 **QUALITY ASSURANCE**

- .1 Manufacturer: Minimum 10 years' experience in manufacture of architectural lighting controls.
- .2 Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
- .3 Central dimming control system:
 - .1 Meets UL, cUL, and/or CSA Standards specifically for the required loads. Provide evidence of compliance upon request.

1.6 **PROJECT CONDITIONS**

- .1 Do not install equipment until following conditions can be maintained in spaces to receive equipment:
 - .1 Ambient temperature: 0° to 40° C (32° to 104° F).
 - .2 Relative humidity: Maximum 90 percent, non-condensing.
 - .3 Lighting control system must be protected from dust and sprays during installation.

1.7 **WARRANTY**

- .1 Provide manufacturer's warranty covering 5 year 100 percent parts to repair and replace defective equipment.
 - .1 Systems that do not provide 100 percent parts at no extra charge for the first 5 years of installation shall not be acceptable.
- .2 Provide manufacturer's additional warranty options to customer where required.
 - .1 Provide warranty options beyond initial 5 year period as an additional purchased service.

1.8 **COMMISSIONING**

- .1 Provide factory-certified field service engineer to a site visit to ensure proper system installation and operation under following parameters:
 - .1 Qualifications for factory-certified field service engineer:
 - .1 Certified by the equipment manufacturer on the system installed.
 - .2 Make a visit upon completion of installation of central dimming control system:
 - .1 Verify connection of power feeds and load circuits.
 - .2 Verify connection Wallstation controls.
 - .3 Verify proper connection iCAN link.
 - .4 Download system panel data to dimming panels.
 - .5 Check dimming panel load types and currents and remove by-pass jumpers.
 - .6 Verify system operation control by control, circuit by circuit.
 - .7 Obtain sign-off on system functions.
 - .8 User to be trained on system operation

1.9 **MAINTENANCE**

- .1 Make ordering spare parts available to end user.
- .2 Make new replacement parts available for minimum of ten years from date of manufacture.
- .3 Provide factory direct technical support hotline.
- .4 Provide on-site service support where required.
- .5 Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits to customer if desired.

1.10 **DELIVERY, STORAGE AND FIELD CONDITIONS**

- .1 Ensure products are delivered as shipped, including pallet assembly and packaging has not been damaged in shipment.
- .2 Store products in a clean, dry location in manufacturers original packaging.
- .3 Store products in an environment that meets products ambient and storage temperature per products specification sheets.

- .4 Store products in an environment that meets products relative humidity of less than 90 percent, non-condensing as outlined on the product specification sheets.

1.11 **SYSTEM DESCRIPTION AND OPERATION**

- .1 The Lighting Control and Automation system as defined under this section covers the following equipment:
 - .1 Distributed dimming control system – Simplified factory assembled dimming and switching solutions that meet typical applications and simplify low voltage wiring to help a space meet the latest IECC, ASHRAE and Title 24 energy codes.
 - .2 Centralized dimming control system – Factory assembled dimming and switching solutions that allow for applications to scale from small to enterprise while providing simplified low voltage wiring to allow for system completion faster. This system includes third party integration and features to simplify complex application designs.
 - .3 Occupancy Sensors – PIR, DT and ULT Auto adjusting, NEMA WD7 compliant occupancy or vacancy sensors.
 - .4 Wallstations – Smart device that are fully programmable, pre-engraved digital pushbutton wallstations and dimmers.
 - .5 Scene Wallstation – Smart device that are fully programmable, pre-engraved digital pushbutton scene wallstations, dimmers and programmable scene buttons.
 - .6 Daylight Photosensor – Smart device that is a multi-zone open loop daylight sensor with two-way active infrared (IR) communications, which can provide dimming control for daylight harvesting.
 - .7 Touchscreens – Full color touchscreen that can be programmed to control any area on the lighting control network. Shall include multiple screens with templates for simplified programming as well as password protected screen locking features.
 - .8 3rd Party Integration – Interface shall be provided to allows for 3rd party integration via serial or Ethernet into the iLumin Plus lighting system using standard ASCII commands
 - .9 BAS Integration – BACnet interface shall be available to allow BAS systems to detect and control area status.
 - .10 Demand Response – OpenADR or other demand response input shall be connected to one or more iLumin Plus panels. The DR signal will trigger a response to the lighting and is fully programmable based on a single area or the entire network.
 - .11 iLumin Plus communication network – iCANnet CANbus wiring using Belden 1502 or 1502P network wire to create the iLumin Plus system lighting control network.
 - .12 2 wire topology free polarity free low voltage network – 18AWG or 14AWG twisted pair wire (purple and purple) is preferred for connecting user interface devices to the iLumin Plus lighting control panels. This simplifies the design, installation and controls allowing the installer and designer to get off the job faster.

- .2 Minimum lighting control performance required, unless local energy code is more stringent.
 - .1 Occupancy/vacancy requirements - Provide occupancy/vacancy sensors as indicated on drawings and sequence of operation.
 - .2 Daylight Zones – Primary sidelit or toplit areas within an enclosed space shall be controlled separately and automatically by a multi-level photocontrol device.
 - .3 Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to dim electric light to the lowest light level.
 - .4 Provide the ability to adjust the high end and low end trim of the dimmers to ensure the lighting automatically provides energy saving even when daylighting calls for full illumination.
 - .5 Provide the ability for the dimmers and the relays to function separately. Systems where the 0-10V dimmers and relays are tied together reduce design capabilities and shall not be acceptable.
 - .6 Provide the ability to provide occupancy status to a Building Automation System.
 - .7 Shall be capable of automatically responding to a Demand Response Signal and adjusting the lighting level. (Required for California Title 24 2013)

2 Products

2.1 **MANUFACTURERS**

- .1 Acceptable Manufacturers:
 - .1 Cooper Lighting Solutions
 - .2 Douglas Controls
- .2 Basis of design product: Cooper iLumin Plus system or subject to compliance and prior approval with specified requirements of this section, one of the following:
 - .1 Cooper iLumin Plus system
 - .2 Douglas Controls
- .3 Substitutions:
 - .1 No substitution will be accepted prior to award of Contract.
 - .2 All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional
 - .3 Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
 - .4 Provide complete engineered shop drawings (including power wiring) with deviations for the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

2.2 **GENERAL**

- .1 Provide system hardware that is designed, tested, manufactured, and warranted by a single manufacturer.

- .2 Architectural Lighting Controls: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0° C (32°F) to 40° C (104°F) and 90 percent non-condensing relative humidity.
- .3 Designed and tested to withstand electrostatic discharges up to 12,000 V without impairment per IEC 801-2.

2.3 **ILUMIN PLUS PANELS**

- .1 Mechanical:
 - .1 Meets UL, cUL, and/or CSA Standards specifically for the required loads. Provide evidence of compliance upon request.
 - .2 Delivered and installed as a factory assembled panel listed to UL508.
 - .3 Field wiring accessible from front of panel without need to remove dimmer or relay assemblies or other components.
 - .4 Panels passively cooled via free-convection, unaided by fans or other means.
- .2 Electrical:
 - .1 Electrolytic capacitors to operate under the component manufacturer's maximum temperature rating when device is under fully-loaded conditions in 40° C (104° F) ambient temperature.
 - .2 Design and test dimmers/relays to withstand line-side surges without impairment to performance.
 - .1 Panels: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41 and per IEC 61000-4-5 surge requirements.
 - .2 Other power handling devices: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 200 amps per ANSI/IEEE C62.41.
 - .3 Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.
 - .4 Power failure memory and dimmer/relay recovery:
 - .5 When power is interrupted and subsequently returned, lights will automatically return to same levels (dimmed setting, full on, or off) prior to power interruption.
 - .6 In 3 phase panels loss of power to any phase should not effect operation or control dimmers on any other phase.
- .3 Performance:
 - .1 Shall be UL listed to relevant standards (UL508A, UL916, cULus)
 - .2 Shall be capable of mixed voltages 120/277VAC 50/60Hz
 - .3 Shall be capable of mixed sources including normal and emergency power
 - .4 Shall include a panel SCCR rating of 25kA
 - .5 Shall be capable of providing a mixed module solution panel including relays, dimmers and DALI controls.

- .6 Shall be capable of meeting the latest IECC, ASHRAE and Title 24 energy codes
- .7 Shall support three enclosure sizes
 - .1 Small Enclosure
 - .1 Shall support up to two modules
 - .2 Medium Enclosure
 - .1 Shall support up to four modules and PC connection module
 - .2 Shall include configurations with Ethernet connection to building LAN or VLAN
 - .3 Large Enclosure
 - .1 Shall support up to eight modules and PC connection module
 - .2 Shall include configurations with Ethernet connection to building LAN or VLAN
 - .4 Relay Module: (SCMR1220)
 - .1 Up to 48 relays in large enclosure
 - .2 Each relay module shall support up to twelve 20A fully rated relays
 - .1 Shall include heavy duty 20A @40C relays
 - .3 Rated life of relay: Minimum 1,000,000 cycles.
 - .4 Load switched in manner so that there is no arcing at mechanical contacts when power is applied to and removed from load circuits.
 - .5 Fully rated output continuous duty for inductive, capacitive, and resistive loads.
 - .6 Relay controller shall include the capability for DMX input control with base address
 - .7 Relay controller shall include the capability for DALI input control
 - .8 Relay controller shall include alert dry contact input for hardware override of all relay.
 - .5 Dimmer Module: (SCMH1200)
 - .1 Up to 48 Low Voltage Dimming (0-10V) channels in large enclosure
 - .2 Each dimmer module shall support up to twelve 0-10V channels; Meet following requirements:
 - .3 Capable of controlling any 0-10V source.
 - .4 0-10V dimmers shall include a fail to full output safety feature by default

- .5 Provide isolated 0-10V output signal conforming to IEC 60929.
 - .1 50mA sink current per channel via IEC 60929.
 - .2 50mA source current per channel
- .6 0-10V controller shall include the capability for DALI input control
- .6 DALI: (SCMD4)
 - .1 Up to 16 DALI buses in medium enclosure
 - .2 Each DALI module shall support up to four DALI buses
 - .3 Shall include dedicated test/override buttons for each DALI bus
 - .4 Shall include a separate power supply for each DALI bus
 - .1 Shall provide 16V nominal, 250mA max current per bus
 - .2 Shall support 64 standard DALI devices per bus
 - .5 DALI controller shall include the capability for DMX input control with base address
 - .6 DALI controller shall include the capability for DALI input control
 - .7 DALI controller shall include alert dry contact input for hardware override of all relays
- .7 Ethernet: (EG2)
 - .1 Shall provide a single ethernet port for connection to the building LAN or VLAN
 - .2 Shall be capable of facilitating a LAN or Wi-Fi connection to the iLumin Plus system
 - .3 Shall include an integral web server
 - .4 Shall provide the capability for mobile devices to override the lighting system via scene or channel slider commands
 - .5 Shall provide the capability for 3rd party integration via ASCII control strings
 - .6 Shall provide the capability for bridging the iLumin Plus network across LAN or VLAN connections

2.4 INPUT DEVICES

.1 WALLSTATIONS & TOUCHSCREENS

- .1 Product: DALI Wallstation
 - .1 Electronics:
 - .1 Use 18AWG – 14AWG wiring for low voltage communication to SCMD4 module
 - .2 Functionality:

- .1 Upon button press, LEDs to immediately illuminate.
 - .2 Each button shall be programmable to control any area, scene, channel
 - .3 Color: White
 - .4 Provide color matching faceplates with concealed mounting hardware where specified.
 - .5 Engrave wall stations with appropriate button, zone, and scene descriptions as specified.
 - .2 Product: Ineo Wallstation
 - .1 Electronics:
 - .1 Use iCANnet wiring for low voltage communication to ensure reliable data communication in high electrical noise environments.
 - .2 Functionality:
 - .1 Upon button press, LEDs to immediately illuminate.
 - .2 Each button shall be programmable to control any area, scene, channel
 - .3 Color: White
 - .4 Provide color matching faceplates with concealed mounting hardware where specified.
 - .5 Engrave wall stations with appropriate button, zone, and scene descriptions as specified.
 - .3 Product: [TSC-30]
 - .1 Communication: iCANnet protocol.
 - .2 Power: From the 9V external power supply (included)
 - .3 Connections: Five (5) wires Belden 1502 or 1502P
 - .4 Mounting: Wallbox (included)
 - .5 VGA 320x240 pixel resolution, 65,000 colors available
 - .6 3.5" diagonal backlit LCD touchscreen
 - .7 Shall allow up to 250 pages to be stored in memory
 - .8 Groups: The set of fixtures controlled by a given touchscreen shall be completely configurable through software and can span entire iLumin Plus network.
 - .9 Shall support individual zone level adjustment and save scene controls
- .2 ADDRESSABLE MULTI-SENSOR
 - .1 Product: [MST-6], [MTS-12],

- .1 Communication: DALI protocol.
 - .2 Power: From the DALI bus.
 - .3 Maximum Current Draw: 3.75 mA.
 - .4 Connections: Two (2) wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to the DALI communication bus.
 - .5 Sensing Technologies: Occupancy, daylight and temperature.
 - .6 Daylight Sensing Range: 0-400 lux.
 - .7 Daylight Sensing Coverage: Light input within 60° cone.
 - .8 Occupancy Detection Technology: Passive infrared.
 - .9 Occupancy Detection Coverage Area: 600 sq. ft. or 1,200 sq. ft.
 - .10 Occupancy Detection Angle: 360°.
 - .11 Mounting: Junction box or ceiling tile.
 - .12 Groups: The set of fixtures controlled by a given multi-sensor shall be completely configurable through software and can span iLumin Plus network.
 - .13 Timers: All times shall be configurable through the web software and shall not require any manual configuration of settings prior to installation. Timer values can range from 1 second to 24 hours
 - .14 Shall be capable of occupancy forwarding to send occupancy status to other areas within the system
- .2 Product: [NC3-C]
- .1 Communication: iCANnet protocol.
 - .2 Power: From the iCANnet bus.
 - .3 Connections: Five (5) wires Belden 1502 or 1502P
 - .4 Sensing Technologies: Occupancy, daylight
 - .5 Daylight Sensing Range: 0-400 lux.
 - .6 Daylight Sensing Coverage: Light input within 60° cone.
 - .7 Occupancy Detection Technology: Passive infrared.
 - .8 Occupancy Detection Coverage Area: 250 sq. ft.
 - .9 Occupancy Detection Angle: 360°.
 - .10 Mounting: ceiling tile.
 - .11 Groups: The set of fixtures controlled by a given multi-sensor shall be completely configurable through software and can span entire iLumin Plus network.

- .12 Timers: All times shall be configurable through the web software and shall not require any manual configuration of settings prior to installation. Timer values can range from 1 second to 24 hours
- .13 Shall be capable of occupancy forwarding to send occupancy status to other areas within the system
- .14 Capable of sending a command to turn HVAC on and off
- .3 ADDRESSABLE SENSOR POWERPACK
 - .1 Product: [FLT-SP-MV-DC2], [FLT-SP-MV-DC1], [FLT-SP-347-DC2], [FLT-SP-347-DC1], [FLT-SP-240-DC2], [FLT-SP-24-DC1]
 - .1 Communication: DALI protocol.
 - .2 Power: 347VAC.
 - .3 Maximum Current Draw: 2 mA.
 - .4 Maximum number of sensors: Up to five (5) PIR or DT sensors are connected and report to the system as a single addresss.
 - .5 Connections: Two (2) wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to the DALI communication bus.
 - .6 Sensor connections: Five (5) wires (16/18AWG, FT6, non-twisted,non-shielded, non-polarized and plenum rated) connected to sensor for controls and addressing
- .4 CEILING MOUNTED SENSORS
 - .1 Product: [OAC-DT-2000-R], [OAC-DT-1000-R], [OAC-P-1500-R], [OAC-U-2000-R]
 - .1 Provide all necessary mounting hardware and instructions.
 - .2 Sensors shall be Class 2 devices.
 - .3 Connect up to five (5) sensor to the DALI Powerpack for power and signal back to the iLumin Plus system
 - .4 Device calibration and features:
 - .1 Sensitivity – 0-100% in 10% increments.
 - .2 Time delay – 1-30, self-adjusts to 10 min based on room occupancy.
 - .3 Test mode – Fifteen second time delay.
 - .4 Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - .5 Walk-through mode.
 - .6 Ultrasonic and Dual Technology Sensors utilize two independent sensor detection circuits simultaneously to ensure optimum performance, regardless of location or proximity to walls and structures.

- .7 Ultrasonic and Dual Technology Sensors utilize Variable Drive Circuitry (VDC) in cases of over saturation from misapplication, which automatically adjusts the volumetric output without reducing detection capability. Systems that reduce detection coverage area shall not be acceptable.
- .8 Automatically and continually self-adjust ultrasonic frequency to ignore specific frequency, continuous noise from airflow to prevent detuning which can lead to inadvertent lights out. Sensors that require detuning shall not be acceptable.
- .5 Device Status LEDs including:
 - .1 PIR Detection
 - .2 Ultrasonic detection
- .6 Manual override of controlled loads
- .7 Where specified, sensor packaging shall be 100% recycled [made entirely from post-consumer waste (100% post-consumer fiber content) as well as, 100% recyclable].
- .8 Sensors shall be RoHS compliant.
- .5 WALL/CORNER MOUNTED SENSORS
 - .1 Product: [OAWC-P-120W-R], [OAWC-P-009L-H-R], [OAWC-DT-120W-R],
 - .1 Provide all necessary mounting hardware and instructions.
 - .2 Sensors shall be Class 2 devices.
 - .3 Connect up to five (5) sensor to the DALI Powerpack for power and signal back to the iLumin Plus system
 - .4 Device calibration and features:
 - .1 Sensitivity – 0-100% in 10% increments.
 - .2 Time delay – 1-30, self-adjusts to 10 min. based on room occupancy.
 - .3 Test Mode – Fifteen second time delay.
 - .4 Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - .5 Walk-Through Mode.
 - .6 Automatically and continually self-adjust ultrasonic frequency to ignore specific frequency continuous noise from airflow to prevent detuning which can lead to inadvertent lights out. Sensors that require detuning shall not be acceptable.
 - .5 Device Status LEDs including:

- .1 PIR Detection
- .2 Ultrasonic detection
- .6 Manual override of controlled loads.
- .7 Where specified, sensor packaging shall be 100% recycled [made entirely from post-consumer waste (100% post-consumer fiber content) as well as, 100% recyclable].
- .8 Sensors shall be RoHS compliant.

2.5 **END DEVICES**

.1 **ADDRESSABLE RELAYS AND DRIVERS**

- .1 Product: [FLT-DAC-DALI-DC1], [FLT-DAC-DALI-DC2]
 - .1 0-10V Addressable Dimming Modules
 - .2 Communication: DALI protocol.
 - .3 Power: From the DALI bus.
 - .4 Maximum Current Draw: 3.75 mA.
 - .5 Communication Connections: Two wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to the DALI communication bus.
 - .6 Power Ratings: Up to 4A Ballast 120/277/347 VAC.
 - .7 Dimming Control: 0-10V, 50 mA max current sink.
 - .8 Mounting: Fixture or conduit (90° elbow and mounting clips included).
 - .9 UL 924 Listed component.
- .2 Product: [FLT-HPRS-DALI]
 - .1 Communication: DALI protocol.
 - .2 Power: From the DALI bus.
 - .3 Maximum Current Draw: 3.75 mA.
 - .4 Enclosure: Standard outlet box or NEMA 250, Type 1, unless otherwise indicated.
 - .5 Communication Connections: Two (2) wires (16/18AWG, FT6, non-twisted,
 - .6 non-shielded, non-polarized and plenum rated) connected to the DALI communication bus.
 - .7 Power Ratings: Up to 20 A at 347 VAC.
 - .8 Field relays shall be capable of controlling plug loads.
 - .9 Mounting: Junction box.

2.6 **INTEGRATION AND ACCESSORIES**

.1 BAS INTEGRATION

.1 Product: [FPA-W34-1130] BMSPro 2 - BACnet Interface

- .1 The iLumin Plus network shall permit data protocol translation through a building automation interface Gateway. The BACnet Gateway shall permit BACnet communication protocol to operate individual areas, scenes or channels and read the status. The iLumin Plus network shall respond efficiently to the requested information from the BACnet network.
- .2 The BMSPro2 provides up to 10,000 points of control and can communicate to multiple panel types.
- .3 The BMSPro 2 requires a dedicated EG2 interface for connectivity either installed in an iLumin Plus panel or as a separate accessory.
- .4 Provide PIC list definition and object model to other system manufacturers.

.2 LAN/VLAN INTEGRATION

.1 Product: [EG2-NA] Ethernet Gateway

- .1 Shall provide a single ethernet port for connection to the building LAN or VLAN
- .2 Shall be capable of facilitating a LAN or Wi-Fi connection to the iLumin Plus system
- .3 Shall include an integral web server
- .4 Shall provide the capability for mobile devices to override the lighting system via scene or channel slider commands
- .5 Shall provide the capability for 3rd party integration via ASCII control strings
- .6 Shall provide the capability for bridging the iLumin Plus network across LAN or VLAN connections
- .7 Provide ability for bi-direction communication by means of Ethernet communication to system by means of user-supplied PC, digital audiovisual, or BAS equipment. Control to be located on the same Local Area Network.
- .8 Allow for custom communication command strings to be entered in to software to allow lighting control system to control other devices

.3 SERIAL INTEGRATION

.1 Product: [SI-2-NA] RS232 Interface

- .1 Communication: iCANnet protocol.
- .2 Power: From the iCANnet bus.
- .3 Connections: Five (5) wires Belden 1502 or 1502P
- .4 Mounting: Junction box

- .5 Provide ability for bi-direction communication by means of RS232 serial communication to system by means of user-supplied PC, digital audiovisual, or BMS equipment. Control to be located within 50 feet (15 meters) of RS232 source.
- .6 Allow for custom RS-232 command strings to be entered in to software to allow lighting control system to control any other device
- .4 PARTITION CONTROL;
 - .1 Product: [UIG-NA], [UIM-NA]
 - .1 Communication: iCANnet protocol.
 - .2 Power: From the iCANnet bus.
 - .3 Connections: Five (5) wires Belden 1502 or 1502P
 - .4 Inputs: Four (4) digitally optically isolated inputs
 - .5 Mounting: Junction box
 - .6 partitioning: Shall provide partitioning and room join capabilities using either a button press, input, or IR wall partition sensors
 - .7 Low Voltage Input: Shall provide the capability for contact closures to integrate between lighting controls and other systems.
 - .1 The contact closure input device will accept both momentary and maintained contact closures.
 - .2 Product: [IRTR]
 - .1 Infrared Transmitter & Receiver
 - .2 Provide the ability to sense the presence or absence of partitions.
 - .3 Requires the connection to a UIG-2-NA or UIM-NA
- .5 NETWORK ACCESSORIES
 - .1 Product: [LCNJ]
 - .1 Communication: iCANnet protocol.
 - .2 Power: From the iCANnet bus.
 - .3 Connections: Five (5) wires Belden 1502 or 1502P
 - .4 Mounting: Junction box
 - .5 Shall allow direct access to the iLumin lighting control network while in the space being modified.
 - .2 Product: [BN-2-NA]
 - .1 Network Bridge

- .2 Communication: iCANnet protocol.
- .3 Power: From the iCANnet bus.
- .4 Connections: Five (5) wires Belden 1502 or 1502P
- .5 Mounting: Junction box
- .6 Shall allow the network to extend more than 1000m/3200 feet.
- .7 Shall permit the connection of multiple networks allowing up to 65,000 devices on one system.

2.7 SOFTWARE

.1 ICANsoft Suite

.1 Product: [SW-2]

- .1 Software shall support multiple functions to setup entire enterprise iLumin Plus system
 - .1 DALI addressing tool
 - .2 Device editor for system programming and scheduling
 - .3 iCANsoft editor for system programming and scheduling
 - .4 Smartphone configuration tool for mobile applications
 - .5 Touchscreen configuration tool
 - .6 Panel editor for floor plan control
- .2 Software shall support multiple diagnostic tools for troubleshooting the iLumin Plus system
 - .1 Network monitor
 - .2 Flash tool for updating system device firmware
 - .3 Device simulator
- .3 Shall include with user-friendly software suitable for operation on computer workstations which serve as central control stations for the selection and operation of lighting scenes
- .4 Clients shall interface with the software via Eaton Lighting Systems iCANsoft application

.2 Execution

2.8 INSTALLATION

- .1 Install equipment in accordance with manufacturer's installation instructions.
- .2 Provide complete installation of system in accordance with Contract Documents.
- .3 Define each dimmer's/relay's load type, assign each load to a zone, and set control functions.

- .4 Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- .5 100 digital devices (Source Controllers, User Interfaces, etc) may reside on a single network segment with a network length not to exceed 3000 feet. Additional network segments shall be accomplished by the employment of a network bridge up to 65000 devices. Network segments shall be terminated at the end of each segment.
- .6 Devices to be connected via Daisy Chain topology.
- .7 Network wire recommended is Belden#1502R or 1502P (plenum) or similar. Wire shall meet color code requirements to insure proper installation of the network polarity.
- .8 All panels are "masters" and may be added to the network in any location and any amount as long as network installation guidelines are met.
- .9 Panels are designed to function independently from external control devices.

End of Section

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IDEN. No	AREA	CONTROLS	SEQUENCE
1	Corridors	Local low voltage switches Occupancy sensors Low voltage relays Time of day schedule	ON: 50% by time of day schedule; remaining 50% by occupancy sensor when space is occupied ADJUST: Reduced to 50% when space is not occupied, increased to 100% when occupied OFF: by time of day schedule OVERRIDE: local manual switches to override ON when scheduled OFF
2	Washrooms; Janitor Room	Local low voltage switches Low voltage relays Vacancy sensors	ON: manual by local switches OFF: vacancy sensors
3	Private Offices	Local dimming type wall switch sensor or vacancy sensor & dimming switch as indicated on drawings Photocells where Primary and/or Secondary sidelighting is available Low voltage relay	ON: 100% manual by local wall dimmers/dimming sensor ADJUST: Local dimmer; photocell where daylighting is available OFF: vacancy sensor
4	Open Offices; Copy/Print Rooms	Local dimming switches preset for 50% ON, 100% ON, OFF (no additional manual adjustment) Photocells where Primary and/or Secondary sidelighting is available Vacancy sensor Low voltage relays	ON: manual by local dimming switches ADJUST: Local dimmer (2 levels only); photocell where daylighting is available OFF: by switch or vacancy sensor
5	Meeting Rooms, Conference Rooms, Multipurpose rooms	Local dimming switches Photocells where Primary and/or Secondary sidelighting is available Vacancy sensor Low voltage relays	ON: manual by local dimmer switches ADJUST: Local dimmers; photocell where daylighting is available OFF: vacancy sensor, and manual override by local dimmer switches
6	Mechanical, Electrical, Comms. Rooms	Local low voltage switch Low voltage relay	ON: Manual by local control OFF: Manual by local control or schedule
7	Lobby, Vestibule	Local low voltage switch Occupancy sensor Photocell where daylighting is available Low voltage relays Time of day schedule	ON: 50% Auto on by schedule; remaining 50% by occupancy sensor when space is occupied ADJUST: Dimmed to 50% by occupancy sensor when not occupied; dimmed by photocell in response to daylighting OFF: time of day schedule OVERRIDE: local manual switch to override ON when scheduled OFF
8	Storage up to 1000 sq ft	Local wall switch or sensor switch Vacancy sensors Low voltage relays	ON: Manual on using local switch; OFF: Auto off using vacancy sensors when space is not occupied
9	Exterior	photocell Low voltage relays time-of-day schedule	ON/OFF: by time of day schedule and photocell REDUCE: dimmed by time of day schedule

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- 1 General
- 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- 1.2 **ALTERNATE PRODUCTS**
 - .1 Submit a Tender Bid based on the use of Products indicated as base system Products.
 - .2 Voluntarily submit an alternative Bid based on the use of Products indicated as alternative Products. Indicate in the Bid Form, the change in Bid Price by the use of alternative Products. By submitting a Bid based on alternative Products the Bidder accepts responsibility for coordination and interferences that may arise from their use.
- 1.3 **SYSTEM DESCRIPTION**
 - .1 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 Open Hook Hangers
 - .1 Open hook hangers (J hooks) permitted only where expressly indicated.
 - .2 Open hook hangers (J hooks) only of the type expressly indicated.
 - .3 Cable Retention Wraps
 - .1 Cable retention wraps permitted only of the type and where expressly indicated.
 - .2 Cable retention wraps permitted only of the type indicated.
 - .3 Hard nylon cable retention wraps (Tiewrap™) or like Products not permitted as communications cable retainers nor permitted to be in direct contact with cable jacket.
 - .4 Pathways – Conduits
 - .1 Comply with Section 26 05 01.
 - .2 Metallic and non-metallic conduit and cable tray to TIA 569.
 - .3 Flexible conduits at building expansion joints, connections from overhead pull-boxes to furniture access poles, and between wall pass-through boxes and modular systems furniture assemblies.
 - .4 Flexible liquid-tight metallic conduit for isolation and protection of communications cables between outlet boxes and enclosed raceways installed below access floors in areas not designated as a computer room.
 - .5 Pathways – Conduit Device Boxes
 - .1 Comply with Section 26 05 01.
 - .2 Metallic and non-metallic device boxes to TIA 569.
 - .3 Device boxes of sufficient depth and width to prevent cable curvature in breach of manufacturer's specification for bending radius.
 - .4 Device boxes of sufficient capacity to permit storage of cable working allowance without interference to outlets and terminations.

- .6 Pathways – Cable Tray and Cable Runway
 - .1 Overhead cable tray in telecommunications rooms and computer rooms where indicated.
 - .2 Overhead cable runway in finished and unfinished areas where indicated.
 - .3 Under floor cable tray in finished areas with access floor where indicated.
- .7 Pathways – Ducts
 - .1 Underground and buried duct conduit and services to TIA 569.
 - .2 Ducts installed complete with flexible inner-duct sleeving and marked mule tape.
- .8 Grounding and Bonding
 - .1 Comply with CSA C22.1.
 - .2 Grounding and bonding to TIA 607.
 - .3 Comply with Telcordia GR-295-CORE
 - .4 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.
 - .3 Main technical grounding bus bar(s).
 - .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.
 - .5 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 Electrical enclosures with the exception of computer and communications equipment cabinets bonded to electrical safety ground
 - .4 Grounding conductors in buried telecommunications ducts bonded to electrical safety ground.

.6 Pathways

- .1 Communications cable tray, cable runway, bonded to electrical safety ground through continuous minimum 10 AWG copper conductor. Bonding at intervals of 2440 mm or less.

.9 Submittals

- .1 Comply with Section 01 33 00.

- .2 Affix Engineer's seal or RCDD stamp of qualified persons identified herein to all submissions tendered under this division of the work to indicate work submitted has been reviewed by the qualified person. The indicated engineer seal or RCDD stamp in addition to seal or stamp required under provincial law.

- .3 Submit the following:

- .1 Prepare and submit detailed and dimensioned drawings to describe and illustrate coordination of overhead communications systems, including but not limited to:

- .1 Overhead support grid and suspension.
- .2 Overhead cable tray.
- .3 Overhead cable runway.
- .4 Insulators.
- .5 Top of equipment cabinets, frames and racks.
- .6 Exhaust air containment ducts, flexible and rigid.
- .7 Ceiling mounted AC units.
- .8 Lighting fixtures.
- .9 Overhead power distribution cables.
- .10 Overhead power distribution busway.
- .11 Overhead power tap boxes.
- .12 Overhead optical fibre cable troughs and down drops.
- .13 Overhead patch panels.
- .14 Cable entry cable chimney to equipment cabinets.

- .2 Shop Drawings

- .1 Submit Shop Drawings for 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.

- .4 Working, progress and constructed drawings

- .1 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.

.2 "As-Constructed" 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

.3 Flat ASCII text file in CSV format

.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 ten days following submitting a claim for Substantial Performance.

.5 Test reports

.1 Submit test reports within three days of testing.

.6 Manuals

.1 Submit Operating and Maintenance Manuals.

1.4 **TENDER SUBMISSIONS**

.1 Tender submissions from pre-qualified bidders

.1 Submit a Tender to undertake work described under this division only if pre-qualified by the Owner.

.2 Tenders to undertake this work will be accepted from other bidders only if accompanied by written approval from the Owner to have Tender Bid considered.

.2 Tender submissions from bidders at large

- .1 Submit a Tender to undertake work described under this division only if:
 - .1 Fully qualified and certified to undertake the work by the manufacturer(s) of the Product(s) proposed in the Tender;
 - .2 Compliant with bidder qualifications required and outlined herein below.

1.5 **PRE-AWARD SUBMISSIONS**

- .1 On request of the Owner submit the items listed herein before award of Contract as a condition of award. Failure to comply will be justifiable grounds for cancelling the Contract or disqualification of the bid at the sole discretion of the Owner.
- .2 Submit the following items prior to, or no later than ten working days following, the award of Contract.
 - .1 Personnel
 - .1 Submit a list of personnel who will be directly involved in overseeing the technical interpretation of the work described in the Contract Documents.
 - .2 Submit a list of personnel who will be directly involved in assessing the quality of the work during execution and in ensuring quality standards are upheld.
 - .3 Submit a statement indicating that the Bidder maintains the minimum number of trained installation technicians to comply with the structured cabling system manufacturer's business partner or certified partner program. Provide information on the manufacturer's requirements.
 - .4 Submit a list of trained personnel who will or may be assigned to the Project. Indicate the degree of training each technician has received and whether training was factory training or in-field. Submit for each person named, a record of factory training credentials issued by the named manufacturer(s) stating training curriculum and date of training applicable to the Products identified.
 - .5 Submit for each person named, professional and/or industry recognized credentials endorsing the ability and competency to undertake quality assurance, overseeing and technical guidance of the work.
 - .2 Corporate
 - .1 Submit a list to identify five or more like-sized systems undertaken by the Bidder. Identify the completion date of each. Provide on demand a reference who can and is willing to attest to the quality of the work results for each named project.
 - .3 Manufacturer
 - .1 Submit a statement from the manufacturer of the cabling Products proposed for use in this Contract indicating the Bidder's good standing with the manufacturer and the manufacturer's willingness and agreement to underwrite the performance warranty on the final installation.
 - .2 Failure to comply within ten working day following award may result in the disqualification of the bid at the sole discretion of the Owner.

1.6 **CONTRACTOR QUALIFICATIONS**

- .1 At any time before date of award or within ten business days following the date of award of Contract, submit the name of one or more persons who are qualified to undertake the work to implement and oversee the work of this division and described in the Contract Documents.

- .2 Identify one or more persons to fulfil two identified roles. Acceptable for both roles to be fulfilled by one person.
 - .1 Technical design supervisor
 - .2 Site work supervisor
- .3 Acceptable qualifications are:
 - .1 Active member of BICSI and currently registered under BICSI RCDD program. Acceptable form of statement is RCDD certificate expiring no sooner than the date of substantial completion or one full year following the date of award whichever is the later.
 - .2 Active individual member or corporate member of BICSI and licensed within Canada as Professional Engineer with ten years demonstrated practice in the field of design and installation of communications infrastructure. Acceptable form of statement is an image of the signed Professional Engineer seal as cover to a history of work undertaken similar in nature and scope to the work described in the Contract Documents.
- .4 Provide commitment to maintain same personnel or direct and immediate replacements through period of Contract. Acceptable replacements include personnel possessing like credentials for term including construction period.
- .5 Provide commitment that qualified personnel will execute a tenure of commitment expiring no less than one year from the date of award, or a period conterminal with the final completion of the work whichever is the sooner.
- .6 Quality assurance.
- .7 Pre-Installation Meetings
 - .1 Arrange for and attend pre-installation design and construction meetings. Attendees at meetings to include site work supervisor and technical design supervisor.
 - .1 Minimum of one meeting to review the Contract scope of work.
 - .2 Minimum of one meeting to review the proposed execution of the work.
- .8 Site Meetings
 - .1 Arrange for and attend construction progress meetings. Attendees at meetings to include site work supervisor and technical design supervisor.
 - .1 Minimum of two site meetings per month commencing on day of mobilization and running until four weeks after site work completion.
 - .2 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.
 - .3 Where requirements of the Specifications exceed referenced standards, the Specifications apply. Where standards differ between authorities, the most stringent applies.
 - .4 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.

- .5 Equipment must be acceptable to electrical inspection authorities.
- .6 Where any part of the Work fails tests, on approval of the manufacturer repair the fault in a manner to prevent recurrence and re-test.
- .7 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.
- .9 Area Classification
 - .1 No area in the Work is classified as hazardous.
- .10 Warranty
 - .1 Comply with the terms of the warranty described in the Contract Documents.
 - .2 All components comprising the structured cabling channel as defined by TIA 568 by one manufacturer only and under the protection of a single installation and performance warranty.
 - .3 Provide Products protected under a single warranty where providing such is of benefit to the Owner. Provide evidence of this benefit.
 - .4 Assemble the cabling system using Products protected by a single warranty of minimum twenty-five years.
 - .5 Warranty to include protection against defective manufacture of Products and guarantee of fit for purpose for present and future uses for cable of stated performance level. Warranty to protect the Owner from defects in Product made evident by long term exposure to operating environment for which the Product is specified.
 - .6 Do not propose the use of Products or to provide contracting services if the manufacturer of the Products proposed will not warrant the Work to the best warranty most beneficial to the Owner.
- 2 Products
 - 2.1 **MANUFACTURERS**
 - .1 Use Products manufactured by stipulated manufacturer where identified.
 - .2 Use Products manufactured by the identified preferred manufacturer as the basis of the Base Bid.
 - .3 Use Products manufactured by identified alternative manufacturers as the basis of voluntary alternative bids. Provide justification for the use of alternative Products.
 - .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 identified in the Contract Drawings.
 - 2.2 **ACCEPTABLE MANUFACTURERS**
 - .1 Submit a Tender that includes only those Products identified in this and related sections in this division of the Specification.
 - .2 All components comprising the structured cabling channel as defined by TIA 568 by one or more manufacturers and under protection of a single installation and performance warranty.
 - 2.3 **PRODUCT VENDORS**
 - .1 Provide Products by a sole stipulated manufacturer where indicated.

- .2 Provide Products by listed alternative manufacturers where indicated for voluntarily proposed alternates. Acceptable alternative Products are listed within this and other sections comprising this division of the Work.
- .3 Use of Products not identified in this division as substitutes for stipulated or preferred Products is at the risk of the Contractor. At the discretion of the Owner, the Contractor may be called to replace the substituted Products at no cost to the Owner. A claim by the Contractor for a time delay caused by the need to replace substituted Products will be rejected.
- .4 For each alternative Product submit justification for use as alternates indicating benefits to the Owner. Identify if benefits are based on price, delivery, or performance.

2.4 **COMMUNICATIONS GROUNDING AND BONDING**

- .1 Pre-drilled Copper Bus Bar
 - .1 Telecommunications Grounding Busbar (TGB)
 - .1 Type T-250
 - .1 250 mm TGB telecommunications grounding bus bar, 6.5 x 50 x 250 mm, tin plated; four sets holes 6 mm diameter, spaced 16 mm; three sets of 10 mm holes spaced 25 mm, standoff insulators and mounting brackets.
 - .2 Type T-300
 - .1 300 mm TGB telecommunications grounding bus bar, 6.5 x 50 x 305 mm, tin plated; six sets holes 6 mm diameter, spaced 16 mm; three sets of 10 mm holes spaced 25 mm, standoff insulators and mounting brackets.
 - .3 Type T-500
 - .1 500 mm TGB telecommunications grounding bus bar, 6.5 x 50 x 508 mm, tin plated; twelve sets holes 6 mm diameter, spaced 16 mm; three sets of 10 mm holes spaced 25 mm, standoff insulators and mounting brackets.

Table 1 - Telecommunications ground bus bar - by manufacturer

Type	Panduit		
T-250	GB2B0304TPI-1		
T-300	GB2B0306TPI-1		
T-500	GB2B0312TPI-1		

- .2 Telecommunications Main Grounding Bus Bar (TMGB)
 - .1 Type TM-300
 - .1 300 mm TMGB telecommunications main grounding bus bar, 6.5 x 100 x 305 mm, tin plated; twelve sets holes 6 mm diameter, spaced 16 mm; six sets of 10 mm holes spaced 25 mm, standoff insulators and mounting brackets.
 - .2 Type TM-500
 - .1 500 mm TMGB telecommunications main grounding bus bar, 6.5 x 100 x 508 mm, tin plated; twenty-four sets holes 6 mm diameter, spaced 16 mm; six sets of 10 mm holes spaced 25 mm, standoff insulators and mounting brackets.

Table 2 - Communications main ground bus bar - by manufacturer

Type	Panduit		
TM-300	GB4B0612TPI-1		
TM-500	GB4B0624TPI-1		

- .3 Two-hole long barrel lug
 - .1 Comply with BICSI/J-STD-607A.
 - .2 Tin plated long barrel with inspection window to confirm cable insertion; two holes according to NEMA size and spacing.

2.5 PATHWAYS FOR COMMUNICATIONS SYSTEMS

- .1 General
 - .1 Comply with Section 26 05 01 for rigid overhead cable tray.
 - .2 Supplement approved electrical raceways with items described herein.
- .2 Cable Hangers and Supports
 - .1 Use only where expressly indicated as permitted.
 - .2 Cable supports of open hook construction (J hooks) with 54 mm wide cable bearing surface curved with radius greater than minimum required by supported cable.
 - .3 Listed manufacturers and Products:
 - .1 Panduit: JMJD2-X
 - .2 Ideal
 - .4 Cable retention wraps, soft, reusable hook-and-loop tie, coloured to match colour code indicated. Plenum rated.
 - .1 Panduit: HLTP and HLSP series
 - .5 Nylon cable retention wraps (Tiewraps™) not permitted.
- .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
 - .1 Nominal inside diameters 25 mm, 32 mm.
 - .2 Fire ratings FT4, FT6.
 - .3 Manufacturer:
 - .1 Arlington
- .5 Flexible Fabric Thin Wall Inner Duct Sleeve
 - .1 White with colour identification stripe including pull tape in one-, two-, three-cell on micro-cell format.
 - .2 Fire ratings of normal, riser and plenum with optional copper 18 gauge tracing strips.
 - .3 Listed manufacturer and Products:
 - .1 Max cell

- .1 Three-cell: 103 mm MXC4003XX series
- .2 Three-cell: 78 mm MXC3456XX series
- .3 Two-cell: 53 mm MXC2002XX series
- .4 Micro two-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
- .8 Cable Trays for Communications Systems
 - .1 Rigid ladder tray
 - .1 Comply with Section 26 05 00 and Section 26 05 33.
 - .2 Rigid solid bottom cable tray
 - .1 Comply with Section 26 05 00 and Section 26 05 53.
 - .3 Open wire mesh cable tray
 - .1 Form
 - .1 Tray formed of circular or ovaloid steel wire welded to form grid pattern of nominal 50 mm x 100 mm
 - .2 Folded sides to provide longitudinal structural support
 - .3 Widths ranging from nominal 200 mm to nominal 600 mm
 - .4 Fixed or snap-on cable retention side wall depths ranging from 50 mm to 150 mm
 - .5 Standard lengths of nominal 3 m
 - .2 Finishes:
 - .1 Painted black, white
 - .2 Zinc electroplated
 - .3 Certifications
 - .1 ULc or UL Canada or Certification acceptable to the AHJ
 - .2 CSA 22.2 No 126.1 Metal Cable Tray Systems
 - .3 NEMA VE 1
 - .4 Accessories

- .1 Accessories as required
 - .1 Splicing kit
 - .2 Edge hanger
 - .3 Cantilever brackets
 - .4 Underfloor C bracket
 - .5 Split bolt grounding lug and clamp
 - .6 Divider
 - .7 Radius drop
 - .8 Side bracket
 - .9 Radius control side wall brackets
 - .10 Vertical radius bracket
 - .11 Conduit bracket
 - .12 Solid liner insert
 - .13 Side supported cable hanger brackets
- .5 Manufacturer
 - .1 CPI Chatsworth
 - .2 T&B Thomas and Betts
 - .3 Legrand
 - .4 Panduit
- 2.6 **UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS**
 - .1 Comply with Section 26 05 01.
 - .2 Rigid PVC Conduit
 - .1 Rigid PVC conduit manufactured to CSA C22.2 No. 211.2
 - .2 Rigid PVC fittings, long sweep bend
 - .3 Rigid Ferrous Metal Conduit with PVC Coating
 - .1 Rigid ferrous metal conduit to CSA C22.2 No. 45-M with PVC coating to nominal thickness of 1.02 mm conforming to NEMA publication RN1-1998
 - .2 Matching rigid ferrous metal PVC coated fittings and couplings; matching long sweep bends
 - .4 Underground Enclosure
 - .1 Precast polymer concrete underground enclosure
 - .2 Precast polymer concrete enclosure reinforced with glass fibre, to 9072 kg loading application, open base, tamperproof cover locks
 - .3 Width: 305 mm square; depth: 457 mm, 609 mm, 913 mm
 - .4 Manufacturers:
 - .1 Synertech
- 3 Execution

3.1 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 Install measuring tape for full length of communications pathways in those pathways approaching cable performance distance limits. Measure length and confirm that distance limits are not exceeded.
- .7 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 overvoltage protection devices, demarcation terminal blocks and CATV distribution and amplification devices. Use removable tape to prepare proposed layout for Consultant's review. Overlay with black permanent marker after review by Engineer.

3.2 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 Bus Bars
 - .1 Mount bus bars insulated from building ground and in locations and at elevations indicated.
 - .2 Mount horizontally with fasteners able to resist axial pull of 50 kgf.
 - .3 Ensure clearance of 50 mm from other metallic objects including components of dissimilar grounding systems.
- .3 Enclosures
 - .1 Bond communications enclosures only to telecommunications ground bus bar. Do not bond directly to electrical safety ground.
 - .2 For arrays of four or fewer communications cabinets, connect individual #6 grounding cables between technical grounding bus bar and individual communications cabinets.

- .3 For arrays of five or more communications cabinets, connect individual #6 grounding cables between individual cabinets and a common #2 AWG insulated aisle ground cable using crimp taps. Connect aisle ground cable to technical ground bus bar using two-hole long barrel lug with window.
 - .4 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.
 - .5 Flexible Conduits
 - .1 Bond armour and bonding wire to ground through manufactured conduit accessories.
- 3.3 **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.
- 3.4 **PATHWAYS FOR COMMUNICATIONS SYSTEMS**
- .1 General
 - .1 Pathways laid out and installed to comply with latest release of ANSI/TIA 569.
 - .2 Pathways 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 minimum clearances measured from any point of the communications system to any point on the 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 | AC90 cable (enclosing 30A branch circuits) | 450 mm |
| .12 | EMT conduit (enclosing 20A branch circuits) | 75 mm |
| .13 | ENT conduit (enclosing 20A branch circuits) | 150 mm |
| .14 | AC90 cable (enclosing 20A branch circuits) | 150 mm |
| .15 | EMT conduit (enclosing 15A branch circuits) | 65 mm |
| .16 | ENT conduit (enclosing 15A branch circuits) | 100 mm |
| .17 | AC90 cable (enclosing 15A branch circuits) | 100 mm |
| .18 | Control cabling (in separate conduit) | zero |
| .19 | Control cabling (exposed) | 100 mm |
| .20 | Class 2 wiring (in separate conduit) | zero |
| .21 | Class 2 wiring (exposed) | 100 mm |
| .22 | Conduit (all others) | 75 mm |
| .23 | Fluorescent luminaires | 600 mm |
| .24 | Pipes (gas, oil, water, etc.) | 300 mm |
| .25 | 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. Space hangers at maximum 1 m separation.
- .2 Limit cables to twenty-four 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 1.2 m 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 Do not use nylon cable retention wraps (Tiewraps™) for cable retention.
- .4 Conduit
- .1 Extend distribution and backbone conduit to cable tray.
- .2 Form field-formed raceway to comply with TIA 569 specifications.
- .3 Fit conduit guard bushings on each exposed entrance to conduit raceway.
- .4 Field form "gooseneck" bends in conduit where surface run conduit changes direction to penetrate a wall or partition at ninety degrees. Assume the gooseneck bend includes one hundred eighty degrees of bending.

- .5 Innerduct Sleaving
 - .1 Provide and 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 Provide and install flexible fabric low friction pre-lubricated inner duct sleeve in all backbone conduits and in conduits intended to carry backbone cabling, and in all conduits below grade and also where indicated. Colour coded, with pre-installed pulling tape; electrically traceable where indicated.
 - .1 Three-cell construction for installation in 103 conduits
 - .2 Three-cell construction for installation in 78 conduits
 - .3 Two-cell construction for installation in 54 conduits
 - .4 Micro two-cell construction for installation in 27 conduits
- .6 Flexible Metallic Conduit
 - .1 Flexible non-combustible metallic liquid-tight conduit permitted below access flooring as pathway 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.
- .7 Flexible Non-metallic Tubing
 - .1 Flexible non-metallic tubing not permitted in damp or wet locations.
 - .2 Flexible non-metallic cable not permitted between locations separated by greater than 150 m.
 - .3 Flexible non-metallic electrical tubing not permitted where aggregated bending exceeds one hundred eighty degrees.
 - .4 Acceptable use of flexible non-metallic tubing as replacement for rigid non-metallic conduit when minimum of one trade size larger than required size of indicated rigid conduit.
 - .5 Flexible non-metallic tubing permitted if maximum permitted pull tension of installed cable is not exceeded. Provide pull tension reports to the Engineer on request.
 - .6 Flexible non-metallic tubing installed complete with colour identified and measured mule tape.
 - .7 Mule tape incorporating copper tracing conductor for use in non-metallic tubing.

3.5 **UNDERGROUND DUCTS AND RACEWAYS**

- .1 General
 - .1 Clean out each section of duct by pulling a steel wire brush and mandrel of the correct size through the duct before pulling cables.
 - .2 Notify the Engineer if immovable obstructions are encountered when cleaning existing ducts.
 - .3 Protect cable at entry and exit from ducts by flexible corrugated non-metallic conduit.

- .4 Install pull string with length markers ("Mule tape") in each duct and in each inner-duct where applicable.
- .5 Conduit ducts below concrete slab on grade at minimum 300 mm below finished concrete floor or 100 mm below lowest elevation of concrete, whichever dimension is the greater.
- .2 Cable Placement in Underground Ducts
 - .1 Pull cables in underground ducts in continuous length, without splicing.
 - .2 Install cables in lower ducts first, leaving upper ducts for future; install cables in inner-ducts where provided.
 - .3 Apply only manufacturer recommended or approved lubricant to cables to reduce friction between the cable and the duct.
 - .4 Apply cable grips with ball bearing swivel to the cable sheath or strength members to avoid applying tensile force directly to conductors or fibres when pulling cables.
 - .5 Station personnel at each access point to observe and lubricate the cables during pull.
 - .6 Provide cable slack at manholes for expansion and contraction; mount with clips to prevent sagging.
 - .7 Submit tension pulling calculation prior to installation of cables to Consultant for review.
 - .8 Monitor cable pull tension during installation. Do not exceed maximum tensile rating of cables.
 - .9 Avoid bending cables to a radius less than manufacturer's recommendation, or ten times the cable outside diameter, whichever is the greater.
 - .10 Where cable is pulled through a distance of greater than 30 m or through a pathway containing more than one ninety degree bend, use a dynamometer to record installation tension and a tension limiting device to prevent exceeding the maximum pulling tension specification during installation. Set the tension limit at or below the manufacturer's maximum limit. Take up the cable at intermediate pulling points with an intermediate cable take-up device reviewed by the Consultant.
 - .11 Make cable pulls continuous and steady between pull points. Avoid interruptions to the pull unless necessitated by excessive tension on the cable.
 - .12 Seal duct entrance into buildings with duct sealing compound to prevent the ingress of moisture, foreign materials and rodents.
 - .13 Deem exposed any cable portion which is in a buried raceway and extends 1 m or more beyond the building curtain perimeter and provide over-voltage protection at each terminal.

3.6 **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.

3.7

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 the technician's credentials as a Shop Drawing within five days of receiving a request from the Engineer or within five days of award of Contract, whichever is the sooner.
- .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.

End of Section

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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 General

- .1 Comply with TIA 606.

- .2 Use identification schema parameters identified on Contract Drawings.

- .3 Identification of cables, cabinets, electrical raceways, grounding conductors, communications outlets, faceplates, firestops, by use of printed alphanumeric labels and colour coding markers as further described on the Contract Drawings and herein.

.2 Standard Colours

- .1 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 Armourcoat: Fire Red 98-4748-6

- .2 Blue: Pantone 300C or 291C

- .1 Benjamin Moore: 133-33

- .2 Armourcoat: Commodore Blue 98-4745-2

- .3 White: Pantone White C

- .1 Benjamin Moore: 133-01

- .2 Armourcoat: Gloss White

- .4 Orange: Pantone 166C or 150C

- .1 Benjamin Moore: 007

- .2 Armourcoat: Zesty orange

- .5 Yellow: Pantone Yellow C or 101C

- .1 Benjamin Moore: 133-12

- .2 Armourcoat: Holland Yellow

- .6 Green: Pantone 336 or 353C

- .1 Benjamin Moore: 133-40

- .2 Armourcoat: Shutter Green
- .7 Brown: Pantone 478C or 465C
 - .1 Benjamin Moore: 133-60
 - .2 Armourcoat: Havana Brown
- .8 Black: Pantone Black C
 - .1 Benjamin Moore: 133-80
 - .2 Armourcoat: Gloss Black
- .9 Purple: Pantone 257C or 264C
 - .1 Benjamin Moore: 1396
 - .2 Armourcoat: N/A
- .10 Grey: Pantone 422C
 - .1 Benjamin Moore: Not specified
 - .2 Armourcoat: Not specified

1.3 **SUBMITTALS**

- .1 Prepare a sample printed copy of the identification labels and submit to the Consultant for review.

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 **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, -18°C to +104°C
 - .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, coloured, 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

2.3

LABELS

- .1 General
 - .1 Comply with TIA-606A and CSA-T528.
 - .2 Prepare labels by use of machine printing.
 - .3 Avoid use of handwritten labels.
 - .4 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.

2.4 **PAINT**

- .1 Comply with Section 09 91 00; otherwise treat as shop primed ferrous metal - alkyd finish.
 - .1 One coat 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.

3 Execution

3.1 **COLOURS**

- .1 Use components in the colour as indicated.

3.2 **LABELLING**

- .1 General
 - .1 Identify conduits, electrical raceways, pullboxes, junction boxes, for communications according to the colour scheme indicated on the Contract Drawings and herein.
 - .2 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.
 - .3 Use cables, jacks, cords, icons, manufactured in the colours identified in the Contract Drawings and herein.
 - .4 Use the identification scheme as indicated.
 - .5 Apply labels so that the printed information may be read without the need to disturb the cables.
 - .6 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.
 - .7 Apply labels on jacks, faceplates and patch panels in the manner prescribed by the original equipment manufacturer.
 - .8 Apply more than one label where immediate obstructions may prevent ease of reading the prescribed label.
 - .9 Apply a label on the inside of the electrical device outlet box corresponding to each cable terminated on the faceplate mounted on the device box.
 - .10 Use only approved cable marking materials.
 - .11 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.
 - .12 Use only machine printed labeling for outlets.
 - .13 Use only engraved plastic plates for the labeling of enclosures and racks.

- .2 Horizontal Distribution Cabling
 - .1 Use the identification scheme as stipulated in the Contract Documents or herein.
- .3 Backbone Cabling
 - .1 Use the identification scheme as stipulated in the Contract Documents or herein.
- 3.3 **LABELLING AND IDENTIFICATION SCHEMA**
 - .1 Schema H: Industrial
 - .1 General
 - .1 Schema applicable to large scale multiple level industrial premises.
 - .2 Horizontal distribution cables defined by alpha-numeric full definition of cabling termination hub, followed by cable family, followed by cable medium, followed by cable ordinal.
 - .3 Backbone cables defined by alpha-numeric full definition of cabling termination hub of source termination point, followed by destination termination point, followed by cable family, followed by cable medium, followed by cable ordinal.
 - .4 Prefix terms omitted where all cables share common term.
 - .5 Outlet defined.
 - .2 Scheme
 - .1 Comply with proxy values indicated on the Contract Drawings.
 - .2 Scheme consisting of the following terms
 - .1 Region identifier
 - .1 Example: Country
 - .2 Alpha: Two characters
 - .3 Proxy: RR
 - .2 Facility identifier
 - .1 Example: City
 - .2 Alpha: Two characters
 - .3 Proxy: CC
 - .3 Premises / area / building identifier
 - .1 Example: Production plant
 - .2 Alpha-numeric: Two characters
 - .3 Proxy: AA
 - .4 Floor / level identifier
 - .1 Indicates floor of cabling hub

- .2 Example: Mezzanine
 - .3 Alpha-numeric: Two characters
 - .4 Proxy: FF
- .5 Cabling hub identifier
 - .1 Example: Telecom enclosure
 - .2 Alpha-numeric: One to six characters
 - .3 Proxy: hhhhhH
- .6 Cable family
 - .1 Example: Production network
 - .2 Alpha: One character
 - .3 Proxy: G
- .7 Medium type
 - .1 Example: Optical fibre
 - .2 Alpha: One character
 - .3 Proxy: M
- .8 Cable ordinal
 - .1 Example: Numeric value
 - .2 Numeric: Four character, zero filled, right justified
 - .3 Proxy: NNNN
- .3 Horizontal distribution format
 - .1 Fully defined form
 - .1 RR-CC-AA-FF-hhhhhH-G-M-NNNN
 - .2 Abbreviated form for cables within a sole region
 - .1 CC-AA-FF-hhhhhH-G-M-NNNN
 - .3 Abbreviated form for cables within a sole facility
 - .1 AA-FF-hhhhhH-G-M-NNNN
 - .4 Abbreviated form for cables within a sole premises
 - .1 FF-hhhhhH-G-M-NNNN
 - .5 Abbreviated form for cables within a sole premises and within a sole family
 - .1 FF-hhhhhH-M-NNNN
 - .6 Abbreviated form for cables within a sole premises and within a sole family and of a single medium

- .1 FF-hhhhhH-NNNN
- .4 Horizontal distribution format examples:
 - .1 Administration network copper Category 6 distribution cables on grade level terminating at communications enclosure at grid reference WA/11
 - .1 01-WA/11-A-C-0001.....01-WA/11-A-C-9999
 - .2 Production network copper Category 6 distribution cables on grade level terminating at communications enclosure at grid reference WA/11
 - .1 01-WA/11-P-C-0001....01-WA/11-P-C-9999
 - .3 Production network multimode optical fibre distribution cables on grade level terminating at communications enclosure at grid reference WA/11
 - .1 01-WA/11-P-M-0001....01-WA/11-P-M-9999
 - .4 Administration network copper Category 6 distribution cables on 2nd floor terminating at communications enclosure in telecom room 201.
 - .1 02-201-A-C-0001.....02-201-A-C-9999
- .5 Back bone format
 - .1 Fully defined form
 - .1 RR-CC-AA-FF-hhhhhH-AA-FF-hhhhhH-G-M-NNNN
 - .2 Abbreviated form for cables within a sole region
 - .1 CC-AA-FF-hhhhhH-AA-FF-hhhhhH-G-M-NNNN
 - .3 Abbreviated form for cables within a sole facility
 - .1 AA-FF-hhhhhH-AA-FF-hhhhhH-G-M-NNNN
 - .4 Abbreviated form for cables within a sole premises
 - .1 FF-hhhhhH-FF-hhhhhH-G-M-NNNN
- .6 Backbone cabling format examples
 - .1 Administrative network copper multi-pair Category 6 backbone cables originating at second floor main telecom room #201, terminating at equipment enclosure WA/11 on grade level
 - .1 02-201-01-WA/11-A-C-0001
 - .2 Production network single mode optical fibre multi strand originating at second floor main telecom room #201, terminating at equipment enclosure WA/11 on grade level
 - .1 02-201-01-WA/11-P-S-0001

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- .2 Example:
 - .1 Floor 12: 012
 - .2 Basement 3: 0B3
 - .3 Concourse 2: 0C2
 - .4 Mezzanine 2: 0M2
 - .5 Ground floor: 001
- .4 Termination Identifier
 - .1 Use a sequential alphabetic identification character to indicate in which telecommunications room the cable is terminated: Match to existing convention such as N (North), S (South) otherwise use A, B, C etc.
- .5 Telecommunications Room Horizontal Cable Patch Panel Termination
 - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling, padded left to three characters using zero and the pad character.
 - .2 Label the data 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, etc.
 - .3 Label the cable at the patch panel with the same identification as the jack to which the cable is connected.
- .6 Cable Count Ordinals
 - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling, padded left to three characters using zero and the pad character.
 - .2 Example: Cable 32: 032.
- .7 Work Area Outlet
 - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
 - .2 Install voice and data jacks with the same numeric ordinal on a common faceplate where local conditions permit.
- .3 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.
 - .1 Where an outlet is tagged on the Contract Drawings as "T", designate the jack for convenience telephone service.
 - .2 Where an outlet is tagged on the Contract Drawings as "P" designate the cable for payphone service.

- .3 Where an outlet is tagged on the Contract Drawings as "M", designate the cable for monitored line service.
 - .4 Where an outlet is tagged on the Contract Drawing as "I", designate the cables for intercom service.
 - .5 Where an outlet is tagged on the Contract Drawing as "C", designate the cables for special communications service.
- .2 Facility Prefix
- .1 Prefix all identifies 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 with new or 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 Pay Phone Cables
- .1 Identify payphone cables as Pnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and P is a literal value.
 - .1 Example: Pay phone cable #1: P001; pay phone cable #2: P002
- .7 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
- .8 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
- .9 Work Area Outlet
 - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
- .10 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.
 - .1 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.
 - .2 Example
P001, P002, P003, P004
T001, T002, T003, T004,
M001, M002, M003, M004,
C001, C002, C003, C004,
- .11 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
- .4 Scheme M: Modular Numbering
 - .1 General
 - .1 Where an outlet is tagged on the Contract Drawings as "V/2D", designate one jack as voice, the other two jacks as data.
 - .2 Where an outlet is tagged on the Contract Drawings as "V/D", designate one jack as voice, the other jack as data.
 - .3 Where an outlet is tagged on the Contract Drawings as "T" or "T1", designate the jack for convenience telephone service.
 - .4 Where an outlet is tagged on the Contract Drawings as "P" or "P1", designate the cable for payphone service.

- .5 Where an outlet is tagged on the Contract Drawings as “M”, designate the cable for monitored line service.
- .6 Where an outlet is tagged on the Contract Drawing as “I” or “I1”, designate the cables for intercom service.
- .2 Facility Prefix
 - .1 Prefix all identifiers with a numeric value indicating the floor within the premises or facility for the telecommunications room in which the cable is terminated.
 - .2 Follow the prefix with an alpha character to identify the specific telecommunications room where there is more than one to any floor.
 - .3 Separate the prefix from the alphanumeric identifier with a hyphen separator.
- .3 Numeric Ordinals
 - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling.
- .4 Voice Cables
 - .1 Identify voice cables as V-rr-pp-jj where
 - .1 “rr” is a unique two character numeric ordinal identifying the rack on which the cable is terminated beginning at 01.
 - .2 “pp” is a consecutive two character numeric ordinal, unique in any rack or cabinet, identifying the patch-panel on which the cable is terminated, commencing at 01 at the uppermost patch panel in the rack.
 - .3 “jj” is a consecutive two character numeric ordinal, unique in any one patch panel, identifying the jack on which the cable is terminated, commencing at 01 at the uppermost, left most jack position in the panel.
 - .4 “V” is a literal value.
- .5 Data Cables
 - .1 Identify data cables as D-rr-pp-jj where
 - .1 “rr” is a unique two character numeric ordinal identifying the rack on which the cable is terminated beginning at 01.
 - .2 “pp” is a consecutive two character numeric ordinal, unique in any rack or cabinet, identifying the patch-panel on which the cable is terminated, commencing at 01 at the uppermost patch panel in the rack.
 - .3 “jj” is a consecutive two character numeric ordinal, unique in any one patch panel, identifying the jack on which the cable is terminated, commencing at 01 at the uppermost, left most jack position in the panel.
 - .4 D is a literal value.

.6 Telephone Cables

.1 Identify telephone cables as T-rr-pp-jj where

- .1 "rr" is a unique two character numeric ordinal identifying the rack on which the cable is terminated beginning at 01.
- .2 "pp" is a consecutive two character numeric ordinal, unique in any rack or cabinet, identifying the patch-panel on which the cable is terminated, commencing at 01 at the uppermost patch panel in the rack.
- .3 "jj" is a consecutive two character numeric ordinal, unique in any one patch panel, identifying the jack on which the cable is terminated, commencing at 01 at the uppermost, left most jack position in the panel.
- .4 T is a literal value.

.7 Pay Phone Cables

- .1 Identify payphone cables as Pnnn where nnn is a unique numeric ordinal not occurring in the existing Pay phone cabling beginning at 001 to 999 and P is a literal value.

.8 Monitored Line Cables

- .1 Identify monitored line cables as Mnnn where nnn is a unique numeric ordinal not occurring in the existing monitored line cabling beginning at 001 to 999 and M is a literal value.

.9 Intercom Cables

- .1 Identify intercom line cables as Innn where nnn is a unique numeric ordinal not occurring in the existing intercom cabling beginning at 001 to 999 and I is a literal value.

.10 Work Area Outlet

- .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.

.11 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 voice 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: V001, V002, V003, etc.
- .3 Label the data termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally in A and B pairs, left to right, and progressing vertically as each row of jacks is completed. Example D001A, D001B, D002A, D002B, etc.

.5 Scheme C: Consecutive Numbering

.1 General

- .1 Where an outlet is tagged on the Contract Drawings as "V/2D", designate one jack as voice, the other two jacks as data A and data B respectively.
- .2 Where an outlet is tagged on the Contract Drawings as "V/D", designate one jack as voice, the other jacks as data A.
- .3 Where an outlet is tagged on the Contract Drawings as "T" or "T1", designate the jack for convenience telephone service.
- .4 Where an outlet is tagged on the Contract Drawings as "P" or "P1", designate the cable for payphone service.
- .5 Where an outlet is tagged on the Contract Drawings as "M", designate the cable for monitored line service.
- .6 Where an outlet is tagged on the Contract Drawing as "I" or "I1", designate the cables for intercom service.
- .2 Facility Prefix
 - .1 Prefix all identifiers with a numeric value indicating the floor within the premises or facility for the telecommunications room where the cable is terminated.
 - .2 Follow the prefix with an alpha character to identify the specific telecommunications room where there is more than one to any floor.
 - .3 Separate the prefix from the alphanumeric identifier with a hyphen separator.
- .3 Numeric Ordinals
 - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling.
- .4 Voice Cables
 - .1 Identify voice cables as Vnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and V is a literal value.
- .5 Data Cables
 - .1 Identify one data cable to an outlet as DnnnA where nnn is a unique numeric ordinal beginning at 001 to 999 and D and A are literal values.
 - .2 Identify the second data cable to an outlet as DnnnB where nnn is a unique numeric ordinal beginning at 001 to 999 and D and B are literal values.
- .6 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.
- .7 Pay Phone Cables
 - .1 Identify payphone cables as Pnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and P is a literal value.
- .8 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.
- .9 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.
- .10 Work Area Outlet
 - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
 - .2 Install voice and data jacks with the same numeric ordinal on a common faceplate.
- .11 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 voice 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: V001, V002, V003, etc.
 - .3 Label the data termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally in A and B pairs, left to right, and progressing vertically as each row of jacks is completed. Example D001A, D001B, D002A, D002B, etc.
- .6 Scheme D: Ottawa City
 - .1 General
 - .1 Where an outlet is tagged on the Contract Drawings as "VV/DD", the outlet is served by two cables; cable A dedicated to a data jack, designated as DATA 1; cable B split between three jacks, designated as VOICE 1, VOICE 2, DATA 2.
 - .2 Where an outlet is tagged on the Contract Drawings as "T", the outlet is served by one cable and is for convenience telephone service.
 - .3 Where an outlet is tagged on the Contract Drawings as "P", the outlet is served by one cable and is for payphone service.
 - .4 Where an outlet is tagged on the Contract Drawings as "M", the outlet is served by one cable and is for monitored line service.
 - .5 Where an outlet is tagged on the Contract Drawing as "I", the outlet is served by one cable and is for intercom service.
 - .2 Jack Colours
 - .1 Jack colours and position in faceplate:
 - .1 Data 1 colour: Grey: Position - lower left
 - .2 Voice 1 colour: Blue: Position - upper left
 - .3 Voice 2 colour: Beige: Position - upper right

- .4 Data 2 colour: Orange: Position - lower right
- .3 Facility Prefix
 - .1 Maintain records in an electronic data file. Prefix all alpha-numeric identifiers with an alpha-numeric character string indicating the site reference.
 - .2 For city of Ottawa sites, use the following site identifiers:
 - .1 Dispatch building: D
 - .2 Garage: G
 - .3 Bylaw building: B
- .4 Termination Room Identifiers
 - .1 Use a room identifier to identify the telecommunications rooms as follows:
 - .1 "1": Telecom room, dispatch building, 2nd floor
 - .2 "2": Telecom and equipment room, garage
 - .3 "3": Telecom enclosure, office mezzanine
 - .4 "4": Telecom room, garage, tire bay
 - .5 "5": Telecom room, garage entrance
 - .6 "6": Telecom enclosure, garage mezzanine
 - .7 "9": Telecom room, bylaw building
- .5 Distribution Cable Identifications
 - .1 Label each end of every distribution cable. Label each cable with a unique identifier. Use the same identifier at each end of each respective cable.
 - .2 Use a cable identifier to identify the various distribution cable purposes as follows:
 - .1 Data jack (D1): Cable type A
 - .2 Hybrid (V1 V2 D2): Cable type B
 - .3 Voice only (V): Cable type V
 - .4 Wireless access: Cable type W
 - .5 Express POTS: Cable type P
 - .6 Building ECMS: Cable type E
 - .3 Identify the cables comprising the pair of cables to a MIXED USE outlet as follows, where "b" is facility prefix: "h" is terminating room identifier, "xxx" is the cable ordinal, and "A" or "B" to identify the respective cables. Use the same cable ordinal for the two cables terminating at a common outlet.

- .1 Cable to data 1: b-n-A-xxx
- .2 Cable to voice 1, voice 2, data 2: b-n-B-xxx
- .4 Identify the cable to a single use outlet as follows, where “b” is facility prefix, “n” is terminating room identifier, “xxx” is the cable ordinal, and “C” or “D” or “E” or “F” to identify the respective cables.
 - .1 Cable to voice: b-n-V-xxx
 - .2 Cable Wireless Access Point (WAP): b-n-W-xxx
 - .3 Cable to POTS outlet: b-n-P-xxx
 - .4 Cable to building EMCS: b-n-E-xxx
- .6 Numeric Ordinals
 - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling.
 - .2 Two cables terminating at a common faceplate to carry the same ordinal.
 - .3 Cable ordinals for all cables types to begin at 001, restarting at 001 for each cable type at each telecom room.
- .7 Telephone Cables
 - .1 Treat telephone cables as single purpose voice cables (above).
- .8 Payphone Cables
 - .1 Treat pay telephone cables as single purpose (POTS) cables (above).
- .9 Monitored Line Cables
 - .1 Treat power utility monitoring cables as single purpose (POTS) cables (above).
- .10 Intercom Cables
 - .1 Not specified
- .11 Work Area Outlet
 - .1 Label single use and mixed use outlets according to the respective schemes described below.
 - .2 Label the faceplate at a mixed use outlet as follows where “b” is facility prefix, “n” is terminating room identifier, “xxx” is the cable ordinal of the two cables terminating at the outlet
 - .1 b-n-xxx
 - .3 Label the jacks at the MIXED USE work area outlet faceplate
 - .1 Upper left: Voice 1
 - .2 Upper right: Voice 2
 - .3 Lower left: Data 1

- .4 Lower right: Data 2
 - .4 Install voice (V1, V2) and data (D1, D2) jacks with the same numeric ordinal on a common faceplate.
 - .5 Label the faceplate at a single use outlet as follows where "b" is facility prefix, "n" is terminating room identifier, "X" is replaced with "V" or "W" or "P" or "E" to identify the respective cables type and "xxx" is the cable ordinal of the cable terminating at the outlet.
 - .1 b-n-X-xxx
- .12 Telecommunications Room Horizontal Cable Patch Panel Termination
 - .1 Label each patch panel with facility prefix and room identifier as indicated above, where "b" is facility prefix, "n" is terminating room identifier
 - .1 b-n
 - .2 Label the jacks at the patch panel with the same identification as the cable connecting to the jack
 - .1 Jack connected to Cable A: A-xxx
- .13 Telecommunications Room Horizontal Cable Wall Mounted Panel Termination
 - .1 Label each wall mounted panel with facility prefix and room identifier as indicated above, where "b" is facility prefix, "n" is terminating room identifier
 - .1 b-n
 - .2 Label the terminations at the termination panel with the same identification as the cable connecting to the termination
 - .1 Termination for Cable B: B-xxx
 - .2 Termination for Cable V: V-xxx
 - .3 Termination for Cable W: W-xxx
 - .4 Termination for Cable P: P-xxx
 - .5 Termination for Cable E: E-xxx
 - .3 Label terminations beginning at the upper most and left most position, starting with the lowest ordinal, advancing horizontally, left to right, and progressing vertically as each row of jacks is completed. Example: B-001, B-002, B-003, etc.
 - .4 Terminate cables of only a single type on a termination block.
- .7 Scheme E
 - .1 Generic Horizontal Cabling
 - .1 Use this scheme for converged horizontal systems with separate CCTV.
 - .2 Identifier scheme template: ITx-nnn or ITx-Cppp
 - .1 IT: Literal to indicate IT room or enclosure.

- .2 X: Ordinal from 0 through 6 to indicate different communication wiring hubs as shown on the layout drawings.
- .3 Nnn: Consecutive cable ordinals to identify each cable with a unique identifier. Series resets to 001 at each IT room or enclosure.
- .4 C: Identifier to distinguish cables for CCTV camera connections.
- .5 Ppp: Three digit identifier to uniquely distinguish each camera. Same ordinal used to identify cable to the camera.
- .3 Telecommunications Room Horizontal Cable Patch Panel Termination
 - .1 Label the data 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.
 - .2 Repeat for CCTV. Segregate CCTV cables from other cables.
 - .3 Label the cable at the patch panel with the same identification as the jack to which the cable is connected.
- .4 Cable Count Ordinals
 - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling, padded left to three characters using zero and the pad character.
- .5 Work Area Outlet
 - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
- .2 Presto horizontal cabling
 - .1 Use this scheme for cables specific to Presto systems
 - .2 Identifier scheme template:
 - .1 Label each cable as indicated on the riser diagram and layout drawings.
 - .2 Cable identification strings:
SPAAC
TPT-P
DRD-P
SPOS-P
DSC-P
SPOS-T1 through SPOS-T2
WP-1 through WP-9
 - .3 Cabinet identification strings:
CC-P1 through CC-P3
DC-P
CC-T

- .4 Telecommunications room horizontal cable patch panel termination.
 - .5 Label the data termination field beginning at the upper most and left most jack position.
 - .6 Label the cable at the patch panel with the same identification as the jack to which the cable is connected.
 - .3 Work Area Outlet
 - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
- .8 Scheme U: Unified Numbering – Single Outlet
 - .1 General
 - .1 Use this scheme where an outlet is indicated on the Contract Drawings as data, or IP phone, or POTS, or red phone.
 - .2 Identifier Scheme
 - .1 Scheme template: DxxxTTTTTcccYYY where
 - .1 D (literal) indicates DATA cable; P (literal) indicates POTS telephone.
 - .2 XXX (variable, ordinal) indicates building floor of outlet.
 - .3 TTTTT (variable) indicates the telecommunication room in which the cable is terminated.
 - .4 Ccc (variable, ordinal) indicates cabinet/panel identification.
 - .5 YYY (variable, ordinal) indicates cable count ordinal.
 - .6 Use full scheme for labels affixed to cables and jacks. Do not abbreviate.
 - .3 Floor Ordinal
 - .1 Use the numeric value of the floor on which the Work area outlet is situated, padded left to three characters using zero as the pad character. Use numbers for floors above grade, prefix floors below grade with B or character to suit local conditions, use M to indicate mezzanine levels. In North America avoid the value "000".
 - .2 Example:
 - .1 Floor main at grade: 001
 - .2 Floor 2 above grade: 002
 - .3 Mechanical mezzanine: BM1
 - .4 Mechanical main: B01
 - .5 Transformer level: B02
 - .6 Cabling level: B03

- .4 Termination Identifier
 - .1 Use a sequential alphanumeric identification to indicate which telecommunications room the cable is terminated: Use full room number.
 - .2 Example:
- .5 Telecommunications Cabinet/Panel
 - .1 Use a sequential alphanumeric identification to indicate which telecommunications cabinet/panel the cable is terminated.
 - .2 Example
- .6 Telecommunications Room Horizontal Cable Patch Panel Termination
 - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling, padded left to three characters using zero and the pad character.
 - .2 Label the data 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.
 - .3 Example 001, 002, etc.
 - .4 Label the cable at the patch panel with the same identification as the jack to which the cable is connected.
- .7 Cable Count Ordinals
 - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling, padded left to three characters using zero and the pad character.
 - .2 Example: Cable 32: 032.
- .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 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
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.

.5 Scheme D: Ottawa City

- .1 Use "facility prefix" and "termination room identifiers" as indicated above for horizontal distribution cabling.
- .2 Identify backbone cables as lying between the far-end facility and near-end facility where the near-end is closest to the work area.
- .3 Label each end of every backbone cable. Label each cable with a unique identifier. Use the same identifier at each end of each respective cable.
- .4 Label each cable within each pull box or maintenance hole.
- .5 Identify each cable indicating the media type, shown below as "MMM", as follows:
 - .1 Optical fibre: Multi mode: OM1
 - .2 Optical fibre: Multi mode: OM2
 - .3 Optical fibre: Multi mode: OM3
 - .4 Optical fibre: Single mode: OS1
 - .5 Copper unshielded: Cat 1: UT1
 - .6 Copper unshielded: Cat 3: UT3
 - .7 Copper unshielded: Cat 5e: UT5

- .8 Copper shielded: Cat 1: ST1
- .9 Copper shielded: Cat 3: ST3
- .10 Copper shielded: Cat 5e: ST5
- .11 Copper armoured: Cat 1: AT1
- .12 Copper armoured: Cat 1: AT3
- .13 Copper armoured: Cat 5e: AT5
- .6 Multi-pair backbone copper cables
 - .1 Label the termination field with the identification of the cable that terminates thereon.
 - .2 Identify each cable as follows, where “F” facility prefix for far-end facility, “f” is terminating room identifier at the far end, “N” is the facility prefix for the near end, “n” is the termination room identifier at the near end, “MMM” indicates the media type, indicates “ppp” indicates the number of pairs, left padded with zero, “xxx” is the cable ordinal, left padded with zero
 - .1 F-f -N-n-MMM-ppp-xxx
- .7 Multi-strand optical fibre cables
 - .1 Label the optical fibre termination patch field with the identification of the cable that terminates thereon.
 - .2 Identify each cable as follows, where “F” facility prefix for far-end facility, “f” is terminating room identifier at the far end, “N” is the facility prefix for the near end, “n” is the termination room identifier at the near end, “MMM” indicates the media type, indicates “ppp” indicates the number of strands, left padded with zero, “xxx” is the cable ordinal, left padded with zero
 - .1 F-f -N-n-MMM-ppp-xxx
- .8 Backbone ordinals
 - .1 Number all copper cables with a common far-end identifier using unique consecutive ordinals beginning at 001.
 - .2 Number all optical fibre cables with a common far-end identifier using unique consecutive ordinals beginning at 001.
- .6 Scheme E:
 - .1 Generic backbone cabling
 - .1 Identifier scheme template: ITx-ITy-M-nnn
 - .1 IT: Literal to indicate IT room or enclosure.
 - .2 X: Ordinal from zero through six to indicate different communication wiring hubs as shown on the layout drawings. (x) is always numerically less than (y).

- .3 M: Identification of medium:
 - O to indicate optical fibre,
 - C to indicate copper
 - .4 Nnn: Consecutive cable ordinals to identify each cable with a unique identifier.
 - .2 Presto optical fibre backbone cabling
 - .1 Identifier scheme template: DCP-Px-M-nnn
 - .1 DCP: Literal to indicate main Presto panel
 - .2 P: Literal to indicate Presto panel
 - .3 X: Ordinal from one through three to indicate different Presto panels
 - .4 M: Identification of medium:
 - O to indicate optical fibre,
 - C to indicate copper
 - .5 Nnn: Consecutive cable ordinals to identify each cable with a unique identifier.
- .10 Connecting Cords
 - .1 Do not label connecting cords.
 - .2 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

3.4 **COMMUNICATIONS PATHWAY IDENTIFICATION**

- .1 General
 - .1 Identify only those communications conduits used for backbone cabling.
 - .2 Identify communications ducts.
- .2 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.
- .3 Do not identify surface raceways mounted below ceiling line in finished areas. Do not apply colour code identifier markings to outlet faceplates.
- .4 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.
- .5 Employ system colours as indicated in table below.
- .6 Apply a small area of paint to inside of outlet, junction and pull boxes.

- .7 Apply identifying mark as paint to full surface of junction box and pull box cover panels for boxes of 150 mm x 150 mm or smaller.
- .8 Apply identifying mark as stripe for junction and pull boxes greater than 150 mm x 150 mm.
- .9 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.
- .10 Use wraparound identification bands to identify exposed communications cabling 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 base mark of minimum 19 mm wide. Where indicated, apply stripes of minimum 8 mm maximum 12 mm each. Apply marking with separation of 12 mm to 20 mm between adjacent bands. Apply the base marking band nearest to the junction of the conduit with the junction box, outlet box or pull box.
- .13 Use the following system colours

System	base colour	1 st stripe	2 nd stripe
Communications	blue		
Communications – backbone	blue	blue	
Communications – backbone – copper (public)	blue	blue	green
Communications – backbone – copper (private)	blue	blue	blue
Communications – backbone – fibre (public)	blue	blue	orange
Communications – backbone – fibre (private)	blue	blue	yellow
Communications – distribution	blue	green	
Communications – distribution – copper	blue	green	green
Communications – distribution – fibre	blue	green	orange
Security	green		
Security – access control	green	yellow	
Security – intrusion detection	green	yellow	green
Security – CCTV	green	blue	
Security – magnetic locks	green	red	
Security – duress alarms	green	red	green
Fire alarm	red		
Fire alarm – speakers	red	white	
Fire alarm – telephone	red	blue	
Distributed communications	white		

Distributed communications – intercom	white	brown	
Distributed communications – PA	white	white	
Distributed communications – AV	white	white	green
Distributed communications – radio	white	green	
Distributed communications – CATV	white	blue	
End of Section			

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

- .1 Telecommunications Industry Association (www.tiaonline.org)
.2 Building Industry Consulting Services International (BICSI) (www.bicsi.com)
.3 International Electrical Testing Association Inc. (www.netaworld.org)

1.3 **SUBMITTALS**

- .1 Submit test reports for review by Consultant. Include in Operating and Maintenance Manual. Comply with Section 01 33 00.
.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 two-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 a summary report for each optical fibre strand indicating insertion loss for each strand tabulating each result by cable sheath and strand number.
.7 Submit detailed test results for all copper and optical fibre cables including backbone and distribution communications cables.
.8 Deliver the reports in a media format selected from the following:
.1 CD-ROM
.2 DVD/R-RW
.9 Within thirty days of award of Contract but no later than ten days before site mobilization of forces, 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.
.10 Submit test and field reports before submitting claim for Substantial Performance.

1.4 **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 and 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 twelve 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.

1.5 **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.

1.6 **FIELD INSPECTION**

- .1 Provide field Engineer for inspection and certification of facilities during installation, testing and commissioning as required.
- .2 Concurrent with testing, 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 and submit to the Consultant, summary report attesting to the findings of the field inspection.

1.7 **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 or fails visual inspection, 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.

- .7 At the reasonable discretion of the Engineer, replace cable or cabling components that fail performance tests, or fail to comply with work practices described in TIA and BICSI published standards and with practices published by the vendor of cabling used on the Project. Make these replacements at no cost to the Project, not in material cost, nor labour charges, nor in delays incurred to make such replacements.
- 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
- 3 Execution
- 3.1 **MATERIAL ACCEPTANCE**
 - .1 Before installing any cable on site, perform the following material acceptance tests:
 - .1 Perform OTDR and flux loss measurements on optical fibre cable after delivery to site and before installation. Prepare summary report and submit as a Shop Drawing to the Engineer for review. Reject material which fails performance tests or appears physically damaged.
 - .2 Perform visual inspection tests on communications cables after delivery to site and before installation. Reject material which fails performance tests or appears physically damaged.
 - .3 Perform full performance testing on samples removed from each spool of communications cable after delivery to site and before installation. Submit the test results to the Engineer for review as a Shop Drawing. Record the manufacturer's production data as imprinted on the cable sheath. Use a cable sample of physical length 50 meters \pm 500 mm. Retain sample for further testing until after Shop Drawings are returned as "Reviewed as Submitted".
- 3.2 **VISUAL AND MECHANICAL INSPECTION**
 - .1 Immediately following installation of cables and connector hardware, perform the following visual and mechanical inspections:
 - .1 Compare cable, connectors and splice data with Drawings and Specifications.
 - .2 Inspect cable and connectors and connections for physical and mechanical damage.
 - .3 Verify that all connectors and splices are correctly installed.
 - .4 Verify colour and marking identification is correctly installed.
- 3.3 **ELECTRICAL TESTING**
 - .1 Test horizontal and backbone copper cables according to the following criteria:

- .1 Cable length measurement and construction defect inspections.
- .2 Connector integrity tests.
- .3 Cable and connector attenuation and performance testing.
- .4 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.
- .5 For Category 5, and 5e 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 350 MHz. Perform tests in accordance with TIA 568B.
- .6 For Category 6 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 650 MHz. Perform tests in accordance with TIA 568B.
- .7 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.
- .8 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 six-around-one cable sets selected by the Engineer.
- .9 Test coax cabling for center conductor continuity, shield continuity, impedance (75 ohms), attenuation to limits dependent on the application as described in TIA 942-1.
- .2 Test optical fibre cable according to the following:
 - .1 Cable length measurement, fibre fracture inspection and construction defect inspections using an Optical Time Domain Reflectometer (OTDR).
 - .2 Connector and splice integrity tests using an OTDR.
 - .3 Cable attenuation and loss measurements using an optical power loss test set.
 - .4 Test every fibre of each cable with an OTDR for length and attenuation. Include a hard copy chart recording with the test documentation.
 - .5 Test every fibre of each cable with a power meter/light source combination in both directions. Tabulate and include test results with the test documentation.
 - .6 Multi Mode Fiber
 - .1 Perform factory tests for loss measurements at 850 nm and 1300 nm in both directions using a source and power meter calibrated at these wavelengths. Perform the tests using an LED source. Comply with procedures described in FOTP-171 Methods A1 or D1, or FOTP-34 Method A2. Archive measurement results electronically showing pass/fail results measured using limits provided in TIA 568-C.3 and deliver with viewer/reporting software.

- .2 Perform testing with an optical time domain reflectometer using a launch fiber at both ends. Submit OTDR trace data along with a viewer program. Submit OTDR event table showing reflective events with an absolute value less than 50 dB return loss and non-reflective events with a loss value greater than 0.1 dB.

.7 Single Mode Fiber

- .1 Perform tests for loss measurements at 1310 nm and 1550 nm in both directions using a source and power meter calibrated at these wavelengths. Comply with procedures described in FOTP-171 Methods A3 or D3, or FOTP-34 Method B. Measure against limits provided in TIA-568-C.3. Archive measurement results electronically and show pass/fail results delivered with viewer/reporting software.
- .2 Perform testing with an OTDR using a launch fiber at both ends. Submit OTDR trace data along with a viewer program. Submit OTDR event table showing reflective events with an absolute value less than 50 dB return loss and non-reflective events with a loss value larger than 0.1 dB.
- .3 For single mode fiber runs longer than five km deployed for 10 Gbps or higher rates, measure chromatic dispersion showing absolute dispersion at 1550 nm and polarization mode dispersion. Record and submit results for these fibers in addition to the tests above.

.3 Test Values

- .1 Assemble test results and submit to the Engineer in a timely manner.
- .2 Analyze the results and repair or replace cabling so that the Work results comply with the Specifications.
- .3 Verify that the installed cabling conforms to the manufacture's Specifications.

3.4 **REPAIRS**

- .1 Replace defective or damaged cables and components and re-execute tests.
- .2 Replace defective cables without splicing where splicing is not permitted.

End of Section

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- 1 General
- 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
 - .2 This section shall be read in conjunction with Section 28 02 00 – City of Toronto Structured Cabling Standard and all other Divisions in order to comply with the requirements of the General Conditions of the Contract. Sections 28 02 00 shall take precedence where there is a conflict in this section.
 - .2 Related Sections
 - .1 Refer to all divisions of Work in the Specifications.
- 1.2 **REFERENCES**
 - .1 Safety
 - .1 National
 - .1 Canadian Standards Association CSA C22.1
 - .2 Provincial
 - .1 Ontario Electrical Safety Code
 - .2 Ontario Building Code
 - .2 Performance
 - .1 International Standards Organization
 - .1 ISO11801 Information technology — Generic cabling for customer premises
 - .2 Telecommunications Industry Association (www.tiaonline.org)
 - .1 TIA-526-7 measurement of optical power loss of installed single-mode fibre cable plant
 - .2 TIA-526-14 optical power loss measurements of installed multimode fiber cable plant
 - .3 TIA-568 commercial building telecommunications cabling standard
 - .4 TIA-569 telecommunications pathways and spaces
 - .5 TIA-598 optical fiber cable color coding
 - .6 TIA-606 administration standard for telecommunications infrastructure
 - .7 TIA-607 generic telecommunications bonding and grounding (earthing) for customer premises
 - .8 TIA-758 customer-owned outside plant telecommunications infrastructure standard
 - .9 TIA-862 building automation systems cabling standard
 - .10 TIA-942 telecommunications infrastructure standard for data centers
 - .11 TIA-1005 telecommunications infrastructure standard for industrial premises
 - .12 TIA-1152 requirements for field test instruments and measurements for balanced twisted-pair cabling

- .13 TIA-TSB-62 informative test methods (ITMS) for fiber-optic fibers, cables opto-electronic sources and detectors, sensors, connecting and terminating devices and other fiber-optic components
- .14 TIA-TSB-130 generic guidelines for connectorized polarization maintaining fiber and polarizing fiber cable assemblies for use in telecommunications applications
- .15 TIA-TSB-162 telecommunications cabling guidelines for wireless access points
- .16 TIA-TSB-184 guidelines for supporting power delivery over balanced twisted-pair cabling
- .17 TIA-TSB-190 guidelines on shared pathways and shared sheaths
- .3 Building Industry Consulting Services International (BICSI) (www.bicsi.com)
 - .1 ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices
 - .2 ANSI/NECA/BICSI-568-2006, Standard for Installing Commercial Building Telecommunications Cabling
 - .3 NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
 - .4 Telecommunications Distribution Methods Manual
- .4 International Electrical Testing Association Inc. (www.netaworld.org)

1.3

DEFINITIONS

- .1 Accept the following definitions of terms used within this document
 - .1 Approved sole equivalent. A single Product proposed by the Bidder to displace a named Product as being beneficial to the Contract and which has been reviewed and accepted by the Owner as suitable and acceptable as the only substitute to the named Product.
 - .2 Sole manufacturer: One only manufacturer of indicated Products to the exclusion of all other manufacturers.

1.4

ABBREVIATIONS

- .1 Not specified

1.5

SYSTEM DESCRIPTIONS

- .1 Structured Cabling – Outside Plant
 - .1 Extensions of existing outside plant facilities to new locations in doors.
 - .2 Interception, modification, expansion and improvements to existing incoming carrier pathways where previous pathways exist.
- .2 Structured Cabling – Architecture
 - .1 Organized system of information systems extra low voltage power limited copper cabling arrayed as individual communications channels between end point device connections.
 - .2 Communications channels indicated as *network channels* to operate at 1 Gbps data transfer rate consisting of 8 conductor small gauge copper conductors arranged as four-independently twisted pairs in a common unshielded flame spread rated plastic sheath.

- .3 Organized systems of information systems extra low energy optical fibre cabling arrayed as individual communications channels between end point device connections.
- .4 Communications channels indicated as *network channels* to operate at up to 10 Gbps consisting of two strands of multimode optical fibre in a common sheath sometimes shared with other like fibre strands.
- .5 Network subscribing field devices arrayed in the work area each attached to a network channel outlet jack by work area equipment patch cord.
- .6 Network energizing equipment aggregated in centrally located telecommunications spaces.
- .7 Network energizing equipment attached to network channels by equipment patch cords.
- .8 Network terminations aggregated on common rack mounted patch panels in centrally located telecommunications spaces.
- .9 Work area network outlet terminations mounted on work area faceplates individually, or shared with other like outlet terminations.
- .10 Work area network outlets mounted on faceplates mounted on furniture outlet mounts, electrical conduit wall and surface mounted enclosures.
- .11 Network channels terminated at each end with a connector firmly attached to the fabric of the premises or firmly attached to a faceplate within furniture and fixed to the premises.
- .3 Communications Pathways
 - .1 Comply with TIA 569.
 - .2 Avoid exceeding cable pathway occupancy density of 40% measured by cross section area. Report to the Consultant occurrences where occupancy density exceeds 40% in cable trays or cable runways or optical fibre overhead raceways.
 - .3 Communications pathway infrastructure complying with this document and Division 26 of this Specification.
 - .4 Cables fully enclosed by continuous conduits or continuous cable tray or optical fibre containment raceways or within electrical utility rooms or combination to achieve a fully protected cable distribution system.
 - .5 Optical fibres in medium to large telecommunications rooms or communications equipment rooms in dedicated fibre management raceways with controlled cable entry and descent pathways.
 - .6 Optical fibre cables in cable trays protected by flexible thin wall non-metallic electrical inner duct conduit.
 - .7 Optical fibre cables exposed in cable tray in airborne oil environments installed in protective flexible liquid tight conduit.
 - .8 Communications pathways supplemented with multi-cell pre-lubricated flexible cloth detectable innerduct.
 - .9 Route diversity established by use of two separate and distinct conduits or cable trays or combination within 50 m of distribution point.
- .4 Communications Equipment Room Fittings
 - .1 General

- .1 Entrance protection devices to reduce damage due to overvoltage and over-current conditions on exposed cabling.
- .2 Communications cabinets racks, frames and enclosures and overhead supporting structures and associated components.
- .3 Cabling termination blocks, patch panels, as components of a structured cabling installation.
- .4 Runway mounted cable management systems.
- .5 Termination blocks for multi-pair copper cables.
- .6 Patch panels for 4-pair copper UTP network distribution cables.
- .7 Termination panels for optical fibre cabling.
- .8 Rack mounted cable management systems.
- .2 Cabinets racks, frames and enclosures
 - .1 Cabinets, racks, frames and enclosures as secure and managed spaces to support structured cabling components and network energizing equipment communications equipment, computer equipment, communication cabling terminations and power distribution strips, bars and accessories including inside mounting rails, vertical cable management accessories, air exhaust chimney, doors, side panels, air dams, door locks, with grounding bar securing and bracing brackets all by a sole manufacturer.
 - .2 Communications rack mounted power distribution, protection and power strips.
- .3 Air management and containment systems
 - .1 Overhead supported air management system of panels and supports and doors as supplement to equipment cabinets to create hot / cold air containment system.
- .4 Copper medium termination blocks
 - .1 Termination blocks and patch panels for structured cabling systems manufactured by a sole vendor furnished under a single manufacturer's warranty.
- .5 IDC termination blocks and patch panels
 - .1 IDC termination blocks
 - .1 Wall or backboard mounted insulation displacement wire termination strips in multiples of fifty pins (twenty-five pair) per strip, for 22-26 AWG conductor, inserted in wall mounted panels in assemblies of increments of 300 pairs, in "110" or "BIX" format as indicated; wall or backboard mounted wire management rings, troughs and accessories to match
 - .2 Communications patch panels
 - .1 Panels mounted on flat vertical surfaces, or rails within racks or frames supporting individual or modules of multiple cable terminations
 - .2 Panels supporting individual cable termination jacks
 - .3 Panels supporting cassettes of pre-terminated cable jacks
 - .4 Panels supporting individual optical fibre termination connectors

- .5 Panels supporting cassettes of preterminated optical fibre connectors
- .6 Communications cable management and ladder racking
 - .1 Rack mounted lateral cable retention strips; vertical rack mounted cable troughs; to retain and manage cables within a rack or enclosure.
 - .2 Cable runway supported overhead as open pathway for communications cabling and as support for cable, cable patch panels and power distribution conduits.
 - .3 Cable raceway supported overhead as protected covered pathway for optical fibre cabling, patch cables, providing support and escort into communications racks.
- .7 Communications distributed enclosures
 - .1 Custom surface mounted enclosures to accommodate DIN rail mounted cabling terminations and DIN rail mounted network energizing equipment including DIN rail cabling termination blocks, patch panels, as components of a structured cabling installation, DIN rail mounted termination panels for optical fibre cabling, DIN rail rack mounted cable management systems. Components to support structured cabling components and network energizing equipment.
 - .2 Overhead ladder racking cable runway support including fittings, structural supports, braces, rods and brackets necessary for suspension, attachment or support of communications cabinets, racks, frames and enclosures. Cable management guides and retainers, support brackets, section joining elements, horizontal bends, vertical inside/outside bends, wall support brackets, and ground bonding links all by a sole manufacturer.
 - .3 Rack mounted power distribution and power protection strips for in-rack power distribution, monitoring and control. Mounted vertically and horizontally.
- .5 Communications Copper Backbone Cabling
 - .1 Multi-pair copper pair cabling installed between termination panels within premises and between premises of common owner.
 - .1 Applications
 - .1 Voice frequency band telemetry
 - .2 Voice communications
 - .3 Data network 10 Mbps -100 Mbps,
 - .2 Exposed copper backbone cable protect against overvoltage conditions.
- .6 Communications Copper Backbone Terminations
 - .1 Multipair termination strips, wall or panel or surface mounted.
- .7 Communications Optical Fibre Cabling
 - .1 Multi-strand optical fibre cable.
 - .1 Multi-strand optical fibre of various types as indicated in the contract drawings.
 - .2 Multi-strand optical fibre cables to suit environmental conditions including
 - .1 Physical environments including

- .1 Indoor,
 - .2 Indoor/outdoor, and
 - .3 Outdoor
 - .2 Chemical / Climate conditions including
 - .1 Indoor – dry
 - .2 Indoor – damp
 - .3 Outdoor – damp
 - .3 Multi-strand optical fibre cables of various forms of construction including combinations of OFNP, OFNR, OFNG, loose tube, loose tube with water blocking barrier, tight buffer, tight buffer with water blocking barrier, steel armour, aluminum armour, steel armour with plastic outer jacket, aluminum armour with plastic outer jacket.
 - .4 Multi-strand field terminated and pre-terminated single mode and multimode optical fibre cable assemblies installed between termination panels within premises and between premises of common owner in support of the following applications:
 - .1 Data networking Ethernet: 1 Gbs, 10 Gbs,
 - .2 Data networking carrier: OC-3, OC-12, OC-48, OC-192
- .8 Communications Optical Fibre Terminations
 - .1 Multi-strand optical fibre terminations and couplers
 - .1 Optical fibre terminations of various types as indicated in the Contract Drawings.
 - .2 Factory terminated factory polished cable multi strand assemblies.
 - .3 Field terminated factory polished mechanical attached single strand connectors.
 - .4 Optical fibre termination adapters.
 - .5 Optical fibre field splicing tray and cassettes.
 - .6 Optical fibre rack mounting accessories.
 - .7 Optical fibre fan out cassettes.
- .9 Communications Optical Fibre Termination Enclosures
 - .1 Rack or wall or surface mounted enclosures or trays to accommodate optical fibre terminations, splice trays, and cable loops
 - .2 Accommodation for connector mounting faceplate adapter panels.
- .10 Communications Horizontal Distribution Cabling
 - .1 Four-pair shielded or unshielded copper cabling installed between termination panels and work area outlet in support of the following applications:
 - .1 Voice frequency band telemetry.
 - .2 Voice communications.
 - .3 Data network 10 Mbps, 100 Mbps, 1 Gbps, 10 Gps.
 - .4 Elevator communications intercom.

- .2 Multiple conductor cabling installed between termination panels or field devices and other field devices in support of the following applications:
 - .1 Building management systems.
 - .2 Premises security systems.
 - .3 Premises access and gate controls.
- .3 Modular connectors as terminations of horizontal distribution cables.
- .4 Multi-strand single mode or multimode field terminated or pre-terminated optical fibre cable installed between termination panels and work area terminations in support of the following applications:
 - .1 Data networking Ethernet: 1 Gbs, 10 Gbs, 40 Gpbs, 100 Gpbs.
- .5 Coaxial cables installed between termination panels and work area terminations in support of the following applications:
 - .1 Radio antenna connections.
- .6 Single pair copper cabling installed between termination panels and field devices in support of the following applications:
 - .1 Public address speaker distribution.
- .11 Work Area Faceplate
 - .1 Modular faceplate adapter for mounting on conduit box enclosures to mount single or multiple fixed or modular work area outlets for copper or optical fibre horizontal distribution cables and for audio / visual cable terminations.
- .12 Communications Connecting Cords, Devices, and Adapters
 - .1 Network cords installed between devices and cabling terminations to form or complete a communications channel:
 - .1 Copper medium
 - .1 Copper four-pair, unshielded patch cords of various lengths and colour
 - .2 Optical medium
 - .1 Optical fibre two-strand optical fibre single and multi-mode patch cords of various lengths; duplex LC to duplex LC connector polarity field adjustable A-A and A-B
 - .2 Optical fibre twelve-strand, single mode and multi-mode patch cords of various length
 - .3 Common cord for configuration of 40-GBASE channels using either Method A and Method B or a combination of cabling arrangements compliant with TIA-568-C.0 by manual and non-intervention manipulation of in-field setting of connector pinning polarity and key polarity without need of tools
- .13 Antennas Communications Horizontal Cabling
 - .1 Network wireless access points
 - .1 Horizontal distribution cabling connection from wireless access point to network active device in telecommunications room or enclosure.
 - .2 Wireless access point
 - .1 Comply with Section 27 20 00

1.6 **SHOP DRAWINGS SUBMITTALS**

.1 General Instructions

- .1 Comply with Specification Section 01 33 00.
- .2 Shop Drawings issued and reviewed before construction.
- .3 Retain the services of a person accredited by BICSI as a Registered Communications Distribution Designer (RCDD) to review and stamp shop drawings submitted under this division of work to attest to compliance with contract specifications.

.2 Shop Drawings

.1 Submit Shop Drawings for field installations

- .1 Telecommunications rack equipment elevations for telecommunications rooms, data centre, and AV systems indicating outlet placement and identification of cable terminations by type and by administration labels.
- .2 Wall elevations for telecommunications rooms, data centre, AV equipment spaces.
- .3 Wall elevations and floor layout for carrier entrance rooms.
- .4 Spreadsheet file indicating location on patchpanel the termination of backbone cables and cabling with terminations in the equipment server room and telecom rooms.

.2 Submit Shop Drawings for communications systems Products

- .1 Cables and connectors.
- .2 Termination panels, patch panels, termination blocks.
- .3 Work area faceplates and outlet connectors.
- .4 Manufactured items.
- .5 Enclosures and panels.
- .6 Cable runway and racking.
- .7 Optical fibre raceway systems and accessories
- .8 Cable management accessories.

.3 Submit Shop Drawings to justify and explain proposed deviations from the design depicted in the Contract Documents.

.4 Submit Shop Drawings for manufactured assemblies

- .1 Telecommunications industrial wall mount enclosures.
- .2 Overhead heat containment baffles.

.3 Samples

- .1 Submit test results of cable samples.
- .2 Comply with Specification Section 27 08 00.

.4 Manufacturer's Field Reports

- .1 Provide manufacturer's representative to prepare pre-installation report on communications cabling infrastructure as pre-construction condition in support of manufacturer's warranty. Submit copy of report for Owner's review four weeks before installation commences.

- .2 Obtain statement from manufacturer attesting to fulfillment of terms of manufacturer's warranty. Submit copy of statement for Owner's review four weeks before installation commences.
 - .3 Provide services of manufacturer's representative to conduct periodic site reviews and prepare summary reports of work in progress. Submit each report for Owner's review within two days of observation on site.
 - .5 Close Out Submittals
 - .1 Comply with Section 01 10 00.
 - .2 Submit as-constructed drawings indicating any deviation of cabling, cable administration, and routing from as shown on Contract Drawings.
- 1.7 **QUALITY ASSURANCE**
- .1 Qualifications
 - .1 Comply with requirements of Section 27 05 00.
 - .2 Certifications
 - .1 Comply with requirements of Section 27 05 00.
 - .3 Field Samples
 - .1 Provide minimum of one field sample of each colour and type of component for use in the Work. Submit samples for Owner's review with sufficient lead time to allow modification of Product at Owner's discretion and with a minimum of two weeks before commencement of installation.
 - .2 Provide representative sample of factory manufactured cable assemblies. Submit samples for Owner's review with sufficient lead time to allow modification of Product at Owner's discretion.
 - .4 Pre-Installation Meetings
 - .1 Arrange for and attend pre-installation design and construction meetings. Attendees at meetings to include site work supervisor and technical design supervisor.
 - .1 Minimum of one meeting to review the Contract scope of work.
 - .2 Minimum of one meeting to review the proposed execution of the work.
 - .5 Site Meetings
 - .1 Arrange for and attend construction progress meetings. Attendees at meetings to include site work supervisor and technical design supervisor.
 - .1 Minimum of two site meetings per month commencing on day of mobilization and running until four weeks after site work completion.
- 1.8 **DELIVERY, SHIPPING, HANDLING AND UNLOADING**
- .1 Acceptance at Site
 - .1 Examine Products delivered to site.
 - .2 Reject Products that appear damaged or unfit for use.
 - .3 Verify quality of components. Comply with requirements of Section 27 08 00.
 - .2 Storage and Disposal
 - .1 Maintain a sufficient supply of components to execute and complete the Work.
 - .2 Store and protect the supply of components against loss or damage.

- .3 Make good losses or damages without penalty to the Owner.
- .4 Comply with conditions of site housekeeping and waste removal in the Specifications.

1.9 **WARRANTY**

.1 General Terms

- .1 Provide best warranty available from component vendor; provide as a minimum a warranty as described in the Project Specifications.
- .2 Perform the Work according to the terms dictated by the manufacturer to obtain the best warranty offered by the manufacturer.
- .3 Submit the manufacturer's warranty declaration to the Owner.
- .4 Arrange for the Owner to receive documents to support the manufacturer's extended warranty.

1.10 **COMMISSIONING**

- .1 Execute testing and compliance measurements to comply with Section 27 08 00.
- .2 Submit results to the Owner for review.

1.11 **MAINTENANCE**

- .1 Clean and inspect all optical fibre connections before handing over the installation.
- .2 Provide inspection reports including photographic images of all optical fibre terminations optical mating surfaces.

2 Products

2.1 **MANUFACTURERS**

.1 Manufacturers – General

.1 Manufacturers - Stipulated

- .1 Products by stipulated manufacturer or manufacturers where identified on the contract drawings without substitution.

.2 Manufacturers – Equal

- .1 Products by manufacturer or manufacturers where manufacturer's products are approved as equal and as acceptable substitution expressly by the Owner or Owner's appointed representative.

.3 Manufacturers- Equivalent

- .1 Products by manufacturer or manufacturers where manufacturer's products are functionally and materially identical or superior to the specified product.
- .2 Proof or evidence of equivalence submitted on demand by the Owner.
- .3 Contractor accepts financial and temporal risks on failure of products to meet conditions of equivalency determined at the sole discretion of the Owner or the Owner's appointed representative.

.4 Manufacturers - Voluntary

- .1 In absence of an indicated manufacturer, a sole manufacturer in common with manufacturer of specified copper cabling components.

- .2 In absence of an indicated manufacturer or manufacturer of specified copper cabling products, a sole manufacturer selected from list of recognized manufacturers listed by class of product.
- .5 Manufacturers – Recognized
 - .1 Manufacturers identified in the sections below by class of product.
- .6 Manufacturers - Substitution
 - .1 Acceptable as substitution of products by a sole manufacturer are products supplied by a business joint venture between a cable manufacturer and component manufacturer represented by either party as a sole provider and furnished under a single manufacturer's warranty where such substitution is of demonstrable material or performance benefit to the Owner. Substitution conditional on express approval by the Owner or Owner representative.
- .2 Communications Equipment Room Fittings
 - .1 Equipment racks – floor mounted
 - .1 Hammond
 - .2 Equipment frames – floor mounted
 - .1 Not specified
 - .3 Equipment cabinets – surface mount
 - .1 Hammond
 - .4 Industrial enclosures – surface mount
 - .1 Hammond
 - .5 Power distribution strips
 - .1 Liebert
 - .6 Termination blocks and patch panels
 - .1 Copper cabling termination blocks
 - .1 Belden – BIX series
 - .2 Copper cabling patch panels
 - .1 Panduit
 - .3 Optical fibre cabling system components
 - .1 Comply with 271000.1
 - .7 Overhead cable runway and accessories
 - .1 Chatsworth Products Inc.
 - .2 Cooper Industries
 - .3 Middle Atlantic
- .3 Communications Optical Fiber Cabling
 - .1 Sole manufacturer
 - .1 Optical fibre cabling of double- or multi- strand, single mode or multimode, field terminated or pre-terminated, panel mounted coupling connectors, termination panels, pre-terminated cable assemblies, work area patch

- cables, telecommunications room equipment patch cables, by a sole manufacturer of optical fibre products.
- .2 Termination housings and enclosures, work area outlet, work area outlet faceplate compatible with optical fibre products
- .2 Manufacturers
 - .1 Optical fibre cables, terminations and accessories
 - .1 Corning Cabling
 - .2 Comply with 271000.1
- .4 Communications Copper Backbone Cabling
 - .1 Sole manufacturer
 - .1 Sole manufacturer in common with copper distribution cabling and cabling components
 - .2 Manufacturers
 - .1 Copper – single pair
 - .1 Copper conductor 12 ga to 20 ga insulated to 300 V
 - .1 Comply with Division 26
 - .2 Copper – multiple conductor non-pair
 - .1 Copper conductors 12 ga to 24 ga insulated to 300 V
 - .1 Comply with Division 26
 - .3 Copper – multi pair, with pair count greater than four.
 - .1 General Cable
 - .2 Belden
 - .3 Comply with 271000.1
- .5 Communications Coaxial Cabling
 - .1 Manufacturers
 - .1 Match to existing
- .6 Communications Coaxial Splicing and Terminations
 - .1 Coaxial cable terminations, patch panels
 - .1 Panduit
- .7 Audio-Video Communications Cabling
 - .1 Shielded pair and multi pair
 - .1 Belden
- .8 Paging Communications Cabling
 - .1 Copper one pair 10 ga to 20 ga, insulated 300V
 - .1 Product and manufacturer
 - .1 Not specified
- .9 Antennas Communications Cabling
 - .1 Coaxial type, multi conductor, pre-terminated and connectorized

- .1 Match to existing
 - .2 Wireless access points cabling and accessories
 - .1 Horizontal cabling to comply with section on communications copper distribution cabling
 - .10 Communications Copper Distribution Cabling
 - .1 Copper category four-pair unshielded cable, panel mounted connectors, termination panels, pre-terminated cable assemblies, work area outlet, work area outlet faceplate, work area patch cables, telecommunications room equipment patch cables, all products by a sole manufacturer
 - .1 Manufacturers
 - .1 General Cable
 - .2 Comply with 271000.1
 - .11 Communications Faceplates and Connectors
 - .1 Wall faceplates
 - .1 Same manufacturer as specified for horizontal data cabling.
 - .2 Furniture adapter faceplates, system furniture adapters, modular furniture adapters
 - .1 Same manufacturer as specified for modular and systems furniture.
 - .12 Communications Connecting Cords, Devices, and Adapters
 - .1 Communications copper patch cords
 - .1 Same manufacturer as specified for copper distribution cabling.
 - .2 Communications optical fibre patch cords
 - .1 Same manufacturer as specified for optical fibre distribution or backbone cabling.
- 2.2 **COMPONENTS**
 - .1 Communications Equipment Room Fittings
 - .1 Communications cabinets racks frames and enclosures
 - .1 General
 - .1 Cabinets, racks, frames and equipment enclosures consisting of equipment cabinets, inside mounting rails, inside power distribution strips, vertical cable management accessories, air exhaust chimney, doors, side panels, air dams, door locks, securing and bracing brackets all by a sole manufacturer
 - .2 Wall mounted optical fibre termination enclosures
 - .3 Grounding bar and grounding jumpers installed in each
 - .1 Wall mounted open frame
 - .2 Communications cabinet enclosure or
 - .3 Any other form of equipment enclosure
 - .2 Wall, pole and surface mount industrial enclosures
 - .1 Provide enclosure of Type ID indicated on Contract Drawings

- .2 Comply with 271000.1
- .3 Network communications / server cabinet enclosure
 - .1 General
 - .1 Provide cabinet enclosure equipment rack of Type ID indicated on drawings possessing characteristics drawn from table below for same Type ID.
 - .2 Comply with 271000.1.
 - .3 Communications floor mounted free standing cabinet for mounting network equipment and cabling terminations on 483 mm panels.
 - .4 Frame grounding lug to CAN/CSA C22.1; grounding connection to frame from grounding lugs on removable elements.
 - .2 Cabinet fixtures
 - .1 Quick release removable side panels; Solid roof plate secured to prevent removal from outside the cabinet.
 - .3 Door style
 - .1 Two sets keys milled to Owner specified combination.
 - .2 Single front ventilated door with reversible hang and
 - .3 Split rear ventilated doors;
 - .4 Quick release hinges; opening range greater than 180 degrees;
 - .5 Effective ventilation ratio of 85% by area for front, rear and roof;
 - .6 Frame grounding lug to CAN/CSA C22.1; grounding connection to frame from grounding lugs on removable elements.
 - .7 Metal parts powder coat painted otherwise chrome or cadmium plated.
 - .8 Colour: Industrial light grey (RGB 215-215-215) RAL 7035.
 - .9 Flammability of plastic components to UL94V-1.
 - .10 Safety to IEC 60950.
 - .4 Door lock
 - .1 Keyed lock on front and rear keyed alike to side panel release;
 - .2 Two sets keys milled to Owner specified combination.
 - .5 Cabinet accessories
 - .1 Levelling feet; four casters.
 - .2 Vertical mounting rails adjustable without use of tools; Front and side mounting flange surface vertical mounting rails machine threaded 10-32 at spacing to EIA-310

- .3 Front and rear equipment mounting rails adjustable forward and backward for front and optional rear support; minimum setback of 75 mm from inside surface of front door, minimum offset of 38 mm between side rails and side panels; calibrated and marked in units of 44.45 mm.
- .4 Kit of sixty captive insert cage nuts M6 with washers and mounting bolts.
- .6 Air management
 - .1 Front panel blanking kit; plastic front mounting panels, full height in 1RU increments, black plastic
- .7 Instrumentation
 - .1 SNMP/Ethernet/IP monitor module to measure, report and alarm on open door, high temperature.
 - .2 Mounting for intrusion detector alarm switch.
 - .3 Door open detector switch on front and rear doors.
- .8 Server cabinets attributes
 - .1 Provide cabinets indicated as "SERVER" with components possessing the following change of attributes
 - .2 Change: Vertical mounting rails machine threaded 10-32 at spacing to EIA-310

Replace with: Vertical mounting rails surface square punched at spacing to EIA-310;
 - .3 Kit of sixty captive insert cage nuts M6 with washers and mounting bolts.
- .4 Cable management channel - inrack
 - .1 Four vertical cable management channels within equipment enclosures and outside equipment space
 - .2 Inside cable openings of 75 mm diameter minimum and outside cable openings of minimum two 100 mm x 100 mm and three 100 mm x 200 mm openings fitted with grommets on each side.
- .2 Products
 - .1 Provide Products indicated in table below corresponding to Type ID and approved manufacturer.
 - .2 Provide approved equivalent.

Table 1 - Network Communications Cabinet Enclosure – By Properties

Type ID	IP rating	NEMA	Rail width	Width	Depth	RU
E751-44	IP21	1	483mm"	762mm	1067mm	44

Table 2 - Network Communications Cabinet Enclosures - By Manufacturer

Type ID	HP	Panduit	Rittal	WrightLine	
E751-44				Paramount-44	

- .5 Cable management side plenum chaseway

- .1 Verical metallic chaseway to complement network rack, side mounted

Table 3 - Enclosure Side Plenum Chase - By Properties

Type ID	IP rating	NEMA	Width	Depth	RU
EC032-44	IP21	1	300mm12in	914mm	44

Table 4 - Enclosure Chase Side Plenum - By Manufacturer

Type ID	HP	Panduit	Rittal	WrightLine	
EC032-44				Paramount side cable chase 44RU x 12 x 42	

- .6 Rack grounding bar
- .1 General
- .1 Grounding bar kit, rack mounted, 483 mm long, tin plated, predrilled to accept twenty thread forming installed 12-24 screws spaced at 15.9 mm, two cage nut bonding screws, four bonding nuts, to C22.2 No 41-13, UL 467, EIA-310.
- .2 Two bolt grounding jumper kit, #6 AWG ground bonding conductor, compression lug terminated one end.
- .2 Product
- .1 Panduit RGRB19CN
- .7 Optical fibre enclosures-Interior
- .1 Wall or surface mount metallic enclosures identified by Type ID below
- .2 Accommodate optical fibre termination connector couplers, splice tray, loop storage
- .3 Provide all accessories to complete fibre splice and connector terminations
- .4 Swing door, exterior door lock
- .5 IP / NEMA ratings
- .1 NEMA 1
- .6 Independent compartments for optional patch cords
- .7 Accommodate splice trays by same or other manufacturer
- .8 Accommodate coupler connectors by same or other manufacturer
- .9 Styles with capacities of
- .1 12 to 192 LC terminations in increments of 12
- .2 Inline splice trays
- .10 Accessories
- .1 Splice tray with heatshrink splice protectors
- .2 Coupler mounting plates
- .11 Products
- .1 Products and fibre splice & connector accessories by sole manufacturer

- .2 Approved Product by sole manufacturer of optical fibre cabling system products.
- .3 Approved manufacturer identified on contract drawings.
- .8 Optical fibre enclosures – interior/exterior
 - .1 Wall or surface mount metallic enclosures identified by Type ID below
 - .2 Stainless steel construction
 - .3 Accommodate optical fibre termination connector couplers, splice tray, loop storage
 - .4 Provide all accessories to complete fibre splice and connector terminations
 - .5 Swing door, exterior door lock
 - .6 IP / NEMA ratings
 - .1 NEMA 4X
 - .7 Accommodate splice trays by sole manufacturer
 - .8 Styles with capacities of
 - .1 144 inline splices connections
 - .9 Accessories
 - .1 Splice tray with heatshrink splice protectors
 - .10 Products
 - .1 Products and fibre splice & connector accessories by sole manufacturer
 - .2 Approved Product by sole manufacturer of optical fibre cabling system products.
 - .3 Approved manufacturer identified on contract drawings.

Table 5 - Fibre Splice Enclosures - By Properties

Type ID	Environment	Termination type	Patch cord compartment	Capacity	Rating	Size
OFSE-12	Interior	Splice/coupler	Yes	12	NEMA 1	279 x 330 x 64
OFSE-24	Interior	Splice/coupler	Yes	24	NEMA 1	279 x 330 x 64
OFSE-48	Interior	Splice/coupler	Yes	48	NEMA 1	279 x 330 x 108
OFSE-96	Interior	Splice/coupler	Yes	96	NEMA 1	279 x 330 x 152
OFSE-144E	Interior / exterior	Inline splice	None	144	NEMA 4X	472 x 422 x 262

Table 6 - Fibre Splice Enclosure - By Manufacturer

Type ID	Corning	Commscope		
OFSE-12		WBE-EMT-BK/1P		
OFSE-24		WBE-EMT-BK/2P		
OFSE-48		WBE-EMT-BK/4P		
OFSE-96		WBE-EMT-BK/8P		

OFSE-144E	SSDC			
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.2 Communications Terminal Blocks, Terminations, Connectors and Patch Panels

.1 Copper paired cables termination block strips

- .1 Termination of unshielded twisted pair copper multipair cables.
- .2 Termination blocks as fixed wall or surface or rack mounted terminations of backbone or distribution cabling.
- .3 Insulation displacement terminations for solid copper conductors between 24 AWG – 20 AWG.
- .4 Termination of shielded twisted pair copper multipair cables with grounding bar.
- .5 Termination strips or wafers panel mounted in groups of fifty through three hundred terminations in increments of fifty.
- .6 Strips in industry format “110” type or “BIX” type.
- .7 Flat wall mount panels for support of multiple BIX wafers; panels in multiples of 250 or 300 terminations; cable dressing spacers between adjacent panels.
- .8 Flat wall mount support for single or multiple 110 type strips.
- .9 Match performance of termination block to performance of cable being terminated.

Table 7 - Termination Block Strips - By Properties

Type ID	U/S	Category	Form	Pin	Ground
B11	U/UTP	1	110	50	
B12	U/UTP	3	110	50	
B13	U/UTP	5e	110	50	
B14	U/UTP	6	110	50	
B15	U/UTP	6A	110	50	
B21	U/UTP	1	BIX	50	
B22	U/UTP	3	BIX	50	
B23	U/UTP	5e	BIX	50	
B24	U/UTP	6	BIX	50	
B25	U/UTP	6A	BIX	50	
B31	S/UTP	1	110	50	Ground
B32	S/UTP	3	110	50	Ground
B33	S/UTP	5e	110	50	Ground
B34	S/UTP	6	110	50	Ground
B35	S/UTP	6A	110	50	Ground
B41	S/UTP	1	BIX	50	Ground
B42	S/UTP	3	BIX	50	Ground
B43	S/UTP	5e	BIX	50	Ground
B44	S/UTP	6	BIX	50	Ground
B45	S/UTP	6A	BIX	50	Ground

Table 8 - Termination Block Strips - By Manufacturer

	Belden	Commscope	Panduit		
B23					
B43					

Table 9 - Vacant (Non-populated) Communications Patch Panel

Type ID	RU	Capacity	F/A/R/W	SNAP IN	Grounding	
V12W1M	1	12	Wall	Module		
V12W6F	1	12	Wall	Faceplate-4		
V24F1	1	24	Flat	Module		
V24F1S	1	24	Flat	Module	Yes	
V24A1	1	24	Angled	Module		
V24A1S	1	24	Angled	Module	Yes	
V24R1	1	24	Recessed	Module		
V24R1S	1	24	Recessed	Module	Yes	
V48F1	2	48	Flat	Module		
V48F1S	2	48	Flat	Module	Yes	
V48A1	2	48	Angled	Module		
V48A1S	2	48	Angled	Module	Yes	
V48R1	2	48	Recessed	Module		
V48R1S	2	48	Recessed	Module	Yes	
V72F1	2	72	Flat	Module		
V72F1S	2	72	Flat	Module	Yes	
V72A1	2	72	Angled	Module		
V72A1S	2	72	Angled	Module	Yes	
V72R1	2	72	Recessed	Module		
V72R1S	2	72	Recessed	Module	Yes	
V24F4	1	24	Flat	Faceplate-4		
V24A4	1	24	Angled	Faceplate-4		
V24R4	1	24	Recessed	Faceplate-4		
V24F6	1	24	Flat	Faceplate-6		
V24A6	1	24	Angled	Faceplate-6		
V24R6	1	24	Recessed	Faceplate-6		
V48F4	2	48	Flat	Faceplate-4		
V48A4	2	48	Angled	Faceplate-4		
V48R4	2	48	Recessed	Faceplate-4		
V48F6	2	48	Flat	Faceplate-6		
V48A6	2	48	Angled	Faceplate-6		
V48R6	2	48	Recessed	Faceplate-6		

Table 10 - Vacant Patch Panel - By Manufacturer

Type ID					Panduit	
V12W1M						
V12W6F						
V24F1						
V24F1S						

Type ID					Panduit	
V24A1						
V24A1S						
V24R1						
V24R1S						
V48F1						
V48F1S						
V48A1						
V48A1S						
V48R1						
V48R1S						
V72F1						
V72F1S						
V72A1						
V72A1S						
V72R1						
V72R1S						
V24F4					CPP24WBLY	
V24A4						
V24R4						
V24F6						
V24A6						
V24R6						
V48F4					CPP48WBLY	
V48A4						
V48R4						
V48F6						
V48A6						
V48R6						

.2 UTP 4-pair cable termination rack mount patch panels

- .1 Patch panels consisting of multiple single position 8P8C (RJ45) jacks or six-position modules of preformed 8P8C (RJ45) jacks, 22-26 AWG IDC connection block for solid or stranded wire to TIA 568B pinning, panel format with lands for individual port identification labels and panel identification label, forming panels of twelve, twenty-four, or forty-eight or seventy-two ports per panel. Cable retention bar and back-of-panel cable support and strain relief bracket to secure cable perpendicular to panel; colour: Black.

.2 Products

- .1 Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.

Table 11 - Termination Patch Panels - UTP 8P8C - By Properties

Type ID	Category	U/F/S	Port	RU			
P25	6A	UTP	24	1	Flat		

Table 12 - Termination Patch Panels - UTP 8P8C - By Manufacturer

Type ID	Panduit	Commscope	Tyco	Belden		
P25	DP246X88TGY			AX103254		

.3 UTP 25 pair cable termination rack mount patch panels

- .1 Patch panels consisting of twelve or twenty-four single position 8P2C RJ45 jacks pins 4-5 active RJ21 connector panel format with lands for individual port identification labels and panel identification label, colour: Black.

.2 Products

- .1 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.

Table 13 - Termination Patch Panels UTP 8P2C - By Properties

Type ID	Category	U/F/S	Port	RU	Face	Term
V11	1	UTP	12	1	Flat	RJ21
V21	1	UTP	24	1	Flat	RJ21

Table 14 - Termination Patch Panels UTP 8P2C - By Manufacturer

Type ID	Panduit				
V11					
V21	VP24382TV25Y				

.4 Copper medium jacks

.1 UTP and STP 2-pair 4P4C jack – non-keyed

- .1 Modular plastic formed telecommunications four-pin four-conductor outlet jack non-keyed, comply with ANSI/TIA/EIA 568 specification and CSA T529, 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 for termination of unshielded and shielded twisted pair cables.

.2 Colour: Black or as indicated on the drawings.

Table 15 - Termination Jacks UTP 4P4C - By Properties

Type ID	Category	Pair	Form
J11	1	2	UTP
J12	3	2	UTP
J13	5e	2	UTP
J14	6	2	UTP
J15	6A	2	UTP

Table 16 - Termination Jacks STP 4P4C - By Properties

Type ID	Category	Pair	Form
J21	1	2	S/UTP
J22	3	2	S/UTP
J23	5e	2	S/UTP
J24	6	2	S/UTP
J25	6A	2	S/UTP

.3 Products

- .1 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.

Table 17 - Termination Jacks 4P4C - By Manufacturer

Type ID	Belden	Panduit	
J14			
J15			

.2 UTP 4-Pair 8P8C (RJ45) modular jack – non-keyed

- .1 Modular plastic formed telecommunications eight-pin eight-conductor ("RJ45") outlet jack non-keyed, comply with ANSI/TIA/EIA 568 specification and CSA T529, 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, built in modular cable strain relief for termination for shielded and unshielded twisted pair cables.
- .2 Colour: Black or as indicated on the drawings.

Table 18 - Termination Jacks 8P8C - By Properties

Type ID	Category	Pair	Form
J51	1	4	UTP
J52	3	4	UTP
J53	5e	4	UTP
J54	6	4	UTP
J55	6A	4	UTP

.3 Products

- .1 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.

Table 19 - Termination Jacks 8P8C - By Manufacturer

Type ID	Belden	Panduit	
J54			
J64			

.3 UTP 4-pair 8P8C (RJ45) modular jack – non-keyed – keystone format

- .1 Modular plastic formed telecommunications eight-pin eight-conductor ("RJ45") outlet keystone jack non-keyed, comply with ANSI/TIA/EIA 568 specification and CSA T529, 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, for use with keystone jack.
- .2 Colour: Black or as indicated on the drawings.

Table 20 - Termination Jacks 8P8C Keystone - By Properties

Type ID	Category	Pair	Form
J81	1	4	UTP
J82	3	4	UTP
J83	5e	3	UTP

J84		6	4	UTP
J85		6A	4	UTP

.3 Products

.1 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.

.2 Comply with 271000.1

.5 Optical fibre termination connectors

.1 Field installed discrete connectors as terminations for optical fibre strands in single or multi-stranded cable assemblies

.1 For installation on fibres of 250 micron, 900 micron tight buffer, 2 mm jacketed, 3 mm jacketed

.2 Type LC, LC duplex, SC, SC duplex, and ST

.3 Multimode OM1, OM2, OM3, OM4 performance: Insertion loss maximum 0.5 dB, typical 0.2 dB, return loss minimum 25 dB

.4 Single mode OS1, OS2 connectors

.1 Finished to UPC (Ultra Physical Contact) with insertion loss maximum 0.5 dB, typical 0.3 dB, return loss minimum 50 dB

.2 Finished to APC (Angled Physical Contact) with insertion loss maximum 0.5 dB, typical 0.3 dB, return loss minimum 60 dB

.2 Field fusion splice connector pigtail assemblies as terminations of single, dual and multi-stranded optical fibre cable assemblies

.1 For installation on fibres of 250 micron, 900 micron tight buffer, 2 mm jacketed, 3 mm jacketed

.2 Type LC, LC duplex, SC, SC duplex, and ST

.3 Multimode OM1, OM2, OM3, OM4 performance: Insertion loss maximum 0.5 dB, typical 0.2 dB, return loss minimum 25 dB

.4 Single mode OS1, OS2 connectors

.1 Finished to UPC (Ultra Physical Contact) with insertion loss maximum 0.5 dB, typical 0.3 dB, return loss minimum 50 dB

.2 Finished to APC (Angled Physical Contact) with insertion loss maximum 0.5 dB, typical 0.3 dB, return loss minimum 60 dB

.5 Single pigtails

.1 900 micron tight buffered

.2 2 mm and 3 mm zip interconnect cable

.3 LC terminated in kit of 12 TIA colour coded

.6 Duplex pigtail

.1 900 micron tight buffered

.2 2 mm and 3 mm zip interconnect cable

- .7 Twelve-fibre ribbon pigtails formed and made ready to mass fusion terminate twelve strand ribbon
 - .1 Jacketed or not jacketed
 - .2 MPO terminated 250 micron loose
 - .3 LC terminated in kit of twelve TIA colour coded
- .8 Products
 - .1 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.
 - .2 Comply with 271000.1

Table 21 - Optical Fibre Terminations - Multimode

Type	Strand	Perform	Mech/Fusion
TM011M-xx	1	OM1	M
TM012M-xx	1	OM2	M
TM013M-xx	1	OM3	M
TM014M-xx	1	OM4	M
TM011F-xx	1	OM1	F
TM012F-xx	1	OM2	F
TM013F-xx	1	OM3	F
TM014F-xx	1	OM4	F
TM121M-xx	12	OM1	M
TM122M-xx	12	OM2	M
TM123M-xx	12	OM3	M
TM124M-xx	12	OM4	M
TM121F-xx	12	OM1	F
TM122F-xx	12	OM2	F
TM123F-xx	12	OM3	F
TM124F-xx	12	OM4	F

Table 22 - Optical Fibre Terminations - Single Mode

Type	Strand	Perform	Mech/Fusion
TS011M-XX	1	OS1	M
TS012M-XX	1	OS2	M
TS011F-XX	1	OS1	F
TS012F-XX	1	OS2	F
TS121M-XX	12	OS1	M
TS122M-XX	12	OS2	M
TS121F-XX	12	OS1	F
TS122F-XX	12	OS2	F

Table 23 - Optical Fibre Termination Type Modifier

-xx	LC	SC	MPO	Duplex	AP
01	Yes				
02		Yes			
04			Yes		
09	Yes			Yes	
10		Yes		Yes	
11	Yes				Yes

24		Yes			Yes
26	Yes			Yes	Yes

.1 Optical Fibre connector adapter mounting panel

.1 6-port, 12 port, LC duplex mounting panel

.2 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.

.3 Manufacturer

.1 Corning:

Table 24 - Optical Fibre Termination Mounting Adapter - By Feature

Type ID	Description	Fibre	Class	Face	Rear
OFMA-6-LD	6-port	12 strand	OM4	LC Duplex	LC Duplex

Table 25 - Optical Fibre Termination Mounting Adapter - By Manufacturer

Type ID	Corning			
OFMA-6-LD	CCH-CP12-E4			

.2 Optical fibre termination cassette

.1 Not specified

.3 Communications Cable Management and Ladder Rack

.1 Rack mounted cable management devices and accessories. High capacity cable managers for horizontal mounting in 483 mm racks, cabinets or frames, complete with removable dual hinged covers, cable management fingers, front and optional rear pathways, suitable for cables of diameter 8.0 mm, manufactured of plastic with optional removable covers of metal or plastic, channel depth greater than 150 mm, colour black

.2 Cable managers in modular units of one, two, three or four rack units.

Table 26 - Rack Mount Cable Management - By Properties

Type ID	RU	channel
M11	1	Front
M12	2	Front
M13	3	Front
M14	4	Front
M31	1	Front/rear
M32	2	Front/rear
M33	3	Front/rear
M44	4	Front/rear

.1 Product

.1 Provide cable management accessories of type ID as shown on the Contract Drawings and of same manufacturer as communications terminations patch panels.

Table 27 - Rack Mount Cable Management - By Manufacturer

Type ID	Belden	Panduit	Commscope
M11			
M12		NMF1	
M13			
M14		NMF4	

Type ID	Belden	Panduit	Commscope
M31			
M32			
M33			
M44			

.3 Overhead ladder racking cable runway and accessories

.1 Cable runway

- .1 UL classified 38.1 deep tubular side stringer, 25.4 x 12.7 rails, welded, spaced at 230, steel, 300 mm wide.
- .2 Length 2959 mm.
- .3 Radius bend connecting section ninety degrees vertical, external and internal.
- .4 Radius e-bend section ninety degrees horizontal.
- .5 Radius cable drop.
- .6 Radius corner bracket.
- .7 Colour: gold over zinc.

.2 Cable runway accessories

- .1 Support "C" clips, couplers, to match and by same manufacturer as runway.

.3 Products

- .1 Chatsworth Products: 11275-012
- .2 Approved sole equivalent

Table 28 - Ladder Racking Runway - By Manufacturer

	CPI	Cooper	Middle Atlantic		
Tubular stringer	11275-012	SB17T			
Solid stringer					

.4 Racking accessories

- .1 Front of rack mounted shelving, 380 mm deep, ventilated, support capacity 23 kg one or two rack units high.
- .2 Products
 - .1 Same manufacture as for equipment cabinets

.4 Rack Mounted Power Distribution Strip

.1 General

- .1 Power distribution strips fully compatible with equipment cabinets and racking
- .2 Power strips with flexible connection whips terminated with lockable twist lock plugs of length sufficient to reach power distribution outlets

.2 Monitoring

- .1 Provide distribution strips with integrated power monitoring where indicated
- .2 Metered units with digital RMS current monitoring, local display, with SNMP reporting and alarm indication

- .3 Power strips formats
 - .1 30A 230V L6-30P; 42 x IEC C13, Metered

Table 29 - Rack Mounted Power Strips - By Properties

TYPE ID	Voltage	Amp phas e	KW	Branc h Recept	Type	Branc h Recept	Typ e	Feed Plug	Mete r
PDI230SM	230	30	5.5	42	IEC C13			L6-30	Yes

- .4 Products
 - .1 Provide power distribution strips of type indicated by listed manufacturers

Table 30 - Rack Mounted Power Strips - By Manufacturer

TYPE ID	Server technology	Geist	APCC	Liebert	
PDI230SM				MPH2	

- .5 Communications Copper Backbone Cabling
 - .1 General
 - .1 Provide CMP rated Backbone cables except where expressly indicated otherwise.
 - .2 Provide CMP or CMR rated backbone cables where no portion of the entire length of cable is exposed to air contact within an air supply or air return plenum or air within an enclosed space.
 - .3 Provide CMP or CMR rated backbone cables where cables are contained within electrical communications utility rooms possessing a fire rating of one-hour or continuous electrical raceway or combination.
 - .4 Avoid using cables outdoors if characterized for inside use
 - .5 Comply with 271000.1
 - .6 Provide cable of the type ID indicated on the Contract Drawings possessing the attributes and characteristics indicted by the table below
 - .2 Copper backbone cable - Inside
 - .1 Multi-pair powersum 24 AWG solid annealed copper twisted pair 100 Ω characteristic impedance cable per ANSI/EIA/TIA 568 in identified binder groups, formed as compact core, covered by dual polyolefin/polyvinyl chloride insulation and an Alplast sheath, cable jacket
 - .3 Apply the following definitions to the terms appearing in the table:
 - .1 Type ID: The cable designation as it appears in the Contract Documents
 - .2 Pair: The number of twisted pairs of conductors in a common sheath
 - .3 Form:
 - .1 U designates unshielded cable;
 - .2 S designates cable protected by an overall electromagnetic shield;
 - .3 F designates cable or individual pairs protected by individual foil electromagnetic shielding.
 - .4 Cat: The performance of the cable further defined within TIA-568 as the performance category of cable
 - .5 Outdoor: Indicates the cable construction is suitable for use outdoors

- .6 Armour: The cable is protected by an outer protective armoured casing
- .7 Blocked: The cable is protected against ingress of water
- .8 Bury: The cable is suitable for direct burial applications
- .4 Manufacturer
 - .1 Use products where specifically identified by Manufacturer in the tables below

Table 31- Unshielded Copper Backbone Cabling – By Properties

Type ID	Pair	Form	Cat	Outdoor	Armour	Blocked	Bury
C52	25	U/UTP	3	No	No	No	No

Table 32 - Unshielded Copper Backbone Cabling – By Manufacturer

Type ID	Belden	Panduit	Systemax	General Cable
C52	DPLN25			2131505

- .6 Communications Optical Fibre Backbone Cabling
 - .1 General
 - .1 Cable of type indicated Contract Drawings possessing characteristics identified in tables below.
 - .2 Manufacturer
 - .1 Use products identified by Manufacturer in the tables below
 - .2 Use products manufactured by Corning to exclusion of all others.
 - .3 Fire rating
 - .1 Cable jacket rated OFNP or OFCP.
 - .2 Cable jacket rated OFNR or OFCR or OFNG or OFCG where permitted by local electrical and building safety codes, unless specifically excluded in this contract.
 - .4 Comply with Section 27 10 00.1

Table 33 - Multimode Fibre, Indoor/Outdoor (Service) by Strand Count, Performance

Type ID	Strand	Env	Purpose	Construction	Armor	dia		Core	Perf	Term
MS1241	12	In/out	Backbone	Tight buffer	Yes	250		50	OM4	

Table 34 - Mutlimode (Service) Type Cable - By Manufacturer

Type ID	Belden	Corning	Panduit	
MS1241		012T8P-31190-A3		

- .7 Communications Optical Fibre Trunk cabling: modular terminated
 - .1 General
 - .1 Ribbon cable assemblies of twelve or twenty-four strand factory made consisting of multi-strand cable factory terminated with multi-fibre push-on pull-off (MPO) connecto(s) at two ends
 - .2 Pigtail assemblies, saem as ribbon assembly with one end not terminated
 - .3 LC Duplex break out cables, same as Ribbon assemblies with near end MPO termination, far end LC Duplex
 - .2 Cable
 - .1 Ribbon cable

- .1 Jacket diameter, nominally 2 mm, 3 mm
- .2 Performance type OM3, OM4, OM5, OS2
- .3 12 or 24 Strand
- .2 Fibre cable assembly with modular connector terminations of type ID indicated in table below
- .3 Terminations
 - .1 MPO style
 - .2 Polished to PC, UPC, APC.
 - .3 Multi strand with Polarity Maintenance
 - .4 Pinned (Male) or Not pinned (Female) and Gender field adjustable
 - .5 Not termination (pigtail)
 - .6 LC Duplex termination
 - .7 Fibre cable assembly termination of type modifier indicated in tables below
- .4 Polarity Maintenance
 - .1 Array trunk cabling using Method B polarity maintenance. Comply with TIA 568.0
 - .2 Multimode cable using Type B terminations with UPC polish
 - .1 Couplers using Type B (key up/Key up)
 - .2 Cassettes using Method B (Key up)

Table 35 - Optical Fibre Trunk Cables: Modular Connector Termination

Type ID+MODIFIER	Strand	Near Connector	Far Connector	Fibre Type
MM1204-pppp	12	MPO	MPO	OM4
MN1204-pppp	12	MPO	None	OM4
ML1204-pppp	12	MPO	LC-Duplex	OM4
ML1202-pppp	12	MPO	LC-Duplex	OS2

Table 36 - Optical Fibre Trunk Cables Termination Type Modifier

-pppp	Near Key	Near gender	Far Key	Far gender	Polish
-11	Key UP	Pinned	None	None	UPC
-11-11	Key UP	Pinned	Key UP	Pinned	UPC

- .8 Audio-Visual Communications Horizontal Cabling
 - .1 HDMI extension cabling
 - .1 Cables of length less than 10 m, Factory made cable preterminated HDMI connectors on multi conductor copper cable.
 - .2 Cables of length greater than 10 m, Factory made cable preterminated with active HDMI transducers on optical fibre cable assembly.
- .9 Paging Communications Horizontal Cabling
 - .1 Comply with manufacturer's installation instructions for 70 V PA distribution.

- .2 2-#12 copper 300V insulated in flexible metallic armour.
- .10 Communications Horizontal Distribution Cabling
 - .1 Cable
 - .1 Four-pair twisted copper 24-23 AWG cables of characteristic impedance 100Ω: Fire rating to CMR (FT4) or CMP (FT6); performance to category class defined by TIA 568; additional EMI protection by conductive foil or metallic shield.
 - .2 Provide cables of type ID possessing characteristics drawn from the table below
 - .1 Outdoor cables
 - .2 Water blocked cables
 - .3 Armoured
 - .4 Direct bury
 - .5 Other
 - .1 HT: High tensile strength
 - .3 Category cables characterized to bandwidths
 - .1 Category 6A: 625 MHz
 - .4 Colour
 - .1 Select cable from tables below to qualify performance criteria.
 - .2 Select cable with same performance criteria and with jacket of colour to match requirements indicated in section on Administration and Identification.
 - .3 Where not indicated otherwise, select the following colours
 - .1 CAT-6A general purpose data cabling: BLUE
 - .5 Products
 - .1 Provide Products of type ID indicated on the Contract Drawing and by the indicated manufacturer.
 - .2 Provide Products same or better than Products identified below.
 - .6 Comply with Section 27 10 00.1A

Table 37 - Copper Horizontal Distribution Cabling - By Properties

Type ID	Form	Cat	EMI	Placement	Waterblock	Armour	Bury	other
C15	U/UTP	6A	No Shield	Indoor	No	No	No	

Table 38 - Copper Horizontal Distribution Cabling - By Manufacturer

Type ID	Amp	Belden	Commscope	Leviton	Panduit	GeneralCable
C15		10GX			PUP6X04BU-	7141819

- .2 Modular jacks
 - .1 Modular jacks mounted as a component of patch panels located in telecommunications equipment rooms:
 - .1 Comply with section "communications terminal blocks and patch panels"
 - .2 Modular jacks mounted on work area faceplate

- .1 Comply with section "communications faceplates and connectors"
- .3 Comply with 271000.1A
- .11 Communications Faceplates and Connectors (Jacks)
 - .1 Wall faceplates
 - .1 Comply with 271000.1
 - .2 Plastic faceplate, as cover to single or multi position electrical conduit outlet box, with capacity of one, two, three, four, six, ten outlets with flat or sloping face, to suit snap-in jack.
 - .1 Colour to match electrical faceplate, or else white if not specified.
 - .2 Blank cover plate to match.
 - .3 Manufacturer same as snap in jack.
 - .3 Stainless steel faceplate, as cover to single or multi position electrical conduit outlet box, with capacity of one, two, three, four, six, ten outlets with flat or sloping face, to suit snap-in jack.
 - .1 Blank cover plate to match.
 - .2 Manufacturer same as snap in jack.
 - .4 Stainless steel faceplate, with two phone mounting lugs, as cover to single position electrical conduit outlet box, with capacity of one outlet with flat face, to suit single keystone snap-in jack.
 - .1 Blank cover plate to match.
 - .2 Manufacturer same as snap in jack.
 - .5 Plastic faceplate, as cover to single position electrical square faced decorator style conduit outlet box, with capacity of one, two, three, four outlets with flat or sloping face, to suit snap-in jack
 - .1 Blank cover plate to match.
 - .2 Manufacturer same as snap in jack.
 - .6 Comply with manufacturer specified for horizontal data cabling.
 - .2 Furniture adapter faceplates, system furniture adapters, modular furniture adapters
 - .1 Plastic faceplate, as snap in mounting plate for single position furniture mounting plate of capacity of one, two, three outlets with flat or sloping face, to suit snap-in jack.
 - .2 Plate form compatible with furniture snap in mounting bracket.
 - .1 Colour to match electrical faceplate, or else black if not specified.
 - .2 Manufacturer same as snap in jack.
 - .3 Same manufacturer as specified for modular and systems furniture.
 - .3 Modular jack
 - .1 Modular jacks, 8P8C, 6P6C, 4P4C suitable for mounting in all faceplates identified, including 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, compatible with shielded panel and shielded cable options.
- .2 Comply with Specification and manufacturer for modular jacks described in section “communications terminal blocks and patch panels”.
- .3 Jacks with colour coded removable identification icon, and modular cable strain relief.
- .12 **Communications Connecting Cords, Devices, and Adapters**
 - .1 **Communications copper patch cords**
 - .1 Factory manufactured and tested patch cords of stranded copper conductor 24 or 28 ga, Unshielded Twisted Pair (UTP), solid or stranded, construction terminated in factory installed RJ45 plugs, of category equal to category of horizontal distribution cabling, of manufacturer equal to manufacturer of horizontal distribution cabling, cords of various length, and colour; diameter 3.8 mm.
 - .2 Patch cord supplied complete with factory test report detailing at least NEXT and electrical length (m)
 - .3 Performance to ANSI/TIA/EIA-1096A, IEC 60603-7, UL1863, CSA C22.2, IEEE 802.3af, 802.3at, temperature range of -40 °C to 60 °C. Polycarbonate housing toUL94V.
 - .4 Manufacturer equal to manufacturer of copper distribution cabling.
 - .5 Provide products as indicated by Type ID on the construct drawings drawn from the table below.

Table 39 - Copper Patch Cords - By Performance

Type ID	Shield	Category	Cond	AWG	Jacket	Pinning	Length (m)
U5-ST24-B-R-210	UTP	5E	stranded	24	CMR	568-B	2.10

- .2 **Communications optical fibre patch cords**
 - .1 Factory manufactured and tested optical fibre patch cords, two-strand terminated duplex LC – duplex LC, cord diameter 1.6 mm, of various lengths and colours. Connectors of low connector insertion / withdrawal force, and high cable retention force; to TIA/EIA-568-c.3, TIA-604-10, ISO/IEC 1101.
 - .2 Factory manufactured and tested optical fibre patch cords, twelve-strand terminated MPO-MPO cord diameter 3 mm, of various lengths and colours. Connectors of low connector insertion / withdrawal force, and high cable retention force; connectors field modified to be male/female, key-up/key down. TIA/EIA-568-c.1, TIA-604-5, ISO/IEC 1101.
 - .3 Performance to OM3, OM4, OS1, or OS2 equal to performance of fixed link cabling.
 - .4 Manufacturer equal to manufacturer of optical fibre distribution or backbone cabling.
- 3 **Execution**
 - 3.1 **PREPARATION**
 - .1 Protect cabling during installation against damage caused by later construction or by activities by others.
 - .2 In areas exposed to welding, protect cabling against damage due to weld fragments.

3.2 **INSTALLATION**

- .1 Communications Equipment Room Fittings
 - .1 Communications terminal blocks and patch panels
 - .1 Install patch panels in racking.
 - .2 Install jacks and connectors in panels.
 - .3 Mount wall mounted components on walls as indicated following manufacturer's recommendations.
 - .4 Protection
 - .1 Install protection modules.
 - .2 Install protection devices on exposed copper communication cables, following manufacturer's recommendations. Bond protection grounding terminal to building ground or electrical safety ground. Do not bond to telecommunications bond.
 - .2 Equipment enclosures
 - .1 Install cabinets, racks, and enclosures. Adjust location on site to align with building, fixtures, flooring. Relocate any cabinet, rack, frame or enclosure within the same room by a horizontal distance of up to 3 m from the location shown without adjustment to Contract Price.
 - .2 Install power distribution strips in cabinets.
 - .3 Communications cable management and ladder rack
 - .1 Suspend overhead cable runway at spacing of supports of 1.5 m or less; use only manufactured accessories; avoid the use of trapeze type supports; finish exposed cut ends with end caps; finish exposed rods with acorn nuts; paint all damaged areas with matching paint.
 - .2 Install cable management accessories; follow manufacturer's recommendations.
- .2 Communications Cabling
 - .1 General
 - .1 Cables and cable pathways run parallel or perpendicular to building lines.
 - .2 Avoid scraping, denting, crushing, twisting, kinking or otherwise damaging cables before, during, or after installation. Contractor to replace damaged cables without additional compensation.
 - .3 Install all cables in accordance with manufacturer's specifications ensuring that proper installation techniques are observed and that the cable maximum pull-force and minimum bend radius specifications are adhered to.
 - .4 Utilize all indicated and available cable pathways such as slots, sleeves, conduits, cable trays, ducts, raceways and furniture system channels except where otherwise noted to route cable vertically and horizontally through the building. Exercise caution when pulling cables in such pathways to avoid damage to any existing cables and follow manufacturer's maximum pull-force and minimum bend radii.
 - .5 Where cables are exposed to risk of being damaged by sharp edges of furniture, cabletray, raceway, etc., protect cables by feeding them through a length of flexible plastic conduit.

- .6 Neatly bundle, secure and wrap all cables. Use only flat, soft hook-and-loop fastening tape. Ensure cable wraps do not deform the cable jacket.
- .7 Where cables are terminated on a patch panel, bundle and dress cables in groups of twelve or twenty-four, each group consisting of cables from a single twelve or twenty-four port patch panel.
- .8 Where cables are terminated on a cross-connect field, bundle and dress cables in groups of twelve or twenty-four, each group consisting of cables from a single cross-connect panel.
- .9 Do not maintain bundles for distances greater than 1 m in cable trays.
- .10 Maintain clearances as indicated in Section 27 05 00.
- .11 Place cable only in conduits and cable tray and other designated cabling pathways. Do not place cable in crevices, cracks or other gaps in the building infrastructure not expressly intended for cabling. Do not run cables on the outside of conduits or piping or building supports or anything not intended expressly for communications cables. Use only protected cable pathways such as formed slots, formed sleeves, conduits, cable trays, ducts, raceways and furniture system channels.
- .12 Avoid scraping, denting, crushing, twisting, kinking or otherwise damaging cables before, during, or after installation. Replace damaged cables without cost to the Contract.
- .13 Pull cables in a continuous run. Do not splice horizontal cables.
- .14 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.
- .15 Protect cables against risk of damage at edges of furniture, cable tray, raceway, etc. Install cable in flexible plastic conduit.
- .16 Protect cable at pathway transitions by use of flexible plastic conduit or manufactured "waterfall" elements.
- .17 Neatly bundle and secure cables. Use light pressure soft wraps.
- .18 Bundle and dress cables in groups of twelve or twenty-four, at patch panels and within cabinets. Dress cables neatly and orderly within cabinets. Follow manufacturer's recommended practices to ensure performance compliance.
- .19 Support cables within cabinets at rear of patch panel and at intervals of 450 mm.
- .20 Support vertically placed cables by attaching to a support, firmly attached to the building fabric, at intervals of 600 mm.
- .21 Separate voice and data cables. Separate copper and optical fibre cables.
- .22 Maintain cable clearances as described in Section 27 05 00.
- .23 Do not maintain bundles for distances greater than 1 m in cable trays.
- .24 Pass cables at backboard terminations from behind, through holes positioned in the center of the termination mount.
- .25 Do not exceed manufacturer's recommended bending of cable. Maintain a radius of four times cable diameter or 25 mm for copper UTP or FTP or STP, whichever is the greater. Maintain a radius of ten times cable diameter or 30 mm for optical fibre cables.

- .26 Do not untwist exposed pairs at terminations for more than 13 mm.
- .27 Bond to ground all metallic cable strength members and metallic sheaths to manufacturer's specifications.
- .2 Identification
 - .1 Comply with identification instructions described in the Contract drawings or Specification.
 - .2 Apply channel identification labels at each end of cable, on faceplates, faceplate outlets, patch panel outlets, and any point of cable termination.
- .3 Copper backbone cabling
 - .1 Pull all UTP cables in a continuous run. Cable splices will not be accepted.
 - .2 Where voice and data cables are separately identified on the Contract Drawings, separate voice and data cable into distinct bundles.
 - .3 For cables being terminated on a backboard mounted cross-connect field, pass all cables behind backboard in bundles and pass them through holes positioned in the centre of the termination mount.
 - .4 For UTP cables, maintain a minimum bending radius of four times cable diameter or 25 mm whichever is the greater.
 - .5 Use vertical pipe split mesh grips to support the weight of the cable at the top of a vertical cable rise of 4 m or more.
 - .6 Use a minimum of five cable ties per floor to prevent side-to-side movement of the cable.
 - .7 Neatly bundle, wrap, secure and route all backbone cables.
 - .8 Separate backbone copper data cables, backbone copper voice cables and backbone fibre optic cables into separate bundles.
 - .9 Secure cable bundles to vertical and horizontal supports and neatly fasten to plywood backboards, cable tray or termination racks and cabinets.
 - .10 Exercise caution when pulling cables in pathways to avoid damage to any existing cabling and ensuring that the cable manufacturer's installation procedure is followed.
 - .11 Inform Consultant immediately of any backbone cable runs exceeding 800 m for UTP cable, 2000 m for multimode fibre and 3000 m for single-mode fibre.
- .4 Optical fibre backbone cabling
 - .1 Use fibre fan out kit at transition from loose tube to tight buffer.
 - .2 Apply shrink wrap to prevent gel leakage.
 - .3 Pull all optical fibre cables in a continuous run. Fibre splices will not be accepted except as a termination method.
 - .4 Follow proper installation and termination practices for optical fibre cabling. Do not kink or exceed manufacturer's restrictions on the optical fibre cable minimum bend radius.
 - .5 Maintain a minimum bending radius of ten times cable diameter or 30 mm, whichever is larger.

- .6 Splicing of fibre cables
 - .1 Splices, except those expressly for the purpose of terminating the optical fibre strands and where expressly called for on the Contract Drawings, will not be accepted except by express and written approval by Consultant.
 - .2 Splicing of the cables is permitted only in designated junction boxes, manholes, buildings and in the fibre patch panels.
 - .3 House splices in manholes, junction boxes and the remote buildings in an outdoor splice enclosure.
 - .4 House all splices in the telecommunication closets in splice trays located in or close to the fibre patch panels.
 - .5 Splice fibres using quality fusion type splicing equipment. Splicing equipment is subject to approval by the Consultant. Provide the Consultant with Specification details of the splicing equipment prior to commencing splicing.
 - .6 Remake all splices with a forward transmission loss in excess of 0.3 dB, at no cost to the Contract.
 - .7 Replace the cable or remake at no cost to the Contract, splices in any one link where the mean splice loss exceeds 0.2 dB.
 - .8 Arrange splices neatly in the support enclosure and protect with a suitable splice protector.
 - .9 Splice and terminate all fibres including spares to provide end to end links.
 - .10 Splice and connect individual fibres so that a constant identification scheme of the fibres is maintained throughout the system.
 - .11 Label all fibres in the splice tray with permanent vinyl markers. Label cables according to the identification plan as shown on the Contract Drawings.
- .5 Coaxial cable backbone cabling
 - .1 Pull all coaxial cables in a continuous run. Splices not accepted.
 - .2 Follow manufacturer's installation instructions. Do not kink or exceed manufacturer's restrictions on the cable minimum bend radius.
 - .3 Allow sufficient spare cable for working allowance at each termination.
- .3 Audio-Visual Communications Horizontal Cabling
 - .1 Comply with manufacturer's installation instructions.
- .4 Paging Communications Horizontal Cabling
 - .1 Comply with manufacturer's installation instructions.
 - .2 Comply with Division 26
- .5 Antennas Communications Horizontal Cabling
 - .1 Comply with manufacturer's installation instructions.

.6 Data Communications Horizontal Distribution Cabling

.1 Cabling

- .1 Inform Consultant immediately and prior to installation of cable of any horizontal cable pathway routes exceeding 90 m in length.
- .2 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.
- .3 When determining a cable routing pathway, give priority to air handling ducts, fire sprinkler pipes and electrical conduits.
- .4 Except for cables expressly indicated as SPARE, terminate all pairs of UTP cable and all strands of fibre optic cable at both ends.
- .5 Terminate all pairs of spare UTP cable in telecommunication closet and store workstation end in ceiling space by coiling neatly and suspending. Do not rest cables on ceilings or air handling ducts.
- .6 Spare cables to be of sufficient length to permit reaching any point in the room to which they apply.
- .7 Where practicable and where the maximum allowable cable length is not exceeded, provide 3 m of slack UTP cable and 3 m of slack optical fibre cable at the workstation end of each distribution cable. Neatly coil and store slack in cable tray.
- .8 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 in the outlet box.
- .9 Select least obstructed pathway through modular or system furniture. Where available, use eye-level pathways in preference to base-level pathways.

.2 Terminations

- .1 Terminate cables at connectors in Work area and in telecommunications rooms.
- .2 Terminate copper backbone cables at IDC blocks or patch panels as indicated on the Contract Drawings.
- .3 Terminate optical fibre cables at patch panels or surface mount outlet assemblies as indicated on the Contract Drawings. Mount connectors or couplers or cassettes in the fibre mounting shelves or modular assemblies.
- .4 Terminate coaxial cables at device using connectors prescribed by the device connection.

.7 Communications Faceplates and Connectors (Jacks)

.1 Outlets

- .1 Install blank cover plates for all unused or abandoned outlet boxes.
- .2 Mounting heights
 - .1 Install telecommunications outlets at elevations indicated on the Contract Drawings; Measure elevations to centre line of outlet.

.2 Faceplates

- .1 Install blank filler plates for all unused modular jack positions on faceplates.

- .8 Communications Connecting Cords, Devices, and Adapters
 - .1 Turn over patch cords to Owner.
 - 3.3 **RE-INSTALLATION**
 - .1 General
 - .1 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.
 - .2 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
 - .3 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.
 - 3.4 **FIELD QUALITY CONTROL**
 - .1 General
 - .1 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
 - .2 Test backbone cables before and after installation.
 - .3 Perform pre-installation testing of Products as detailed in Section 27 08 00.
 - 3.5 **SITE TESTS, INSPECTION**
 - .1 Field Engineer Services
 - .1 Provide Field Engineer for inspection and certification of equipment during installation, testing and commissioning as required.
 - 3.6 **MANUFACTURERS' FIELD SERVICES**
 - .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.
 - 3.7 **ADJUSTING**
 - .1 Wireless Access Point Installation and Adjustment
 - .1 Adjust location of wireless access points and wireless access point assemblies by 10 m in any horizontal direction without additional cost to the Owner.
- End of Section

- 1 General
 - 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
 - .2 Comply with all sections of the Contract Documents.
 - 1.2 **SPECIAL INSTRUCTIONS TO BIDDERS**
 - .1 Attend one briefing session with Engineer and Owner's Representative to establish user population densities, user performance requirements and applications requiring wireless connectivity.
 - 1.3 **SYSTEM DESCRIPTION**
 - .1 Comply with scope of system described in the Contract Drawings.
 - .1 Installation of surface or suspended wireless access points at each location indicated on the Contract Drawings.
 - .2 Access point enclosure to comply with requirements of location.
 - .3 Installation of network connection patch cables.
 - .4 Onsite active survey executed by manufacturer's representative to assess.
 - .2 Owner Supplied Equipment
 - .1 Access points furnished and configured by Owner. Performance parameters to Owner's Specification.
 - .2 Network switching and routing equipment for enterprise applications.
 - .3 Network switching and routing equipment for facility and building management related applications.
 - .4 VoIP routing equipment by Owner.
 - .5 Power over Ethernet midspan injection and end point power injection equipment.
 - 1.4 **QUALITY ASSURANCE**
 - .1 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
 - .2 The Contractor shall provide verification report to confirm data jacks and cables have been installed, terminated and tested.
 - 1.5 **AREA CLASSIFICATION**
 - .1 No area in the Work is classified as hazardous.
- 2 Products
 - 2.1 **MANUFACTURERS**
 - .1 Wireless Access Points and Antenna

.1 Cisco

3 Execution

3.1 **WIRELESS ACCESS POINTS**

- .1 Commission access point manufacturer to perform active site survey to determine optimum set up and configuration of multiple access points. Coordinate with Owner for user population density and traffic predictions.
- .2 Comply with installation instructions provided by the manufacturer.
- .3 Provide mechanical supports to firmly support array.
- .4 Attach supports to building fabric.
- .5 In conjunction, cooperation with and witnessed by the Engineer, perform signal strength field measurements using instrumentation recognized and approved by the manufacturer to verify that better than 90% of randomly selected locations exceed the minimum signal level required for the application as indicated in the manufacturer's published reference material.
- .6 If fewer than 90% test successfully, repeat the test.
- .7 If fewer than 90% continue to test successfully, refer to the Engineer and manufacturer for recommended recourse.
- .8 Provide mounting arrangements and install access point for up to an additional 5% of the total number of wireless access points to compensate for areas of limited coverage.
- .9 Assist Owner to set in place Owner-supplied equipment including switches, routers, and wireless access points.
- .10 Configuration of same systems by Owner.

3.2 **INTERFACE WITH OTHER WORK**

- .1 Comply with the Contract Documents.
- .2 Bestow on the Owner the right to execute work on the site before Contract completion.
 - .1 Be governed by terms of this section in circumstances where the Owner is instrumental in providing or facilitating a communications network that is a necessary part of the facility operations and maintenance Building Management System or any other communications system that is necessary for the completion of the Work.
 - .2 Other communication systems will include networks to facilitate without limitation:
 - .1 CCTV and surveillance
 - .2 Intercom
 - .3 Telephone
 - .4 Access control
 - .5 Intrusion detection

- .3 Receive, uncrate, set in place and energize network devices furnished by the Owner that are required to facilitate a working Building Management System Ethernet network.
- .4 Coordinate with Owner's technician forces to provide access to equipment and equipment spaces and to enable the configuration of network switching, routing, server and data storage equipment.
- .5 Provide the Owner's technician forces necessary networking configuration parameters that describe building systems as required for the completion of a fully operational Building Management System.
- .6 Provide reasonable protection of the Owner-provided equipment against harm or loss caused by accident or negligence.
- .7 Coordinate with the Owner and establish mutually agreed dates on desired scheduling of delivery and set up of equipment.

End of Section

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- 1 General
- 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
 - .2 Common work results as laid out in Section 27 05 00.
- 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 **QUALITY ASSURANCE**
 - .1 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
 - .2 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.
- 1.5 **AREA CLASSIFICATION**
 - .1 No area in the Work is classified as hazardous.
 - .2 Refer to all related Drawings and Specifications in the Contract Documents.
- 1.6 **SYSTEM DESCRIPTION**
 - .1 Voice communications system using network cabling for VoIP services.
 - .2 Telephone system using network cabling for baseband analog and/or TDM and/or POTS voice services.
 - .3 Operating in conjunction with horizontal distribution cabling indicated on Contract Drawings and in Division 27 Specification.
 - .4 System to performance specification set by Owner.
 - .1 Self contained rack mounted telephone switching unit.
 - .2 Switch to provide signal routing for extension-to-extension and extension-to-trunk. Trunk lines as required by system.
 - .3 System to operate with digital TDM desk sets and optionally configurable to VoIP desk sets on set by set basis.
 - .4 Self-contained back-up power supply to provide eight hours survival in event of loss of utility power.
 - .5 Revert to bypass mode after power supply exhausted.

- .6 Provision of two desk set units connected directly to POTS service.
 - .7 Desk sets and interconnecting cables supplied and installed by Owner.
- .5 Emergency Telephone Systems
 - .1 Designated telephones connected to incoming carrier trunk services at demarcation point.
 - .2 Wall / desk mounted individual telephone set instruments directly connected to dedicated express inside wiring.
 - .3 Automatic ring down to programmed carrier assigned number.
 - .4 Wall and desk sets supplied and installed by Carrier (Bell Canada).
- .6 Access to paging and zone selection from telephone key pad and from intercom system.
- 1.7 **PAGING**
 - .1 Public paging system operating through speakers mounted within telephone desk set units.
 - .2 Distinctive tones created with following input:
 - .1 Request to enter push button at main entrance
 - .2 One hundred twenty second warning in advance of expiry of intrusion detection system set-back timer
 - .3 Sixty second warning in advance of expiry of intrusion detection system set-back timer
- 1.8 **PRODUCT VENDORS**
 - .1 Manufacturer as specified by Owner.
- 2 Products
- 2.1 **TELEPHONE SWITCH**
 - .1 As specified by Owner.
 - .2 Manufacturer
 - .1 Representative Product: Nortel BCM50
- 2.2 **TELEPHONE DESK SET**
 - .1 As specified by Owner.
 - .1 Representative Product: Nortel
- 2.3 **EMERGENCY TELEPHONES**
 - .1 Indoor or outdoor industrial analog telephone with non-locking door. Cast aluminum enclosure, corrosion resistance powder coated faceplate, volume control polycarbonate handset and stainless steel hardware material. Provide pole mounting kit as required for the application.

- .1 Acceptable Manufacturer: "ACT Series" (ACT-30 or ACT-40) by Guardian Telecom or approved equal.

3 Execution

3.1 **CARRIER SERVICES**

- .1 Cooperate with Owner and carrier to coordinate Specification and arrangement for installation of incoming trunk line carrier services.
- .2 Inform carrier of emergency telephone ring-down numbers as instructed by Owner.

3.2 **TELEPHONE SWITCH**

- .1 Set up and configuration by Owner.
- .2 Install and configure telephone switch to Owners' specification and satisfaction.

3.3 **TELEPHONE DESK SETS**

- .1 Set up and configuration by Owner.
- .2 Install and configure telephone desk sets to Owners' specification and satisfaction.

3.4 **EMERGENCY TELEPHONES**

- .1 Set up and configuration by Owner.
- .2 Install and configure telephone switch to Owners' specification and satisfaction.
- .3 Telephone to be connected within 15,000 ft. (~4,600 meters) of a main telephone switch in order to maintain voice quality.

End of Section

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HID Signo Card Reader Specifications

Signo 20 - 20NKS-00-000J2V

Signo 20K - 20KNKS-00-000J2V

Signo 40 - 40NKS-00-000J2V

Signo 40K - 40KNKS-00-000J2V



HID® Signo™ Readers

Models: 20, 40, 20K, 40K

READY FOR THE FUTURE NOW

- Mobile-ready by default, including Apple's Enhanced Contactless Polling (ECP) to support credentials in Apple Wallet
- Sleek, innovative design to suit modern architecture
- Integrated OSDP for secure authentication and configuration post installation
- Built on a hardware platform designed to be adaptable to support future technology
- Designed to seamlessly integrate into the HID Origo® ecosystem

THE SIGNATURE LINE OF READERS FROM HID GLOBAL

- **Highly Versatile** — Support for the widest range of credential technologies, including HID Mobile Access® via native Bluetooth and Near Field Communication (NFC).
- **Unparalleled Performance** — Ultra secure storage of cryptographic keys on certified secure element hardware, plus a new surface detection feature that enables the reader to automatically recalibrate and optimize read range performance.
- **Connected to the Future** — All readers include out-of-the-box support for Open Supervised Device Protocol (OSDP) for secure bidirectional communication.

HID Signo™ is the signature line of physical access control readers from HID Global. The versatility, performance and connected capabilities of HID Signo readers set a new industry benchmark for the most highly adaptable, interoperable and secure approach to electronic access control.

Offering an unparalleled breadth of functionality, HID Signo affords security system installers and administrators a simple and effective approach to secure access control for almost any scenario.

With support for the widest array of credential technologies — past, present and future — HID Signo is the perfect choice for those looking to make the transition to a secure authentication technology.

HID Signo readers transcend the traditional approach to security by being designed to be connected and managed remotely without needing to physically touch each device. This functionality empowers access control systems to dynamically respond as new needs, configurations or threats arise.

POWERFULLY SECURE

- Multi-Layered security to ensure data authenticity and privacy
- EAL5+ Certified Secure Element Hardware
- Native OSDP secure channel capability
- Trusted secure authentication using the SIO data model
- Supports iCLASS Elite™ and Corporate 1000 Programs

MEET EVERY NEED, ADAPT TO ANY SITUATION

- Go mobile with native Bluetooth and NFC support
- Integrated 125 kHz credential read support for easy migration
- Supports over 15 common credential technologies
- Flush mount terminal block and pigtail wiring options
- Robust outdoor performance with an IP65 rating

MANAGE, UPGRADE AND CONFIGURE

- Easily and securely managed using HID Reader Manager®
- Configure via a mobile device or OSDP
- Update firmware in response to threats
- Personalize by configuring audio visual or keypad settings
- Deactivate legacy credential technology to conclude secure migration

SPECIFICATIONS

HID Signo Reader Model	20	20K	40	40K
2.4 GHz (Bluetooth) Credential Compatibility	Mobile Credentials powered by Seos® (HID Mobile Access)			
13.56 MHz (NFC) Credential Compatibility	Seos, iCLASS SE®, iCLASS SR®, iCLASS®, MIFARE Classic, MIFARE DESFire EV1/EV2, FeliCa™ & Contactless e-Purse Application Specification (CEPAS), Mobile Credentials powered by Seos (HID Mobile Access)			
125 kHz Credential Compatibility	HID Proximity®, Indala® Proximity, AWID Proximity, and EM Proximity			
Typical Read Range¹	Seos®, MIFARE Classic, MIFARE DESFire EV1/EV2 & ISO14443A Single Technology Cards - 1.6 to 4 in (4 to 10 cm) HID / AWID Proximity®, Indala Proximity®, EM Proximity & 125 kHz Single Technology Cards - 2.4 to 4 in (6 to 10 cm)			
Mounting	Suited for mullion-mount door installations or any flat surface mounting		Suited to mount and cover single gang switch boxes with a slotted mounting plate for alternate back-box spacing	
Color	Black bezel with silver trim baseplate ²			
Keypad	No	Yes (2 x 6 layout)	No	Yes (3 x 4 layout)
Dimensions (width x length x depth)	1.77 in x 4.78 in x 0.77 in (45 mm x 121.5 mm x 19.5 mm)	1.78 in x 4.79 in x 0.85 in (45 mm x 121.5 mm x 21.5 mm)	3.15 in x 4.78 in x 0.77 in (80 mm x 121.5 mm x 19.5 mm)	3.16 in x 4.79 in x 0.85 in (80 mm x 121.5 mm x 21.5 mm)
Product Weight	Pigtail: 3.35 oz (95 g) Terminal: 2.65 oz (75 g)	Pigtail: 3.88 oz (110 g) Terminal: 3.17 oz (90 g)	Pigtail: 4.94 oz (140 g) Terminal: 4.23 oz (120 g)	Pigtail: 5.64 oz (160 g) Terminal: 4.94 oz (140 g)
Operating Voltage	12V DC			
Current Draw³	NSC⁴: 60 mA Peak: 250 mA Max. Avg: 70 mA IPM⁵: 45 mA	NSC⁴: 65 mA Peak: 250 mA Max. Avg: 75 mA IPM⁵: 48 mA	NSC⁴: 65 mA Peak: 250 mA Max. Avg: 75 mA IPM⁵: 45 mA	NSC⁴: 70 mA Peak: 250 mA Max. Avg: 80 mA IPM⁵: 55 mA
Device Input and Output	Input: Tri-color LED, Buzzer, Hold @ Active Low Output: Tamper Relay 0-60V DC @ 100mA Max (Dry Contact)			
Operating Temperature & Humidity	-31° F to +150° F (-35° C to +66° C) 0% to 95% non-condensing			
Storage Temperature	-40° F to +185° F (-40° C to +85° C)			
Environmental Rating	UL294 Outdoor and Indoor rated, IP65			
Transmit Frequency	125 kHz, 13.56 MHz, and 2.4 GHz			
Communications & Panel Connection	Wiegand, Clock-and-Data and RS-485 Half Duplex (OSDP) via Pigtail (18 in / 0.5 m) or Terminal Strip			
Device Management	HID Reader Manager / OSDP configuration			
Certifications	UL294/cUL (US), FCC (US), IC (Canada), CE (EU), RCM (Australia, New Zealand), SRRC (China), KCC (Korea), NCC (Taiwan), iDA (Singapore), RoHS, MIC (Japan), GreenCircle, Bluetooth SIG, and additional regions. www.hidglobal.com/certifications			
Security Ratings	EAL 5+ Certified Secure Element Hardware			
Patents	www.hidglobal.com/patents			
Housing Materials	Polycarbonate - UL94 V0			
UL Reference Number	20	20K	40	40K
Warranty	Limited Lifetime			



hidglobal.com

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Latin America: +52 55 9171 1108

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- 1 Read range listed is statistical mean rounded to nearest centimeter increment for ID-1 or clamshell credentials. HID Global testing occurs in open air. Form factor, technology and environmental conditions, including metallic mounting surface, can degrade read range performance; plastic spacers are recommended to improve performance on metallic mounting surfaces.
- 2 Black trim baseplate & reader spacers available as an additional accessory at an additional cost.
- 3 Measured in accordance with UL294 standards; see Installation Guide for details.
- 4 NSC - Normal Standby Current; see Installation Guide for details.
- 5 Intelligent Power Management (IPM) - Reduces reader current consumption up to 43%, based on model, compared to standard operating mode.

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2020-09-21-pacs-signo-reader-family-ds-en PLT-04831



ASSA ABLOY

Software House Dealer List Toronto ON

SOFTWARE HOUSE DEALER LIST – TORONTO ON
Highlighted are familiar with City of Toronto - Access Control

360 Advanced Security Corporation
31 Constellation Court
Toronto, ON. M9W 1K4

Contact: Christopher Phillips
Email: christopher.p@360asc.com
T: 416.798.2228
M: 647.223.5570

AC Technical Systems Limited
2100 Forbes St. , Units 8-10
Whitby, ON L1N 9T3

Contact: Dominic Burns
Email: dburns@actechnical.com
T: 905.666.8676
M: 905.426.0388

Bond Securcom
41 Scarsdale Road, Unit 1
Toronto, ON M3B 2R2

Contact: Cesar Traverso
Email: Ctraverso@bondsecur.com
T: 416.256.6666
M: 416.951.2494

Chubb Security Systems
6200 Kenway Drive
Mississauga, ON L5T 2N3

Contact: Ammar Alhussaini
Email: Ammar.alhussaini@chubbfs.ca
T: 905.629.2600
M: 416.951.2494

Delco Security
7500 Hwy 27, Unit #9
Vaughan, ON L6H 5R7

Contact: Mark Peterson
Email: mpeterson@delcosecurity.com
T: 416.346.8628

GTECK Advanced Technology
2400 Skymark Ave., Unit 7B
Mississauga, ON L4W 5K5

Contact: Naeemul Ebad
Email: n.ebad@gtecktechnology.com
T: 1.800.931.7107
M: 437.33.5468

Hart-Well Electrical Company
1295 Morningside Ave., Unit #20
Scarborough, ON M1B 4Z4

Contact: Nuno Veiga
Email: nveiga@hart-well.com
T: 905.671.9414
M: 416.936.7854

Johnson Controls L.P.
56 Leek Crescent
Richmond Hill, ON L4B1H1

Contact: Danny Zavaglia
Email: danny.zavaglia@jci.com
T: 905.731.2813
M: 416.629.3508

SOFTWARE HOUSE DEALER LIST – TORONTO ON

Met-Scan

30 Kern Road, Suite 104
Toronto, ON M3B 1T1

Contact: Antoinette Modica
Email: amodica@met-scan.com
T:
M: 416.391.2200 416.391.2200

Paladin Technologies

71 Barber Green Rd.
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Contact: Marc Kingsbury
Email: mkingsbury@paladintechnologies.com
T: 416.916.6767
M: 647.459.5691

Profile Security
110-5525 Eglinton Ave. W
Toronto, ON M9C 5K5

Contact: Jason Cassie
Email: jasonc@profileinc.com
T:
M: 416.695.1260, X 235
647.221.3453

Tyco Integrated Fire & Security
2400 Skymark Avenue
Mississauga, ON L4W 5K5

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905.212.4400 416.629.3508

Securitas Technology
2495 Meadowpine Blvd.
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Email: Scott Jupp
M: scott.jupp@securitas.com
647.458.8058

Siemens Canada Limited
1577 North Service Road East
Oakville, ON L6H 0H6

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Vipond Inc.
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April, 2024

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- | | | | |
|-----|--------------------|---|---|
| .1 | CAN/ULC-S524 | - | Standard for the Installation of Fire Alarm Systems |
| .2 | CAN/ULC-S525 | - | Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories |
| .3 | CAN/ULC-S526 | - | Visual Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories |
| .4 | CAN/ULC-S528 | - | Standard for Manual Stations for Fire Alarm Systems, Including Accessories |
| .5 | CAN/ULC-S529 | - | Standard for Smoke Detectors for Fire Alarm Systems |
| .6 | CAN/ULC-S530 | - | Standard for Heat Actuated Fire Detectors for Fire Alarm Systems |
| .7 | CAN/ULC-S536 | - | Standard for Inspection and Testing of Fire Alarm Systems |
| .8 | CAN/ULC-S537 | - | Standard for Verification of Fire Alarm Systems |
| .9 | CAN/ULC-S561 | - | Standard for Installation and Services for Fire Signal Receiving Centres and Systems |
| .10 | ULC S527 | - | Standard for Control Units for Fire Alarm Systems |
| .11 | CSA C282 | - | Emergency Electrical Power Supply for Buildings |
| .12 | CSA C22.1 | - | Canadian Electrical Code |
| .13 | OBC | - | Ontario Building Code |
| .14 | ASME A17.1/CSA B44 | - | Safety Code for Elevators and Escalators |

1.3 **SYSTEM DESCRIPTION**

.1 Single Stage Fire Alarm System

- .1 System shall be electrically supervised, zoned as indicated on Drawings and designed so that actuation of any manual pull station, smoke detector, heat detector or group of these devices in a zone shall cause the signal bells to sound throughout building. All magnetic door locks and/or door strikes to be deactivated, cause fans to shutdown as indicated, and transmit signal to fire department. Alarm shall indicate on appropriate zone light at control panel.

- .2 Wiring shall be done in class A configuration such that an open circuit in any initiating device shall not prevent alarms from being received by other devices. Each zone shall have its own alarm and trouble lamp.
 - .3 Complete system to be supervised against failure of operating power, open circuits, and grounds. All supervision is to be maintained on all circuits even in event of a power failure, when system is on battery standby. Any of above causes a Sonalert to sound at main control panel and at each remote annunciator and also light a common trouble lamp in same panels. Sonalert to produce a tone distinct from tone of alarm signals. Provide a silencing switch in main control panel, which, when operated, silences trouble bell but causes trouble lamp to remain illuminated until trouble is cleared and system returned to normal. Upon return to normal, trouble signal lamp shall be automatically reset to normal.
 - .4 Provide common control panel containing a system reset button, a system silence push button, and an LED test button. It shall not be possible to reset system until all operated initiation devices have been returned to normal. Failure of a lamp on the supervised annunciator causes a common trouble indication and causes annunciator trouble LED to light. The common control also to contain a signal silence push button. This signal silencing push button is used to silence alarm signals at any time but, if a new alarm should occur after it is pressed, all alarm signals shall again sound. When an alarm is received, the zone LED shall flash, until it has been silenced. At this time the LED indicator shall illuminate continuously. Upon receipt of a subsequent alarm, the LED for that zone shall flash, indicating in which zone the latest alarm occurred.
- .2 Two Stage Fire Alarm System
- .1 The system shall be electrically supervised, zoned as indicated on Drawings and designed so that actuation of any manual pull station, smoke detector, heat detector or group of these devices in a zone shall cause signal bells to sound throughout building, all magnetic door locks and/or door strikes to be deactivated, and cause fans to shutdown as indicated. Alarm shall indicate on the appropriate zone light at control panel.
 - .2 On receipt of an alarm from any zone, bells shall ring at twenty strokes per minute. In the event of a real fire, a general evacuation alarm can be initiated by means of a key switch in each one of the double action stations. If original alarm is not acknowledged within five minutes, general evacuation alarm shall sound automatically by means of a timer in control panel. General evacuation alarm consists of bells ringing at one hundred twenty strokes per minute.
 - .3 Wiring shall be done in class A configuration such that an open circuit in any initiating device shall not prevent alarms from being received by other devices. Each zone shall have its own alarm and trouble lamp.
 - .4 Complete system to be supervised against failure of operating power, open circuits, and grounds. Any of the above causes a Sonalert to sound at main control panel and at each remote annunciator and also light a common trouble lamp in the same panels. Sonalert to produce a tone distinct from tone of alarm signals. Provide a silencing switch in main control panel, which, when operated, silences trouble bell but causes trouble lamp to remain illuminated until trouble is cleared and system returned to normal. Upon return to normal, trouble signal lamp shall be automatically reset to normal.
 - .5 Provide common control panel containing a system reset button, a system silence push button, and an LED test button. It shall not be possible to reset

system until all operated initiation devices have been returned to normal. Failure of a lamp on the supervised annunciator causes a common trouble indication and causes annunciator trouble LED to light. The common control panel also to contain a signal silence push button. This signal silencing push button is used to silence alarm signals at any time but, if a new alarm should occur after it is pressed, all alarm signals shall again sound. When an alarm is received, the zone LED shall flash until it has been silenced. At this time the LED indicator shall illuminate continuously. Upon receipt of a subsequent alarm, the LED for that zone shall flash, indicating in which zone the latest alarm occurred.

.3 Multiplex Fire Alarm System

- .1 Supervised, non-coded, annunciated, (single) (two) stage, closed circuit, twenty-four volt AC/DC multiplexed fire alarm (and security) system. (The system shall provide dual channel voice communication and firefighter phone capabilities. Both voice communication system and firefighter phone system shall be an integral part of fire alarm system).
- .2 The Central Processing Unit (CPU) shall use multiplex communication techniques to receive data from and transmit data to transponders which shall be remotely located throughout facility to minimize wiring costs, simplify design, and allow economical expansion and easy retrofit. (Multiplex communication techniques shall also be used for emergency voice circuits, and firefighter's phones located throughout building.)
- .3 The CPU shall be microprocessor-based to increase system reliability, speed response to alarm conditions, and reduce cost. CPU response time to alarm conditions shall be no more than four seconds, regardless of system size.
- .4 Fire alarm stations, thermal detectors, products of combustion detectors, (emergency evacuation speakers, emergency telephones) shall be fully supervised.
- .5 Upon operation of any manual station or detector, the following will occur:
 - .1 Actuate CPU to cause (signal bells to sound at twenty strokes per minute) (a slow rate tone on emergency evacuation speakers) throughout building. Second stage alarm can be initiated by means of a key switch in each of the double action stations. If original alarm is not acknowledged within five minutes, system automatically enters into second stage alarm which consists of (the bells ringing at one hundred twenty strokes per minute) (a high rate tone on emergency evacuation speakers).
 - .2 Initiate alarm origin on CPU and at graphic annunciator.
 - .3 Shut down air supply and return air fans.
 - .4 Transmit signal to fire department.
 - .5 Deactivate all magnetic door locks and/or door strikes.
 - .6 Activate smoke dampers.
- .6 CPU shall indicate trouble when any fault occurs within the system (or CRT and keyboard).

2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Simplex Grinnell
- .2 Siemens Building Technologies
- .3 Notifier
- .4 Mircom
- .5 Chubb/Edwards

2.2 **MATERIALS**

- .1 Control Panel
 - .1 Control panel shall be housed in a (free-standing) (wall-mounted) cabinet of code gauge construction with baked enamel finish, full viewing window and hinged front door cover complete with lock and two keys. Opening cabinet door shall provide access to all operating controls, but will not expose live electrical connections.
 - .2 Control panel, with number of zones as shown on zone schedule containing the following:
 - .1 Reset button, LED test button, alarm signal silencing push button, ground fault indicator light, system trouble indicating light, trouble signal silencing button and annunciator trouble indicating light.
 - .2 Relays and control modules as required for door releases, fan shut-down, extinguishing system release and audible alarms.
 - .3 Alarm receiving modules for number of zones as indicated on Drawings. Zone modules shall be capable of handling any type of device including pull stations, smoke detectors, and heat detectors to allow for future changing of devices without changing modules. Each module to contain a trouble alarm indicator.
 - .4 Power supply modules as required.
 - .5 Valve supervision module as required.
 - .6 Signal control modules as required.
 - .7 Fire department connection plug-in module complete with disconnect switch and LED "disconnect" indicator.
 - .8 All modules shall have visual supervision against removal.
 - .9 A standby power module shall be provided consisting of lead calcium sealed batteries connected with sufficient amp hour capacity to operate the alarm devices under supervisory condition with AC power disconnected for twenty-four hours and at the end of this period, operate the alarm devices for thirty consecutive minutes. Note that on battery standby all building wiring must be supervised, and give an immediate trouble indication on battery backup when any problem occurs within the system. The batteries shall be sealed maintenance free type with expected life in excess of five years. Batteries shall be enclosed in a steel housing. A fully automatic battery charger shall be provided which shall be capable of restoring 90% of a dead batteries capacity within

twenty-four hours. The battery shall be protected against excessive discharge by automatically disconnecting battery from system when voltage of battery drops to 60%.

.2 Central Processing Unit (CPU)

- .1 Central processing unit shall come complete with alphanumeric display, keyboard and printer. Alphanumeric display and printer shall be fully operational while system is operating on standby batteries.
- .2 CPU shall be housed in (flush mounted) (surface mounted) (free standing) cabinet with sufficient capacity to allow maximum system expansion and to house alphanumeric display and printer (audio system microphone) (master firefighter phone).
- .3 The CPU electronics shall be microprocessor-based. Basic life safety software shall be retained in erasable programmable read only memory (EPROM). CPU shall have special software available in which to make changes on a temporary basis in control by event programming, and also in custom printer labels. This field editing is to enhance flexibility of the system. CPU shall be equipped with software in order to handle _____ monitor points, and _____ control points, and have ability to annunciate all of aforementioned points, including an additional _____ trouble points dedicated to system supervision. All indicators and software shall be in place within the CPU.
- .4 System shall be multi-channel allowing a minimum of _____ monitor points per channel. One or two channels may be used for system. Each channel shall operate independently. Faults on one channel shall not affect operation of the other. System wiring requirements shall be one pair of wires per channel for data communication, two pairs for zoned dual channel audio transmissions, and one pair for a fully supervised and zoned firefighter phone system.
- .5 CPU shall be equipped with a real time output for the purpose of synchronizing clocks.
- .6 CPU shall display both alarm and trouble indication from each fire alarm zone, where each zone can be a device. The system shall indicate the exact location and description of activity.
- .7 As a result of alarm conditions received at the CPU, the system shall have ability to automatically operate specified control points such as tripping municipal box to summon fire department, or stopping exhaust fans or air conditioning units and releasing magnetically held doors and other fire alarm related devices.
- .8 System shall be equipped with a communication input/output "port" to allow use of commercially available remote printers, cathode ray tubes (CRT), and keyboards.
- .9 Multiplex system shall be equipped with standby batteries to provide system operation and vital fire/security protection during commercial power outages. It shall also have provisions to operate an LED annunciator to provide a simple lamp type status indicator for critical system functions. These annunciators shall be operable from the system communication circuits (same wiring used to communicate with transponders), eliminating the need for special wiring.
- .10 CPU shall be designed for use with transponders. Transponders shall have the capability to interface with all specified peripheral devices, such as smoke and

thermal detectors, door holders, (speakers). Communication between CPU and transponders shall be one twisted shielded pair.

- .11 Voice communication system shall be an integrated dual channel system for use in fire alarm and emergency paging. Voice communication system shall have ability to sound an evacuation tone in one area of building, over that areas' speakers, while at the same time being able to sound a first stage alert tone or voice message to other parts of the building.
- .12 Voice communication system shall provide intelligible low level reproduction and incorporate one way voice communication to each floor or compartment of building for selected evacuation and/or one way voice communication to all or any combination of floor or compartments for mass evacuation. Wiring to voice communication transponders shall be one shielded twisted pair from CPU to voice transponders.

.3 Transponders

- .1 Transponder shall be capable of directly running two-wire ionization or photoelectric smoke detectors and shall supervise detector and signalling circuits in accordance with class "A" requirements. Unit shall be a combination of alarm monitor points, control points, supervised signalling circuits, and one detector reset point and shall respond to signal silence and detector reset commands manually initiated at CPU operator's panel.
- .2 Transponders shall use microprocessor based electronics to ensure reliability. Sensing circuits to peripheral devices shall be supervised to provide an indication of sensing circuit faults. Sensing circuit supervision shall not reduce available system monitor points. Sensing circuits shall be capable of working with normally (open) (closed) contacts and shall detect the following conditions: open line, alarm, normal and ground.
- .3 Transponders shall contain the zones as indicated on schedules, and shall be used for monitoring fire alarm zones, sprinkler zones, sprinkler tamper zones, (security zones), (and for monitoring and controlling emergency telephone zones), (and paging zones). Transponders shall also be used for controlling door holders, fan shutdown, and damper circuits.

.4 Demarcation Terminal Box

- .1 A suitable terminal box to be provided as the point of demarcation between the fire alarm control unit and the signal transmitting unit.
- .2 Alarm, trouble and supervisory contacts shall be extended from the fire alarm control unit to the demarcation terminal box.

.5 Alarm Initiating Devices

- .1 Thermodetectors:
 - .1 Fixed temperature thermal detectors shall be of (fast action fusible) (automatic reset) type, rated at (135°F (57°C)) (200°F (93°C)) (with status LED for visual supervision). (Detector shall be addressable).
 - OR-
 - .2 Thermal detectors operating on rate-of-rise and fixed temperature principles shall be sensitive to a temperature rise greater than or equal to 15°F (8°C) per minute or rate fixed temperature of (135°F (57°C)) (200°F

(93°C)) (with status LED for visual supervision). (Detector shall be addressable).

.2 Smoke detectors:

- .1 Ionization smoke detector shall be self-compensating dual chamber type activated by products of combustion. The unit shall be plug-in, mounted to a twist/lock base complete with solid-state amplifier-switching circuit and status LED for visual supervision. (Detector shall be addressable).

-OR-

- .2 Ionization smoke detector shall be self-compensating dual chamber type activated by products of combustion. Detector shall contain internal chamber cover and pre-selected fixed sensitivity for use in high air velocity applications. Unit shall be plug-in, mounted to a twist/lock base complete with solid-state amplifier-switching circuit and status LED for visual supervision. (Detector shall be addressable).

-OR-

- .3 Photoelectric smoke detector shall be a photoelectric detection chamber type activated by light scattering of smoke particles. Unit shall be plug-in, mounted to a twist/lock base complete with status LED for visual supervision. (Detector shall have an integral fixed temperature heat detector rated at 135°F (57°C)). (Detector shall be addressable).

.3 Duct detectors:

- .1 Ionization duct detector shall be dual chamber type with housing and air sampling tubes for detection of combustion products and/or smoke. Provisions shall be made for local or remote indicator lamp and/or auxiliary relay. (Detector shall be addressable).

-OR-

- .2 Photoelectric duct detector shall be solid state photodiode type with housing and air sampling tubes for detection of smoke using light scattering. Provisions shall be made for local or remote indicator lamp and/or auxiliary relay. (Detector shall be addressable).

.4 Manual stations:

- .1 Single action station shall be non-coded (flush) (surface) mounted type consisting of a molded housing with pull-down lever and keylock switch to test and reset. Alarm switch shall be of (N/O) (N/C) sealed contact type and come complete with a normally closed auxiliary contact. (Manual station shall be addressable).

-OR-

- .2 Double action station shall be non-coded (flush) (surface) mounted type consisting of a molded housing with (push-in tab) (break glass), pull-down lever action and key lock switch to test and reset. Alarm switch shall be (N/O) (N/C) sealed contact type and come complete with a normally open auxiliary contact. (Manual station shall be addressable).

.6 Signalling Devices

- .1 Bells shall be of (single stroke) (vibrating) polarized type, (flush) (surface) mounted, red in colour, for operation on (24V DC) (120V AC) audible circuit supply. Bells shall be complete with (150 mm gong) (250 mm gong) (chimes).

- .2 (Horns) (Sirens) shall be of polarized type, (plug-in) (flush) (surface) mounted, red in colour, for operation on (24V DC) (120V AC).
- .3 Speakers shall be 200 mm, of permanent magnet cone type and have an impedance of eight ohms. Speaker shall include a multiple tap transformer (one-quarter, one-half, one, two, and four watts). Frequency response at full rated power shall be 50-80,000 Hz. Baffles shall be fabricated of steel, finished in flat white baked enamel.
- .7 End-of-Line Resistors
 - .1 End-of-line resistors shall be mounted on a stainless steel plate and bear a ULC label.
- .8 Door Holders
 - .1 Door holders shall be magnetic type, (wall) (floor) mounted, with approximately 16 kg holding power, for operation on (12V DC) (24V DC) (24V AC) (120V AC).
- .9 Remote Alarm Indicators
 - .1 Remote alarm indicators shall be (wall) (ceiling) mounted and shall provide remote indication of a specific detector using an electrical connection. Unit shall consist of a red (LED) (lamp) on a mounting plate.
- .10 Remote Test Station
 - .1 Remote test station shall provide testing of a detector and indication of an alarm condition at a remote location. Unit shall consist of a key test switch and a red (LED) (lamp) mounted on a single gang plate.
- .11 Graphic Building Plan
 - .1 Graphic plan to be a wall mounted pictorial representation of the building indicating building outline with fire detection zones. Graphic plan shall indicate separately all levels, with appropriate zones showing exit doors, stairwells and elevators. Graphic plan to be engraved on acrylic material and installed beside annunciator panel depicting proper orientation. Annunciator location to be engraved in red.

3 Execution

3.1 **INSTALLATION**

- .1 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%.
- .2 All wiring within enclosures to be identified with wire markers and termination on terminal strips. Wiring entering and exiting control enclosures shall be laid on terminal strip. Splicing of wiring is not acceptable.
- .3 Wiring entering or leaving building to be provided with lightning protection. Surge protection to be installed in junction box at floor level. Label box as "fire system surge protection".

- .4 Class A wiring shall be used for all alarm initiating devices.
- .5 Class B wiring shall be used for all notification appliances circuits.
- .6 Power to be provided by 120V AC.
- .7 Provide (EMT) (rigid) conduits with (steel set screw fittings with nylon insulated thread) (rigid coupling) as manufactured by T & B or approved equal. Size conduits to code requirements or larger sizes where indicated.
- .8 Terminal cabinets shall be 460 x 610 mm type "T" with wood back, door within the trim complete with latch and lock.
- .9 Outlet box for audible and visible devices to be a single gang, masonry box unless indicated otherwise and shall be flush mounted so that the top of the device will not be less than 2.3 m above the finished floor level in all areas with finished ceilings. In all other areas, outlet boxes shall be 100 mm square surface mounted 2.3 m above finished floor.
- .10 Wall-mounted visible signal devices shall be installed such that the entire lens is not less than 2 m and not more than 2.4 m above the finished floor.
- .11 Outlet boxes for manual stations shall be a single gang masonry box unless indicated otherwise and shall be flush mounted not less than 1.2 m and not more than 1.4 m above finished floor level to centre of box in all areas with finished ceilings. In all other areas, outlet boxes shall be flush mounted if possible.
- .12 The top of fire alarm annunciator or display and control centre legend or operating control shall be mounted not more than 1.8 m from finished floor level.
- .13 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.
- .14 Detectors shall be ceiling mounted unless otherwise specified herein, at the highest point where variations in ceiling height exist and shall not be mounted on sides or underside of beams, joists, ducts, open web steel joists or any structure, etc. projecting more than 100 mm below ceiling level.

3.2 **VERIFICATION**

- .1 Manufacturer shall make an inspection of fire alarm equipment, including those components necessary to direct operation of system. Inspection shall comprise an examination of such equipment for the following:
 - .1 Person(s) carrying out verification to be CFAA certified or equivalent.
 - .2 That the type of equipment installed is that designated by the Consultant's Specifications.
 - .3 That wiring connections to all equipment components show that the installer undertook to have observed ULC and CSA requirements.
 - .4 The equipment of manufacturer's manufacture 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; and
 - .5 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 to the satisfaction of inspecting officials.

- .6 Manufacturer will supply to Contractor reasonable amounts of technical assistance with respect to any changes necessary to conform Work to paragraphs above. During period of inspection by manufacturer, Contractor shall make available to manufacturer, electricians as designated by manufacturer.
- .2 On completion of inspection and when all of above conditions have been complied with, manufacturer shall issue to Consultant:
 - .1 A copy of inspecting technician's report showing location of each device and certifying test results of each device.
 - .2 Inspection report to be in the format as laid out in CAN/ULC S537 Appendix C.
 - .3 A certificate of verification confirming that inspection has been completed and showing conditions upon which such inspection and certification have been rendered.
 - .4 Proof of liability insurance for the inspection.

3.3 **DEMONSTRATION**

- .1 Engage a manufacturer's service representative to provide startup service and to demonstrate and train Owner's personnel for the following:
 - .1 On procedures and schedules related to startup and shutdown.
 - .2 Silencing of alarms, resetting of control panel.
 - .3 Isolating of individual detectors or areas.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

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

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
- .2 ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact With Earth or Granular Fill Under Concrete Slabs
- .3 ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact With Soil or Granular Fill Under Concrete Slabs
- .4 CSA-A23.1 - Concrete Materials and Methods of Concrete Construction
- .5 CAN/ULC-S701 - Thermal Insulation, Polystyrene, Boards and Pipe Covering
- .6 OPSS 1010 - Ontario Provincial Standard Specification, Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
- .7 MOE - Ministry of the Environment of Ontario

1.3 **LINES AND LEVELS**

.1 Establish lines and elevations based on geodetic benchmarks as shown on Drawings.

OR

- .2 Establish lines and elevations from existing lines and elevations shown on Drawings.
- .3 Have necessary lines and levels established by a registered Ontario land surveyor or a qualified registered Civil Engineer.
- .4 Indicate location of building walls relative to property lines on survey plan.
- .5 Protect and maintain the lines and benchmarks as long as they are required.

1.4 **ACCESS ROAD CLEANING**

- .1 Keep access roads clear of mud, debris and dirt resulting from Work of this section.

1.5 **SUBMITTALS**

- .1 Submit a certificate issued by fill Supplier to substantiate that fill materials are free of contaminants.
- .2 If well pointing is required, submit, in accordance with Section 01 33 00, location of piping layout and depth of penetration below water table, for Consultant's review.

- .3 Submit manufacturer's Product data and mix design information of unshrinkable fill to confirm Product conformance to Specifications.

1.6 **GEOTECHNICAL INVESTIGATION**

- .1 Geotechnical investigation of the Site was carried out for the Owner as a guide in design and construction by Forward Engineering & Associates entitled Floor Slab Assessment, City of Toronto King Street Yard, 1116 King Street West, Buildings 8 & 9, Toronto, Ontario dated October 17, 2025, Ref No. G7591. A report and borehole logs on the investigation were prepared and are available in Appendix B1.
- .2 No responsibility is assumed by the Owner or Consultant for the scope, accuracy, or interpretation of the geotechnical investigation report. Soil conditions between boreholes may be at variance with the information shown on the geotechnical investigation report.
- .3 Additional Geotechnical Investigation
 - .1 If any variations or unforeseen subsurface conditions are encountered during construction, the General Contractor shall:
 - .1 Engage an independent geotechnical firm (approved by the Owner) to perform additional investigation and testing as deemed necessary.
 - .2 Bear all costs associated with such investigation and testing.
 - .3 Submit a detailed scope of work for Owner approval, including:
 - .1 Purpose of the investigation
 - .2 Proposed methodology
 - .3 Types of tests to be performed
 - .4 Provide a comprehensive report of findings to the Consultant and Owner for review prior to proceeding with related work.
 - .4 Contaminated Soil and Groundwater: If contaminated or potentially contaminated soil is encountered during excavation, work shall stop immediately, and the Contractor shall notify the Owner and relevant authorities. The Contractor must engage a Qualified Professional to conduct site assessment in accordance with CSA Z768 (Phase I ESA) and CSA Z769 (Phase II ESA) standards, and follow applicable provincial and federal regulations, including CCME Canadian Soil Quality Guidelines. Any required remediation or disposal in accordance with Ontario Regulation 347/558 ,shall be performed by an approved facility or method, with all costs borne by the Contractor. Health and safety measures, including dust control and PPE, must be implemented throughout the process. Additional environmental study and investigation (i.e., Phase I and Phase II Environmental Site Assessments) would generally be required to address these issues. However the finding of a potential issue, if identified by the geotechnical investigation, should be discussed in the report.
 - .5 Be responsible for including in the Work, costs for all conditions identified or inferred in the report, including disposal of contaminated materials, if any, in accordance with MOE regulations.

1.7 **QUALITY ASSURANCE**

.1 Testing and Inspection

- .1 Be responsible for granular/soil materials, placing and compaction throughout the Work of this Contract as it progresses and on completion to ensure specified materials, placing and required compaction densities are obtained.
- .2 Provide the following and pay for all associated costs as part of the Contract:
 - .1 Retain an independent, well established and qualified commercial testing agency to,
 - .1 maintain field quality control operations such as compaction tests,
 - .2 perform material testing in the laboratory and prepare test reports and other submittals.
 - .3 check and approval of the Contractor's material placing and compaction Work.
 - .2 Testing agency shall have enough personnel and resources to perform testing in a timely manner.
 - .3 The testing agency personnel shall be qualified and have had experience on projects equal to the complexity of this Project. Upon request from the Owner, submit qualifications of the testing agencies and include their personnel for approval prior to retaining either one of the agencies.
 - .4 The Owner reserves the right to request change in personnel or testing agency at any time.
 - .5 Submit proposed material, including off-site borrow material, to the testing agency for its analysis and report, in sufficient time so as not to delay the progress of the Work. The testing agency shall approve all fill material prior to placement and shall observe placement to ensure lift thickness is as specified.
 - .6 Testing agency shall submit, in duplicate, test report which includes tests, investigations, findings and recommendations to the Contractor and to the Owner, within twenty-four hours of the tests.
 - .7 For field quality control of operations, testing agency shall determine the compaction of material placed and shall conduct the following minimum number of in-place density tests after monitoring the placing and compacting of each lift.
 - .1 For mass filling: One test per lift of fill for each one hundred square metres.
 - .2 Floor subgrade: One test per final lift (subgrade) or fill or backfill within building wall lines, for each five hundred square metres, both after compaction and before slab construction.
 - .3 For trenches: Three tests per lift of trench backfill for each one hundred fifty linear metres.
 - .8 If compaction tests indicate that a layer has not been brought to the required compaction, re-compact the area, prior to placement of additional material, until the required compaction is obtained. If the layer has been covered by a subsequent operation, remove such material before re-compacting the defective layer.

- .3 Submit a testing and inspection program to account for all the items specified above. Submit to the Consultant at pre-construction meeting or prior to start of construction.
- .2 Cementitious backfill materials will be tested for conformance to the Specifications by an independent inspection company selected and paid for by Owner. Tests include the following:
 - .1 Obtaining certification of cements.
 - .2 Cylinder test. Three test cylinders will be taken from initial pour.
- .3 Cooperate with and assist Owner's inspection/testing company's personnel during inspections and tests.
- .4 Remove defective materials and completed work which fails tests and replace as directed by Consultant.
- .5 Where work or materials fail to meet strength requirements as indicated by test results, pay costs of additional inspection and testing required for new replacement work or materials.

1.8 **PROJECT CONDITIONS**

- .1 Cultural Heritage Resources
 - .1 If cultural heritage resources (such as archaeological sites, artifacts, building and structural remains, and/or human burials) are encountered during performance of Work, contact Consultant immediately and suspend Work in immediate area until assessment has been completed by Ministry of Culture, Tourism and Recreation. Perform required measures to mitigate negative impacts on found resources to acceptance of Consultant.
- .2 Protection
 - .1 Existing buried utilities and structures:
 - .1 Prior to commencing excavation, establish locations of existing buried service installations in the construction area. Notify service owners and obtain their approval to work in such areas. Place adequate markers and take protective measures to ensure that no damage is caused under the work of this section. Repair damaged Work as required at no change in Contract Price.
 - .2 Temporarily cover local existing catchbasins and manholes exposed to construction traffic to prevent entry of earth or debris.
 - .2 Excavations:
 - .1 Erect necessary hoardings, guardrails, markers; place temporary warning lights; take all other measures required to ensure that no damage or injury is caused to persons, or damage to property resulting from this Work.
 - .2 Protect excavations and maintain warning devices during construction and during time when Work is closed down for any cause.

.3 Other contracts, existing buildings and surface features:

.1 Protect work of other trades or of other contracts in progress or completed and protect Owner's existing properties, stored Products, services and utilities from damage.

2 Products

2.1 **MATERIALS**

.1 Granular materials - general: New materials conforming to OPSS 1010, free of organic matter, imported from off-site, and sourced from a member of the Aggregate Producers Association of Ontario. Note: The use of slag and recycled aggregates is prohibited.

.1 Backfill: OPSS Granular "B Type I"

.2 Sub-base: OPSS Granular "B Type I"

.3 Base: OPSS Granular "A"

.4 Base under oil impregnated sand: Granular "A"

.5 Underfloor base: OPSS Granular "A" crushed limestone

.2 Select fill: Native excavated site material approved by Consultant and capable of being compacted to required density and free of:

.1 Any vegetable or organic matter and roots

.2 Cinders or ashes

.3 Building debris

.4 Rocks and stones larger than 75 mm

.3 Impervious fill: Fine grain material such as clay.

.4 Drainage channel panels: "Miradrain 6000" by Mirafi or equivalent by Terrafix.

.5 Oil Impregnated Sand Bed

.1 Sand: Imported natural concrete sand having clean, hard, strong, durable uncoated grains free from lumps, soft or flaking particles, shale, clay, organic matter and other deleterious substances.

.2 Oil: Petroleum based (engine) oil, to provide corrosion protection to steel tank bottom.

.6 Drainage weepers, bedding and surround: Plastic pipe by Big-O or approved equivalent, Type 2 - perforated nominal inside diameter, and complete with a seamless and knitted polyester filter fabric sleeve, non-perforated pipe sections as required for collectors, and all fittings required for the work. Clean coarse aggregate conforming to CSA-A23.1, Table 3, Group 1 (20 to 5 mm).

.7 Perimeter foundation insulation: Styrofoam "SM" by Dow Chemical Co. or "Celfort 300" by Owens Corning conforming to CAN/ULC-S701. Use Lepage "PL Premium" adhesive for use in conjunction with installation of perimeter insulation.

- .8 Unshrinkable fill: Ready mixed Product consisting of CSA-A5, Type 10 portland cement, CSA-A363 cementitious hydraulic slag, sand and water proportioned and mixed to produce a stable, self-levelling, controlled density fill with a compressive strength of 0.7 MPa at twenty-eight days. Cement content to be at 50 kg/m³ of mix.
- .9 Vapour retarder: Minimum 0.25 mm (10 mils) thick sheet membrane conforming to ASTM E1745; Perminator by W.R. Meadows, Stego Wrap Vapor Barrier by Stego Industries or accepted equal.
- .1 Lap tape: 100 mm wide Perminator Tape by W.R. Meadows, Stego Wrap Red Polyethylene Tape or accepted equal.

2.2 **STOCKPILING OF GRANULAR MATERIALS**

- .1 Stockpile materials in a manner to prevent segregation.
- .2 Protect materials from contamination.
- .3 Separate different aggregates by strong, full-depth bulkheads, or stockpile far enough apart to prevent intermixing.
- .4 Do not use intermixed or contaminated materials. Remove and dispose of materials rejected by Consultant within forty-eight hours of rejection.
- .5 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

3 **Execution**

3.1 **EXCAVATION**

- .1 Remove obstructions (ice and snow) from surfaces to be excavated.
- .2 Perform excavation with proper allowance for subsequent work including shoring, bracing and formwork (sheet piling and underpinning). Excavation shall be clean and clear of loose material and true to size. Underpin as shown on Drawings. Also, refer to geotechnical report.
- .3 Securely shore and brace sides of trenches and excavation exceeding 1.2 m in depth with shoring and bracing extending at least 300 mm above the top of trenches or excavation.
- .4 Do not obstruct flow of surface drainage or natural watercourses.
- .5 Excavate to undisturbed soil, level, free from loose, soft or organic matter, and of design bearing strength.
- .6 Perform excavation at or adjacent to existing structures or foundations in such a way that structures and foundations are not weakened or endangered in any way. Where it is required to excavate adjacent to an existing building, all fill under existing floor slabs must be contained.
- .7 If undisturbed soil or bedrock having the required bearing capacity is not encountered at footing depths indicated, determine the possible additional volume of excavation that will be required and obtain Consultant's instructions in writing to excavate to additional required depth.
- .8 Do not expose shale to weather in excavations and in any case, following inspection, cover with 50 mm of 15 MPa concrete within twelve hours after exposure.

- .9 Fill excavations for building foundations which are, through error, carried below the elevation shown or approved depth, with 15 MPa concrete, or as directed by Consultant, at no increase in Contract Price.
- .10 Notify Geotechnical Engineer when bottom of excavation is reached, and have same inspect excavation prior to resumption of Work.

3.2 **DEWATERING**

- .1 Keep excavated areas free from standing water using power operated mechanical equipment.
- .2 Protect open excavations against flooding and damage due to surface run-off.
- .3 Obtain letter of conditional approval from authorities having jurisdiction to dispose of groundwater into sewer drainage system. Apply for water disposal permit.
- .4 Keep excavations and trenches free of water throughout construction period.
- .5 Groundwater removal:
 - .1 Lower groundwater level and maintain at depth below lowest point of excavation to ensure a dry stable surface.
 - .2 Dewater to prevent loss of soil and maintain stability of sides and bottom of excavation and of adjacent structures.
 - .3 Dispose of water in conformance with applicable by-laws and in a manner not detrimental to public and private property, or portion of Work completed, or under construction.
 - .4 Supply and install flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to sewers, water courses or drainage areas in accordance with authorities having jurisdiction. Perform testing on settlement tank discharge to confirm that effluent meets sewer bylaw requirements. Locate tanks to acceptable area determined by Consultant.
- .6 Surface water removal:
 - .1 Remove surface run-off in a manner that will prevent loss of soil and maintain stability of sides and bottom of excavation. Obtain Consultant's approval of dewatering method to be used.
 - .2 Discharge surface water into existing storm drainage system to acceptance of Consultant and local authorities.

3.3 **PERIMETER INSULATION**

- .1 Install insulation with spot daub application of adhesive to ensure tight contact to substrate and to prevent displacement during backfilling. Butt joints tight between boards.

3.4 **DRAINAGE CHANNEL PANELS**

- .1 Secure channel panels with galvanized stick clips with lock washers in accordance with drainage channel manufacturer's directions. Set clips with adhesive compatible with clip-receiving substrate.
- .2 Trim panels and overlap and interlock same. Cover joints and edges with fabric flap.

3.5 DRAINAGE WEEPERS

- .1 Place 100 mm minimum thick granular bedding and tamp to grade.
- .2 Ensure pipe interior and coupling surfaces are clean before laying. Lay pipe with perforations downward. Do not use shims to establish pipe slope. Protect pipe ends from damage and ingress of foreign materials.
- .3 Have Consultant approve installed pipe before placing backfill.
- .4 Place granular surround after pipe installation, 150 mm thick each side and 300 mm minimum over pipe. Place granular material by hand. Consolidate by hand tamping slightly to prevent pipe displacement.
- .5 Backfill balance of excavation with specified granular backfill.

3.6 BACKFILLING

- .1 Prior to backfilling, remove loose materials, debris, etc., from excavated areas. Do not place backfill on contaminated (or frozen) ground.
- .2 Do not use backfill material which (is frozen or which) contains ice, snow or debris.
- .3 Place granular material, grade and compact to levels which provide for superimposed work at levels shown.
- .4 Notify Consultant for inspection when backfill is complete to compacted levels indicated on Drawings.
- .5 Place granular backfill in layers not exceeding 200 mm in depth and thoroughly compact. Each layer shall be compacted and accepted before next layer is placed.
- .6 Backfill simultaneously on both sides of walls. Do not backfill until walls have reached their design strength.
- .7 Take necessary precautionary measures during compaction of fill adjacent to foundations, walls, drains, etc., that such items are not displaced from their proper location or damaged by compacting equipment. In the event damage or displacement occurs during filling or resulting from compaction of fill, correct same, to approval of Consultant, and at no increase in Contract Price.
- .8 Place select fill for backfill where shown in layers not exceeding 200 mm, with each layer thoroughly compacted.

3.7 UNDERFLOOR GRANULAR SUB-BASE

- .1 Prior to filling, remove loose materials, debris, etc., from areas to be filled. Do not place fill on contaminated (or frozen) ground.
- .2 Do not use fill material which (is frozen or) contains ice, snow or debris.
- .3 Proof roll existing earth sub-grade in order to identify inconsistencies or soft areas.
 - .1 If a soft area is encountered, promptly notify the Consultant and obtain his instructions in writing to rectify the soft area.
 - .2 Proceed with filling operations only after inconsistencies or soft areas have been rectified.

- .4 Place Granular "B" sub-base in loose layers not exceeding 200 mm to a compacted depth of 150 mm terminating as follows except where shown otherwise:
 - .1 For facilities with permanent, watertight enclosure installed prior to placing concrete:
 - .1 Terminate compacted granular sub-base 200 mm below underside of slab. This allows for 150 mm granular base plus 50 mm cushion to absorb bleed water from concrete allowing concrete to dry evenly on both sides.
 - .2 For facilities that are not permanently enclosed with a watertight enclosure prior to pouring concrete:
 - .1 Terminate compacted granular sub-base 150 mm below underside of floor slab.

3.8 UNDERFLOOR GRANULAR BASE

- .1 Prior to filling, remove loose materials, debris, etc. from areas to be filled. Do not place fill on contaminated (or frozen) ground.
- .2 Do not use fill material which (is frozen or) contains ice, snow or debris.
- .3 Proof roll granular sub-base in order to identify inconsistencies or soft areas.
 - .1 If a soft area is encountered, promptly notify the Consultant and obtain his instructions in writing to rectify the soft area.
 - .2 Proceed with filling operations only after inconsistencies or soft areas have been rectified.
 - .3 Place Granular "A" crushed limestone base to a compacted thickness of 150 mm in loose layers not exceeding 200 mm.

3.9 VAPOUR RETARDER

- .1 Ensure that granular surface is smooth and free of sharp projections that could puncture vapour retarder.
- .2 Place vapour retarder under floor slabs to receive epoxy, urethane and floor finishes installed with adhesive and thin set mortar:
 - .1 Install vapour retarder in accordance with ASTM E1643 and as specified.
 - .2 Ensure there are no discontinuities in vapour retarder at seams and penetrations.
 - .3 Unroll with the longest dimensions parallel with the direction of concrete placement.
 - .4 Join sections of vapour retarder and seal penetrations in vapour retarder with mastic tape. Ensure vapour retarder surfaces to receive mastic tape are clean and dry.
 - .5 Ensure there is no moisture entrapment by vapour retarder due to rainfall or ground water intrusion.
 - .6 Immediately repair holes in vapour retarder with self-adhesive repair tape.
 - .7 Seal around pipes and other penetrations in vapour retarder with pipe boots in accordance with manufacturer's instructions.

- .8 Protect vapour retarder from damage during installation of reinforcing steel and utilities and during placement of concrete slab or granular materials.
- .9 Immediately repair damaged vapour retarder in accordance with manufacturer's instructions.
- .3 Vapour Retarder Location
 - .1 If the structure is enclosed with a permanent, watertight enclosure prior to concrete placing, place a 50 mm compacted thickness of granular limestone screenings cushion on top of vapour retarder to underside of floor slab.
 - .2 If the structure is not enclosed with a permanent, watertight enclosure prior to concrete placing, place the vapour retarder directly under the floor slab. Do not use cushion method.
 - .3 In any case, extend vapour retarder 1 m into areas without vapour retarder.

3.10 **UNSHRINKABLE FILL**

- .1 Use at locations indicated (or where work area is too limited to permit proper granular material placing and compaction operations.)
- .2 Discharge fluid backfill directly from ready mix truck to points of usage. Place in uniform lifts and simultaneously on both sides of members being backfilled to equalize loading.
- .3 Consolidate fill with vibrators.
- .4 If piping occurs in area being backfilled, coordinate with pipe installer to ensure disturbance of pipe alignment during backfilling is prevented.
- .5 Use temporary plates to support traffic loads over cementitious fill.

3.11 **COMPACTION**

- .1 Use compaction equipment capable of obtaining required material densities.
- .2 Compaction Densities
 - .1 Granular materials: To 98% Standard Proctor Maximum Dry Density (SPMDD) in accordance with ASTM D698.
 - .2 Earth fill and earth subgrade: To 95% Standard Proctor Maximum Dry Density (SPMDD) in accordance with ASTM D698.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with power operated portable plate compactors.
- .6 Depth and layers specified are minimum dimensions of fill after compaction, except where loose layer is specified.
- .7 Ensure compaction operations do not cause vibration and noise levels exceeding acceptable limits established by authorities having jurisdiction.

3.12 **PROTECTION OF FILL AND BACKFILL**

- .1 Protect filled and backfilled areas against damage from any cause.

3.13 **DISPOSAL OF SURPLUS MATERIALS**

- .1 Ensure environmental tracking requirements and fill is disposed of legally and in accordance with City's environmental requirements and regulations.
- .2 Remove from the site and legally dispose of excess excavated material, waste material, trash, debris and rubble.
- .3 Obtain and pay for all necessary regulatory approvals, consents and permits for disposal of surplus material.

OR

- .4 Deposit and spread excess excavated material on site where shown on Drawings.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 CAN/CGSB-1.74 - Alkyd Traffic Paint
- .2 OPSS 310 - Ontario Provincial Standard Specification, Construction Specification for Hot Mix Asphalt
- .3 OPSS 1101 - Ontario Provincial Standard Specification, Material Specification for Performance Graded Asphalt Cement
- .4 OPSS 1150 - Ontario Provincial Standard Specification, Material Specification for Hot Mix Asphalt

1.3 **SUBMITTALS**

.1 Submit Shop Drawings in accordance with Section 01 33 00. Submit the following:

- .1 Asphalt mix designs.
- .2 Information regarding manufacture and installation of pavement markings, blackout paint, asphalt crack sealant and road reinforcement mesh.

1.4 **QUALITY ASSURANCE**

- .1 Refer to "Quality Control" in Section 01 10 00 – General Requirements.
- .2 Implement a quality control program which includes testing and inspection to comply with the intent of these Specifications paid for by the Contractor.
- .3 Owner may employ an independent testing and inspection company to perform additional testing and inspection, and costs of such tests and inspections will be paid for by Owner.
- .4 Consultant may have cores taken from finished pavement by an independent testing firm to ensure that paving has been placed to required thickness as shown and to specified degree of compaction. Testing will be at the expense of the Owner. Patch core holes resulting from the removal of samples, with asphaltic concrete material as specified herein.
- .5 Remove and replace areas of asphalt work proven defective by the tests or contrary to requirements shown and specified, as directed by Consultant and at no cost to Owner.

1.5 **PROJECT CONDITIONS**

.1 Protection

- .1 Protect buildings and work of other trades from damage caused by work of this section. Correct damage caused by work of this section at no cost to Owner.

- .2 Protect work of this section from damage or deformation during period of construction. Remove and replace precast bumper curb that are cracked, chipped, broken or otherwise damaged with new units acceptable to Consultant at no cost to Owner.
- .3 Erect temporary barriers, signs, protective covers, and rain protection as required. Remove protection when pavement is ready for traffic.
- .4 Do not apply pavement during wet weather, or unless granular base is dry in terms of asphaltic concrete paving.

2 Products

2.1 MATERIALS

- .1 Asphaltic concrete paving: Conforming to OPSS 310, composed of a base course and a surface course, of types as shown.
 - .1 Asphalt cement: Conforming to requirements of OPSS 1101, PGAC 58-28 for light duty traffic and PGAC 64-28 for heavy duty traffic.
 - .2 Asphalt primer: Liquid asphalt emulsion, slow drying for spray or brush application.
 - .3 Recycled content: Use recycled asphalt product (RAP) in binder/base course mixes only. Do not use for wearing course.
- .2 Grout: Pre-mixed, non-shrink, flowable type, Euclid "Euco NS", Master Builders "Construction Grout", Sika "Grout 212" or "M-Bed Standard", W.R. Meadows "CG 86", CPD "Non-Shrink" or Dayton Superior "1107 Advantage Grout"; without aggregate fillers.
- .3 Asphalt crack sealant: Hot poured rubberized asphalt thermoplastic sealing compound. Hydrotech Sealz 6165 or approved equivalent.

3 Execution

3.1 EXAMINATION

- .1 Inspect state of paving base preparation and other existing conditions upon which work of this section is dependent. Report to Consultant in writing any defects or discrepancies. Commencement of Work implies acceptance of existing conditions.

3.2 PREPARATION

- .1 Shape bases as necessary to correspond with finish elevations of pavement, providing for slope as shown. Compact granular bases to densities and methods specified in Section 31 00 00.
- .2 Correct irregularities or depressions that develop under rolling by loosening granular material at such locations and adding or replacing material and recompact until the surface is smooth and uniform. Dig out and replace soft spots which develop in granular base during or after compaction operations.
- .3 To aid in compaction work or to reduce dust nuisance or both, sprinkle granular base with water during rolling, tamping and blading. Where water is added for improvement of compaction, apply immediately ahead of the compacting unit pass.
- .4 Maximum allowable tolerance in cross-sectional and longitudinal profile is 6 mm at any place measured with a 3 m straight edge.

3.3 PRIMING

- .1 Prior to application of paving, prime paint vertical contact surfaces with liquid asphalt emulsion.
- .2 Where paving of a course of asphalt has been delayed and/or will not be completed immediately after the underlying course of asphalt has been placed, thoroughly clean surfaces to be paved and apply one full coverage tack coat of asphalt primer immediately before paving.

3.4 TACK COAT

- .1 This Work consists of the application tack coat to existing asphalt surfaces which will be covered with hot mix asphalt.
- .2 Power broom clean and air blast surfaces to remove debris and dust prior to tack coat.
- .3 Apply tack coat of asphalt emulsion diluted with an equal part of water. Apply tack coat to continuous uniform thickness in accordance with manufacturer's recommended rate of application, to bonding surfaces and allow to dry to manufacturer's recommended tackiness before placing hot mix.

3.5 APPLICATION

- .1 Install asphaltic concrete paving to lines and compacted thicknesses shown conforming to methods of application and compaction requirements of OPSS 310.
- .2 Clean prepared base of all foreign matter prior to application of the mixture to substrate.
- .3 Form well bonded joints. Cut back bituminous course to full depth in straight line as required to expose fresh vertical surfaces. Remove broken or loose material. Paint exposed vertical edge of asphaltic joints with asphalt primer prior to placing asphalt courses.
- .4 Form joints between new and existing work in same manner as specified herein for new work, and in such a manner as to ensure continuous bond at interface.
- .5 Finish surface of pavement free from depressions exceeding 6 mm when measured with a 3 m straight edge. Remedy any low or defective areas by cutting out the course and replacing it with fresh hot mixture, and re-compact.

3.6 ASPHALT CRACK REPAIR

- .1 Clean out and let dry existing cracks with hot compressed air lance.
- .2 Fill crack with sealant to minimum depth of 10 mm in accordance with manufacturer's recommendations.
- .3 Dust sealant with sand to prevent vehicle tracking.

3.7 PROTECTION OF PAVING

- .1 After completion of surface course, prevent vehicular parking on pavement until surface has cured and hardened.

End Of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 OPSS 1714 - Ontario Provincial Standard Specification, Material Specification for Field Reacted Polymeric Pavement Marking Materials
- .2 OPSS 710 - Ontario Provincial Standard Specification, Construction Specification for Pavement Markings.
- .3 OPSS 1750 - Ontario Provincial Standard Specification, Traffic Paint Reflectorizing Glass Beads
- .4 OTM - Ontario Traffic Manual, Book 11

1.3 **SUBMITTALS**

.1 Submit Shop Drawings in accordance with Section 01 33 00. Submit the following:

- .1 Product Information regarding manufacture and installation of pavement markings, blackout paint, and asphalt crack sealant.

1.4 **QUALITY ASSURANCE**

.1 Refer to "Quality Control" in Section 01 10 00 – General Requirements.

.2 Installer qualifications: Manufacturer to certify this Subcontractor as an experienced installer who has completed thermoplastic pavement marking projects to the extent that is required for this Project.

.3 Implement a quality control program which includes testing and inspection to comply with the intent of these Specifications.

.4 Owner may employ an independent testing and inspection company to perform additional testing and inspection, and costs of such tests and inspections will be paid for by Owner.

.5 Remove and replace areas of asphalt work proven defective by the tests or contrary to requirements shown and specified, as directed by Consultant and at no cost to Owner.

1.5 **PROJECT CONDITIONS**

.1 Protection

- .1 Protect Work of this section from damage according to manufacturer's recommendations. Protect buildings and work of other trades from damage and replace damaged work that cannot be satisfactorily repaired at no cost to the Owner.

2 Products

2.1 **MATERIALS**

.1 Durable Pavement marking:

.1 Field reacted polymeric pavement marking: Flexible two-component, solvent-free, and lead-free cold-curing acrylic or methacrylate road marking material in accordance with OPSS 1714 and Ontario Traffic Manual Book 11, and with reflectorizing glass beads in accordance with OPSS 1750

.1 Parking bays lines shall be identified with 100 mm (4") wide white or yellow painted lines in accordance with approved parking layout and/or in accordance with the requirements or authorities having jurisdiction.

.2 Blue: For barrier free accessible parking lot stalls and symbols. Barrier free accessible parking bays and refuge areas shall be identified with appropriate symbol designation and/or in accordance with the requirements or authorities having jurisdiction.

.3 Pedestrian walkways shall be identified with 150 mm (6") wide white or yellow painted lines at 45 degrees to path of travel spaced at 400 mm (16") o.c. and/or in accordance with the requirements or authorities having jurisdiction.

.2 Asphalt crack sealant: Hot poured rubberized asphalt thermoplastic sealing compound. Hydrotech Sealz 6165 or accepted equal.

3 Execution

3.1 **EXAMINATION**

.1 Inspect state of asphalt or concrete paving and other existing conditions upon which work of this section is dependent. Report to Consultant in writing any defects or discrepancies. Commencement of Work implies acceptance of existing conditions.

3.2 **PREPARATION**

.1 Immediately prior to application, clean the surface of any contaminants that would hinder adhesion.

.2 Verify pavement surface is free from ponding water, frozen matter, dust, oil, grease, scaling, or laitance, and other foreign matter detrimental to performance.

3.3 **APPLICATION**

.1 The material shall be applied to a dry surface in temperatures no lower than 7°C (45°F).

.2 Clean prepared base of all foreign matter prior to application of the mixture to substrate.

3.4 **PAVEMENT MARKINGS**

.1 Lay out pavement markings as indicated on Contract Drawings and in accordance with manufacturer's instructions.

.2 Allow paving to cure before applying markings.

.3 Paint 100 mm wide lines on pavement for parking stalls and accessible symbol, unless indicated otherwise.

- .4 Apply paint with mechanical equipment to clean, dry surface, to a minimum dry film thickness of 228 microns. Provide well defined and straight lines; do not overspray.
- .5 Lines to be parallel and have neat, straight, clean and sharp edges. Lines to be of uniform colour and density.
- .6 Take precautions to protect freshly painted line work from being marked or otherwise disturbed by traffic, by use of fluorescent cones, barricades or other means until paint is dry.
- .7 Remove spills or tracking of paint and clean up as required.
- .8 Refinish ragged edges or lines incorrectly laid out. Remove incorrect lines and make them inconspicuous in accordance with manufacturer's instructions.

3.5 **REMOVING EXISTING PAVEMENT MARKINGS**

- .1 Remove existing painted pavement markings by grinding or abrasive blasting.
- .2 Totally remove the pavement markings to a minimum 10 mm beyond the edge of the marking and to a maximum depth of 3 mm.

3.6 **ASPHALT CRACK REPAIR**

- .1 Clean out existing cracks with hot compressed air lance and let dry.
- .2 Fill crack with sealant to minimum depth of 10 mm in accordance with manufacturer's recommendations.

3.7 **PROTECTION**

- .1 Protect pavement marking until dry.
- .2 Repair damage to adjacent materials caused by pavement marking application.

End of Section

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- 1 Products
 - 1.1 **TANK APPURTENANCES / ACCESSORIES FOR ENGINE OIL (EO), ENGINE ANTIFREEZE FLUID (EAF), WASTE OIL (WO)**
 - .1 Tank Pressure/Vacuum Relief Devices
 - .1 Relief devices: Tank design working pressure shall be as noted on tank Drawings, and in accordance with ULC, ASME, and NFPA-30. Coordinate all Shop Drawings for tank/device nozzle sized. Sizing criteria shall be submitted with Shop Drawings for all devices.
 - .2 Pressure/vacuum vent totes
 - .1 Pressure setting at 4 oz/sq.in. and vacuum setting at 0.5 oz/sq.in., aluminum construction.
 - .2 Manufacturer: Protectoseal or accepted equal.
 - .3 Pressure/vacuum vent with flame arrester for WWF.
 - .1 Pressure setting at 4 oz/sq.in. and vacuum setting at 0.5 oz/sq.in., aluminum construction
 - .2 Manufacturer: Protectoseal #830 or accepted equal
 - .4 Emergency Pressure Vents
 - .1 For Diesel, Gasoline, EAF, ATF, EO. Size and capacity in accordance with NFPA30 with a maximum pressure differential of 8.61 kPa (1.25 psig) aluminum construction.
 - .2 Manufacturer: Protectoseal or accepted equal
 - 1.2 **TANK FARM PIPING RELIEF VALVES**
 - .1 Adjustable type with orifice size and initial set point as shown on the Drawings or schedules.
 - .2 Pressure relief valve conform to ASME code, all wet parts shall be 304 or 316 stainless steel valve shall be size for 110% pump capacity
 - .1 Manufacturers:
 - .1 Trufflo DSP series
 - .2 Gorman Rupp Rotoprime
 - .3 Farris
 - .4 Or accepted equal
 - 1.3 **BACKPRESSURE CONTROL VALVES**
 - .1 Self-contained, carbon steel or stainless-steel body, flanged ends, as shown on Drawings or schedules.
 - .2 Back pressure regulating valve, self-contained, direct acting complete with all stainless steel trim, pressure control range and minimum pressure differential of valve shall correspond to system pressure shown on drawing. Valve shall be size for maximum pump flow.
 - .1 Manufacturers:
 - .1 CASHCO/KNM
 - .2 Cash Type FR

- .3 Jordan 50 Series
- .4 Or accepted equal

1.4 **SPECIALTY ITEMS**

- .1 Dry quick disconnect coupler, adapter and dust cap. Dry disconnect coupling to provide automatic closure to prevent spillage.

- .1 Manufacturers:

- .1 Coupler - Kamvalok
- .2 Adaptor - Kamvalok
- .3 Dust Cap - Kamvalok
- .4 OPW Products
- .5 Or accepted equal

- .2 Static Grounding Reels

- .1 Provide one heavy duty automatic retracting grounding reel for each tank farm.

- .1 The reel is designed to function under extreme environmental conditions equipped with 15.25 m length of nylon coated galvanized steel cable and 100 amp alligator type solid copper jaw grip clamp assembly.
- .2 The retraction speed is automatically governed by a brake assembly to limit the retraction speed from two to seven feet per second.
- .3 The reel assembly has a baked-on finish and gasketed drum and permanently lubricated bearing surfaces.
- .4 The latching mechanism holds the cable at any desired length and a slight pull on the cable releases the mechanism causing retraction.

- .2 Manufacturer:

- .1 Lind Equipment Ltd. Model ML-2930-46 or accepted equal

- .3 Flexible Piping Connections

- .1 Provide flexible metal hoses for installation on piping connections to the suction and discharge of pumps, and in piping systems where indicated on Drawings
- .2 For flexible hoses up to 50 mm, provide braided stainless steel hose with screwed ends and union nut and nipple with minimum visible live hose length of 300 mm. For hoses 65 mm and larger provide braided stainless steel hoses with Class 150 flanges and minimum visible live hose length of 450 mm.
- .3 For flexible hoses at pumps, provide Flexonics Model BSN up to 50 mm and BSF on piping 65 mm and larger.
- .4 Manufacturer:
 - .1 Senior Flexonics or accepted equal

End Of Section

1 General

1.1 **DESCRIPTION OF WORK**

.1 Specialized lube system provider to design and install complete lube storage and dispensing systems with all design, material, equipment, labor, accessories, services, tests, start-up, commissioning and training necessary to completely execute the specialties work as herein specified and indicated on the Drawings.

.2 Services covered under this Specification shall include the following systems:

System Name	Piping Designation
Engine Antifreeze Fluid	EAF
Engine Oil	EO
Waste Engine Oil	WO

.3 Scope of work

.1 Refer to respective lube system process flow diagram for the minimum requirements, design criteria and scope of work for the lube systems provider.

.2 Lube systems provider to coordinate with general contractor for providing all power, controls, conduits and wiring to lube system components as required.

.3 Lube system provider is responsible to design and provide complete operating lubes storage and dispensing systems including all mechanical, electrical, and control systems. Design and Install as indicated on the Drawings and Specifications, including but not necessarily limited to:

.1 Lubes storage tanks, totes, drums and accessories.

.2 Lubes distribution piping (tubing), valves and fittings.

.3 Lubes compressed air transfer pumps and controls.

.4 Lube Tanks monitoring system.

.5 Tanks fill and containment.

.6 Installation of tanks (complete with concrete pad) and piping system.

.7 Lube and compressed air hose reels.

.4 Some lube local systems (i.e. waste antifreeze, etc.) are shown and described directly in the drawings and do not have a correspondent specification. Lube supplier to provide a standard equipment c/w all components customarily used for an operational system.

.4 Acceptable system providers:

.1 **COMCO Canada Inc.**, 100 Welham Rd., Barrie, On L4N 8Y4

Toll Free: 1-800-461-6620

Local 705-728-0905

Fax 705-728-1438

Attn: James Picton

.2 **TMS (Total Meter Services)** 70 Worcester Rd. Toronto, ON. M9W 5X2

Tel: 416-225-5867

Fax: 416-225-1938

Attn: Dennis Swanek

1.2

REFERENCE SECTIONS

- .1 Section 23 05 01 Basic Mechanical Requirements
- .2 Section 43 40 00 Aboveground Welded Steel Storage Tanks
- .3 Section 43 40 06 Pressure Piping
- .4 Section 43 40 07 Valves - Pressure Piping

1.3

CODES AND STANDARDS

.1 References (Latest Editions)

- .1 National Fire Protection Association (NFPA)
- .2 Ontario Fire Code
- .3 Underwriters' Laboratories of Canada (ULC)
- .4 Canadian Standards Association (CSA)
- .5 Ontario Electrical Safety Code
- .6 Liquid Fuels Handling Code
- .7 Canadian Petroleum Product Institute
- .8 ASTM A36 - Specification for Structural Steel
- .9 ASTM A53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- .10 ASTM A283 - Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
- .11 CAN/CSA G40.40/G40.21-M - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
- .12 SSPC - Steel Structures Painting Council "Steel Structures Painting Manual"
- .13 CAN-S630 - Shop Fabricated Steel Aboveground Vertical Tank for Flammable and Combustible Liquids
- .14 ASTM A167-89A - Standard Specification for Stainless and Heat-Resisting Chromium Nickel Steel Plate, Sheet and Strip
- .15 ASTM A276-89A - Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes
- .16 ASTM A209-88A - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- .17 ANSI/ASME B36.19M-85 - Stainless Steel Pipe
- .18 AW A5.4 - Covered Corrosion-Resisting Chromium and Chromium Nickel Steel Welding Electrodes
- .19 AW A5.9 - Corrosion-Resisting Chromium and Chromium-Nickel Steel Bare and Composite Metal Cored

		and Stranded Welding Electrodes and Welding Rods
.20	AWS C5.5	- Gas Tungsten Arc Welding, Recommended Practices for
.21	AWS C5.6	- Gas Metal Arc Welding, Recommended Practices for
.22	CSA W47.1	- Certification of Companies for Fusion Welding of Steel Structures
.23	CSA W48.1-M	- Carbon Steel Covered Electrodes for Shielded Metal Arc Welding
.24	CSA W59-M	- Welded Steel Construction (Metal Arc Welding)
.25	CAN/CSA-W117.2-M	- Safety in Welding, Cutting and Allied Processes
.26	CSA W178.1	- Certification of Welding Inspection Organizations
.27	CSA W178.2	- Certification of Welding Inspectors

1.4 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 Product Data.
- .2 Shop Drawings: Provide a process flow detailed schematic indicating a complete system, signed by licensed engineer, indicating system layout, pipe sizes, location of supports, elevations, and equipment mounting details, for each lube system. For lube tanks, indicate dimensions, and location of all accessories.
- .3 Product data: Provide data on pipe (tubing) materials, pipe (tube) fittings, valves and accessories. Provide manufacturers catalog information for all equipment.
- .4 Electrical system design: Provide Drawings and Specifications stamped by licensed engineer that include the proposed layout and wiring diagrams for equipment covered in this section that requires electrical connections. Indicate number and size of wires, location of wiring in classified areas and location of intrinsically safe circuits.
- .5 Control system design: Provide control system design stamped by licensed engineer including electrical schematics, panel dimensions and field wiring diagrams.
- .6 Calculations: Provide calculations for pump selection, pipe sizes, pipe support requirements, atmospheric vent sizing, and emergency vent sizing.
- .7 Equipment data: Provide manufacturers information for all equipment.

2 Products

2.1 TANKS

- .1 Refer to Section 43 40 00 Aboveground Welded Steel Storage Tanks.

2.2 AIR ACTUATED PUMPS

- .1 Low Pressure Fluid Systems
 - .1 Compressed Air Powered Diaphragm Pump – Waste Oil
 - .1 This pump shall be a double acting double diaphragm pump with a self-lubricating non-stalling air valve.

- .2 This pump shall be of the self-priming design. This pump shall be compatible with waste antifreeze or waste oil.
- .3 This pump shall be abrasion resistant, and able to handle suspended solids of up to 1/8" OD.
- .4 This pump shall have dual inlet capability for 50-50 product mixture.
- .5 This pump includes all accessories customarily incorporated into this model.
- .2 Engine Antifreeze Fluid 50:50 mixture
 - .1 Heavy duty integrated air motor and pump tube must be capable of supplying 6 litres (1.5 gallons) per minute simultaneously at three dispensing locations for a total of 1.8 Lpm (4.5 gpm).
 - .2 Must be capable of wall mounting as determined to be suitable for the application.
 - .3 3:1 ratio to be confirmed by lube system supplier during detail design, based on lube piping layout shown on the drawings.
 - .4 108 mm diameter air motor piston minimum with 40 to 150 psig of working air pressure. Larger air motors are optional.
 - .5 Air motor to include Airbrake technology to prevent damage due to run-away.
 - .6 Double acting pump, oil output from pump will be equal for both up and down stroke.
 - .7 Stall pressure will be equal for both up and down stroke.
 - .8 Ball check seats will be hardened and suitable for the application.
 - .9 Integrated muffler exceeds OSHA noise requirements.
 - .10 Corrosion resistant air motor will be fully pneumatic logic controlled with divorced from pump tube design. Modular design with a maximum of five moving parts for longer life and ease of maintenance.
 - .11 The pump tube is to contain a carbon steel plunger case hardened with polyurethane seal or equal arrangement. Acceptable manufacturers: Lincoln Industrial or equal
- .2 Medium Pressure Fluid Systems
 - .1 Heavy Duty Integrated Air Motor and Pump Tube for Engine Oil, Automatic Transmission Fluid:
 - .1 Must be capable of supplying 6 Lpm (1.5 gpm) simultaneously at three dispensing locations for a total of 18 Lpm (4.5 gpm).
 - .2 Must be capable of wall mounting as determined to be suitable for the application.
 - .3 5:1 ratio to be confirmed by lube system supplier during detail design, based on lube piping layout shown on the drawings.
 - .4 108 mm diameter air motor piston minimum with 40 to 150 psig of working air pressure. Larger air motors are optional.
 - .5 Air motor to include Airbrake technology to prevent damage due to run-away.

- .6 Double acting pump, oil output from pump will be equal for both up and down stroke.
 - .7 Stall pressure will be equal for both up and down stroke.
 - .8 Ball check seats will be hardened and suitable for the application.
 - .9 Integrated muffler exceeds OSHA noise requirements.
 - .10 Corrosion resistant air motor will be fully pneumatic logic controlled with divorced from pump tube design. Modular design with a maximum of five moving parts for longer life and ease of maintenance.
 - .11 The pump tube is to contain a carbon steel plunger case hardened with polyurethane seal or equal arrangement.
 - .12 Acceptable manufacturers: Lincoln Industrial or approved equal
- .3 Air Pumps Accessories:
- .1 Service Shut off Valves
 - .1 All pumps shall be equipped with a service shut off valve to isolate the pump from the system for testing or service. This valve shall be rated for a working pressure greater than the maximum output pressure of the pump for which it is intended.
 - .2 All pumps shall be equipped with flexible hoses at inlet and outlet of pump to minimize shock transmitted to pump support brackets.
 - .3 Pumps shall be complete with wall mounting frame.
 - .4 Provide neoprene pads between frame and walls, pump and frame, to minimize transmission of vibrations to building structure.
 - .5 Filters Regulators and Lubricators
 - .1 Each compressed air powered diaphragm pump shall have incorporated into its supply line a filter regulator assembly. This assembly shall be securely mounted to the wall or the pump. The filter shall be equipped with an automatic drain and the regulator shall be equipped with an air gauge.

2.3

HOSE REELS

Features and Construction for Heavy Duty, Low Pressure Reels for: Engine Antifreeze and Compressed Air Applications

- .1 Working pressure rating of 1,000 psig.
- .2 13 mm (1/2") NPT (F) thread inlet and outlet connections with ninety degree swivel.
- .3 9 mm (3/8") I.D. hose by 15.24 m (50 ft) in length.
- .4 Multi position, dual arm support.
- .5 For antifreeze applications, all wet parts be stainless steel.
- .6 Components are individually powder coat painted prior to assembly.
- .7 Strain relief for hose connection through reel sheave.
- .8 Spring tension adjustable without disconnected hose, control valve or ball stop.
- .9 One hundred and eighty degree opposed double ratchet non-sparking hose reel stop mechanism.

- .10 Anti-lockout hose clamp.
- .11 Rolled sheave edges.
- .12 Dual needle bearings reduce friction to rotate reels providing smooth balanced operation during both hose extension and retraction.
- .13 Easily accessible yet fully contained power springs designed for optimum performance at various operating pressures.
- .14 Five year limited warranty.
- .15 Acceptable Manufacturers and Models
 - .1 Prime manufacturer or accepted equal: Specifications are based on the equipment identified herein by manufacturers name to establish acceptable standards of quality, performance, features and construction.
 - .2 Prime manufacturer: Lincoln
- .2 Features and Construction for Heavy Duty, Medium Pressure Reels for: Engine Oil and Automatic Transmission Fluid:
 - .1 Working pressure rating of 2500 psig.
 - .2 13 mm NPT thread inlet and outlet connections with ninety degree swivel.
 - .3 13 mm I.D. hose by 15.24 m in length.
 - .4 Multi position, dual arm support.
 - .5 Low restriction, fully ported swivel designed to be corrosion resistant when used with engine antifreeze.
 - .6 Components are individually powder coat painted prior to assembly.
 - .7 Strain relief for hose connection through reel sheave.
 - .8 Spring tension adjustable without disconnected hose, control valve or ball stop.
 - .9 One hundred and eighty degree opposed double ratchet non-sparking hose reel stop mechanism.
 - .10 Anti-lockout hose clamp.
 - .11 Rolled sheave edges.
 - .12 Dual needle bearings reduce friction to rotate reels providing smooth balanced operation during both hose extension and retraction.
 - .13 Easily accessible yet fully contained power springs designed for optimum performance at various operating pressures.
 - .14 Five year limited warranty.
 - .15 Acceptable Manufacturers and Models
 - .1 Prime manufacturer or accepted equal: Specifications are based on the equipment identified herein by manufacturers name to establish acceptable standards of quality, performance, features and construction.
 - .2 Prime manufacturer: Lincoln
- .3 Features and Construction of Metered Dispense Valves:
 - .1 Maximum flow rate of 45.4 Lpm (12 gpm) and maximum working pressure of 1500 psi (103 bar). Operating temperature range is -40-180°F (-40-82°C).

- .2 EO and ATF in repair bays:
 - .1 Supply electronic meter with valve (9 mm flexible hose or rigid extension) to dispense lubes (see drawing(s) for quantities).
 - .2 Meter and valve to have range of 1-18.9 Lpm (.26-5 gpm) and operating pressure range for oils from 45-1000 psi (3.1-69 bar), and an operating pressure range for gear lube from 20-1000 psi (1.4-69 bar).
 - .3 Meter accuracy + .5% and repeatability of +15%. Operating temperature range is 32-120°F (-34.4-48.8°C). Valve is re-settable for daily, weekly or lifetime dispense reports.
 - .4 Provide an isolation valve just upstream the dispensing nozzle, hose mounted.
 - .5 Meter/valve must have a full two year warranty.
 - .6 Acceptable manufacturer: Lincoln or approved equal.
- .3 Reel Mounting Channels and Brackets
 - .1 -Structural contractor shall provide reel banks support beam. Lube system supplier to order the reels complete with mounting plates and brackets to suit structural beam size and shape.
 - .2 Inlet connection hose.
 - .3 All reels shall be furnished with an inlet connection hose of identical construction as the previously specified outlet hoses to isolate the reel from the supply piping. The inlet connection hose shall be minimum two feet in length and the same diameter as the outlet hose.
- .4 Service Shut Off Valve
 - .1 All hose reels shall be equipped with a service shut off valve to isolate the reel from the system for testing or service. This valve shall be rated for a working pressure greater than the maximum output pressure of the pump which is supplying it.
 - .2 Service shut off valves shall include: Low pressure 13 mm valves, low pressure 25 mm valves, medium pressure 13 mm valves medium pressure 19 mm valves, high pressure 13 mm" valves.

2.4 IDENTIFICATION TAGS FOR LUBES

- .1 Clearly identify all lubes and process fluids piping/tubing.
- .2 Provide plastic identification tags on each lube dispensing hose, close to the dispensing nozzle for easy identification.
- .3 Provide plastic identification tags on each reel.

2.5 PRESSURE GAUGES

- .1 Pressure Gauge Assembly (Interior)
 - .1 Gauge: Dry type with 114 mm dual-scale (kPa/psi) dial, solid front, blowout back, polypropylene case, brass movement with bronze bushings, phosphor bronze silver brazed Bourdon tube, ¼ NPT brass socket. Accuracy, 1 percent of scale range, Grade 1A, in accordance with ANSI B40.1.

- .2 All gauges installed over 3.66 m above finished floor shall be remotely mounted on nearest column at 1.68 m above finished floor and tubing extended to gauge from piping or tank. Install gauge lock at pipe and at gauge. Each gauge remotely mounted shall have manufacturer compensate for elevation and temperature difference at factory.
- .3 Impulse dampener: Brass body and insert, ¼ NPT.
- .4 Gauge lock: Brass body and plug, "T" handle.
- .5 Diaphragm seal: Plain design with removable 316 stainless steel diaphragm Teflon coated on process side. Flushing port, 316 stainless steel process housing, ¼ NPT instrument connection, 15 mm process connection.
- .2 Pressure Gauge Assembly (Exterior)
 - .1 Gauge: Glycerin filled, with 12 mm dual-scale dial (kPa/psi), solid front, blowout back, polypropylene case, brass movement with bronze bushings, phosphor bronze silver brazed Bourdon tube, ¼ NPT brass socket. Accuracy, 1 percent of scale range, Grade 1A, in accordance with ANSI B40.1.
 - .2 Impulse dampener: Brass body and insert, ¼ NPT.
 - .3 Gauge lock: Brass body and plug, "T" handle.
 - .4 Diaphragm seal: Plain design with removable 316 stainless steel diaphragm Teflon coated on process side. Flushing port, 316 stainless steel process housing, ¼ NPT instrument connection, ½ NPT process connection.
- .3 Differential Pressure Gauge Assembly (Exterior)
 - .1 Gauge: Glycerin filled, with 114 mm dual-scale dial (kPa/psi), solid front, blowout back, aluminum or polypropylene case, brass movement with bronze bushings, phosphor bronze silver brazed Bourdon tube, ¼ NPT brass socket. Accuracy, 1% of scale range, Grade 1A, in accordance with ANSI B40.1.
 - .2 Impulse dampener: Brass body and insert, ¼ NPT.
 - .3 Gauge lock: Brass body and plug, "T" handle.
 - .4 Diaphragm seals: Plain design with removable 316 stainless steel diaphragm Teflon coated on process side. Flushing port, 316 stainless steel process housing, ¼ NPT instrument connection, ½ NPT process connection.
- 2.6 **POWER CORD REELS**
 - .1 Industrial and heavy duty cord reels, automatic spring retractable.
 - .2 115V, 20 amp rating, double power box at the end of each power reel, minimum 10m power reel cable.
- 3 Execution
- 3.1 **CLEANING OF PIPING SYSTEMS**
 - .1 Refer to section 43 40 06 "Pressure Piping"
- 3.2 **PIPE AND VALVE IDENTIFICATION**
 - .1 Refer to section 23 05 53 "Mechanical Identification."
- 3.3 **PIPING INSTALLATION**
 - .1 Refer to section 23 05 01 "Basic Mechanical Requirements."
 - .2 Refer to section 43 40 06 "Pressure Piping"

3.4 **PIPING SUPPORTS AND HANGERS**

- .1 Refer to section 23 05 29 "Pipe Hangers and Supports."

3.5 **HOSE REEL INSTALLATION**

- .1 Coordinate hose reel installation with structural steel drawings and structural steel Shop Drawings.

3.6 **EXAMINATION**

- .1 Examine areas, equipment foundations, and conditions with Installer present for compliance with requirements for installation and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.
- .2 Examine roughing-in of utilities to verify actual locations of piping / electrical connections prior to equipment installation.

3.7 **INSTALLATION**

- .1 General: Comply with equipment manufacturer's written installation instructions.
- .2 Refer to Section 43 40 06 "Pressure Piping" for piping, fittings, piping installation, flushing and startup of piping systems
- .3 Install equipment in locations indicated and arrange to provide access for periodic maintenance.
- .4 Support piping so that weight of piping is not supported by equipment.
- .5 Lube system provider in coordination with the General Contractor shall perform the following:
 - .1 Arrange for TSSA registration and inspection as required for all pressure systems.
 - .2 Perform all pressure tests as required by code and provide test reports to consultant for review.
 - .3 Perform the start-up check and provide a signed check list to Consultant for review.

3.8 **TRAINING**

- .1 Provide eight hours training session for two lube systems maintenance personnel and two hours sessions for twenty-one vehicle maintenance operators.

3.9 **COMMISSIONING REPORT**

- .1 Upon completion of the installation, start-up and testing procedures, lube system supplier to provide a final commissioning report containing the following:
 - .1 Pressure testing, start-up check list, O&M, training performed.
 - .2 A cover letter, signed and sealed by a Professional Engineer, listing the systems which have undergone the pre-functional and functional testing, and stating any deficiencies.
- .2 Substantial completion of the building's construction phase is dependent on the Owner's acceptance of the final commissioning report.

End Of Section

1 General

1.1 **SECTION INCLUDES**

.1 Labor, Products, equipment and services necessary for installation, testing, and certification of pressure piping systems Work in accordance with the Contract Documents and all applicable codes, including:

- .1 Installation of pressure pipe systems by qualified pipe/tube fitters and welders where applicable.
- .2 High pressure pipe, fittings, and specialties.
- .3 Testing piping systems.
- .4 Inspection of piping systems by TSSA.
- .5 Witnessing of pressure tests by TSSA.
- .6 Certification of installed systems by the Contractor and TSSA.

.2 Pressure Piping Systems

- .1 Engine Oil – EO
- .2 Waste Engine Antifreeze Fluid - WEAFF
- .3 Waste Engine Oil - WO
- .4 Compressed air - CA
- .5 Any other system governed by the Boilers and Pressure Vessels Act and Code.

System Name	Fluid	Abbr	Piping Mat'l	Piping pressure class
Engine Oil	Combustible	EO	SS tubing	Med press (to 1250psi)
Waste Engine Oil	Combustible	WO	CS/SS	Low press (to 150psi)
Waste Engine Antifreeze Fluid	Combustible	WEAF	SS tubing	Low press (to 150psi)

.3 Work by the General Contractor or System Supplier

- .1 TSSA Design Registration:
 - .1 Registration of piping system design with Technical Standards and Safety Authority (Boilers and Pressure Vessels Division) completed by the General Contractor or system supplier.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- .1 ANSI/ASME B1.20.1 - Pipe Threads, General Purpose, Inch
- .2 ANSI/ASME B31.1 - Power Piping, Section IX, Welding and Brazing Qualifications
- .3 ASME B16.3 - Malleable Iron Thread Fittings
- .4 ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS ½ through 24
- .5 ASME B16.11 - Forged Fittings, Socket-Welding and Threaded
- .6 ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

- .7 ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications
- .8 ASTM A106 - Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service
- .9 - Boilers and Pressure Vessels Act of Ontario
- .10 CSA B51 - Boiler, Pressure Vessel, and Pressure Piping Code
- .11 - Ontario Fire Code, Part 4
- .12 SAE J515 - Specification for Hydraulic O-Ring Materials, Properties and Sizes for Metric and Inch Stud Ends, Face Seal Fitting and Four Screw Flange Tube Connections
- .13 SAE J516 - Hydraulic Hose Fittings
- .14 SAE J517 - Hydraulic Hose
- .15 SAE J343 - Test and Test Procedures for SAE 100R Series – Hydraulic Hose and Hose Assemblies
- .16 ASTM A269/A213 - Stainless Steel Seamless Tubing

1.3 **DESIGN/PERFORMANCE REQUIREMENTS**

- .1 All systems shall be free of leaks at test pressures (1.5 times operating pressure).
- .2 Piping/tubing shall be free of excessive vibration, hammer and sway.
- .3 Select all pressure piping, tubing, valves, fittings, hoses and joining methods in strict accordance with this section to meet maximum working pressure in each system as noted on Contract Drawings, typically determined by maximum possible head on pump, compressor, expansion tank and/or pressure relief device.

1.4 **SUBMITTALS**

- .1 Prior to submitting Shop Drawings and/or Product data for any system governed by the Boilers and Pressure Vessels Act, review Contract Drawings and Specifications for conformance with CSA B51 and related standards, and bring any discrepancies to attention of the Owner's Representative well in advance so as not to delay construction. This review is intended to avoid installation of products that may later be rejected by the TSSA.
- .2 Submit results of radiographs, together with copy of welder's license and description of procedures used, to TSSA inspector.
- .3 Contractor's Qualifications
 - .1 For each worker, copies of valid welder's certificates, pipe fitters certificates, and registration with TSSA Boilers and Pressure Vessels Division.
 - .2 References of individual's previous work completed over past five years involving pressure piping systems, including a detailed description of type and magnitude of work, and Contractor's name work was completed with.
 - .3 For tubing installation, contractor shall have a valid license or training by tubing manufacturer.
- .4 Product Data
 - .1 Submit copies of manufacturer's Product data for each product contained herein indicating:
 - .1 Performance criteria, dimensional and pressure rating data, compliance with appropriate reference standard, characteristics, limitations and trouble-shooting protocol.

- .2 Product transportation, storage, handling and installation requirements.
- .5 Shop Drawings
 - .1 Submit Shop Drawings where applicable indicating:
 - .1 Elevations, sections and details of operating components, dimensions, gauges, finishes and relationship of operating components to adjacent construction.
 - .2 Complete engineering design data to confirm design criteria specified is met.
 - .3 Pipe hanging details and attachment to building structure.
- .6 Quality Control Submittals
 - .1 Manufacturers' Instructions:
 - .1 Delivery and storage instructions piping.
 - .2 Provide material test sheets for all tubing material, 11% Nickel minimum.
- .7 Reports
 - .1 Submit written inspection and test.
- .8 Commissioning
 - .1 Submit Commissioning Plan, Commissioning Procedures, Certificate of Readiness, Deficiency Report and Commissioning Closeout Report.
- .9 Submittals to Authorities Having Jurisdiction
 - .1 Prepare and submit all required forms to CSA B51 and TSSA requirements. Submit copies to both the Owner and the TSSA. Items include:
 - .1 List of all welders working upon piping systems, including each welder's certification and welding procedure registration number(s). Submit welders' credentials prior to beginning installation of any system governed by the Boilers and Pressure Vessels Act.
 - .2 TSSA form, "Piping Systems Installation and Test Data Report."
- .10 Documentation
 - .1 Maintain records and provide documentation to TSSA of all certified fittings and assemblies (CRN).
- .11 Closeout Submittals
 - .1 Submit following for incorporation into Operations and Maintenance Manuals:
 - .1 Identification: Manufacturing name, type, year, serial number, number of units, capacity and identification of related systems.
 - .2 Functional description detailing operation and control of components.
 - .3 Performance criteria and maintenance data.
 - .4 Operating instructions and precautions.
 - .5 Safety precautions.
 - .6 Component parts availability including names and addresses of spare part suppliers.
 - .7 All TSSA test and inspection reports.

- .8 Maximum allowable operating pressure of each system.
- .9 Pressure rating of every device in each system, including pipes, fittings, hoses, flexible connectors, and valves.
- .10 Actual working operating pressure of each system.
- .11 Setting of each pressure regulator, PRV, etc.
- .12 Copy of test certificate TSSA form "Piping Systems Installation and Test Data Report" completed and signed by the Contractor and TSSA inspector.

1.5 **ACCEPTANCE**

- .1 The General Contractor or system supplier will register Contract design Drawings and Specifications, where required under Boilers and Pressure Vessels Act, with Technical Standards and Safety Authority (TSSA).

1.6 **QUALITY ASSURANCE**

.1 Quality Assurance Requirements

.1 Installer's qualifications:

- .1 Employ Contractor accepted by Technical Standards and Safety Authority (Boilers and Pressure Vessels Division), Province of Ontario to install systems listed herein. Contractor shall have a Quality Plan filed with the TSSA.
- .2 Certified welders and valid procedures.
- .3 Certified pipe fitters.
- .4 Licensed petroleum mechanics (PM.1).

.2 Regulatory Requirements

- .1 Install all systems required to be registered under Boilers and Pressure Vessels Act in accordance with this Section, to latest requirements of CSA B51 – Boiler, Pressure Vessel, and Pressure Piping Code, and all related codes and standards governing selection and installation of piping, fittings, joining methods, welding, valves, etc.
- .2 Schedule and pay for regular general inspections with authority having jurisdiction at regular intervals throughout construction period including, but not limited to, the following:
 - .1 Pre-construction material inspection.
 - .2 Demonstration of welding procedure.
 - .3 General installation inspections.
 - .4 Other inspections as requested by authority having jurisdiction.

1.7 **GENERAL**

- .1 Refer to Section 23 05 01 for general requirements.
- .2 All system components (including tanks, receivers, piping, tubing, fittings, hoses and valves) clearly identified and marked so their maximum operating pressure and temperature, manufacturer, and standard of manufacture are easily determined.
- .3 All pressure piping, tubing, valves, fittings, hoses, joints specified herein supplied from single respective manufacturer.

1.8 **INSPECTIONS**

- .1 Inspect new piping/tubing prior to hydrostatic test by design engineer and by authority having jurisdiction. Where province has accepted Drawings, TSSA certified inspector to inspect installation.
- .2 Costs for inspection to be paid by Contractor.
- .3 Submit all inspection reports.

1.9 **DELIVERY, STORAGE, AND HANDLING**

- .1 Maintain piping clean and dry at all times.
- .2 Cap pipe ends until ready to be installed.
- .3 Remove piping from site, or reject delivery of piping, that is dirty or rusty.
- .4 Tubing to be free of scratches due to seal on outside diameter.

2 Products

2.1 **GENERAL REQUIREMENTS**

- .1 Materials
 - .1 All piping, tubing, valves, fittings, hoses and joints free of leaks while operating at maximum rated operating pressure of delivery system and during pressure testing. All components rated for maximum rated operating pressure of delivery system. Maximum expected operating pressure for each system shown on the Contract Drawings.
 - .2 Select and size all components so rated working pressure is not exceeded.
 - .3 All valves serving flammable or combustible fluids shall be steel body in accordance with the Ontario Fire Code and Section 43 40 07 Valves – Pressure Piping.
 - .4 Acceptable tubing manufacturer: Swagelok or equal.

2.2 **PIPING SYSTEMS**

- .1 Low Pressure Systems - (Working Pressure: Up to 300 psi)
 - .1 Application: Compressed Air Systems
 - .2 Pipe: All sizes: Galvanized Carbon Steel, Schedule 40, ASTM A106, Grade B, seamless.
 - .3 Fittings:
 - .1 NPS 2½ and smaller: Malleable iron, threaded, galvanized, Class 150.
 - .2 NPS 3 and larger: Butt-weld (compressed air header only).
 - .4 Joints:
 - .1 NPS 2½ and smaller: Threaded.
 - .2 NPS 3 and larger: Welded (compressed air header only).
 - .5 Valves: Refer to Section 15113.
 - .6 Flexible hoses: Refer to Article 2.4.
 - .7 Flanges:
 - .1 NPS 3 and larger: Not applicable.
- .2 Low Pressure Systems – (Working Pressure: Up to 150 psi)

- .1 Application: Storage Tank Vents, suction piping and risers
- .2 Pipe: NPS 4 and smaller: Carbon Steel, Schedule 40, ASTM A106, Grade B, Seamless.
- .3 Fittings and Joints:
 - .1 NPS 4 and smaller: Threaded.
- .4 Valves: Section 15113.
- .3 Low Pressure Fluid Systems – (Test Pressure: Up to 300 psi)
 - .1 Application:
 - .1 Engine Antifreeze
 - .2 Waste Engine Oil
 - .2 Tubing
 - .1 Fully annealed 316/316L (dual-certified) stainless steel seamless tubing, ASTM A269 & A213, Hardness not to exceed 90 HRB, minimum nickel content at 11%, maximum carbon content at 0.035%. Tubing to be free of scratches and suitable for bending.
 - .2 Choose tubing wall thickness based on test pressure.
 - .3 Swagelok tubing.
 - .3 Joints:
 - .1 Tube fittings: 316 stainless steel four piece (nut, rear ferrule, front ferrule, body), mechanical grip-type with hinging-colletting rear ferrule action, 1" and under ferrules with SAT12 hardening process, over 1" ferrules with PFA coating.
 - .2 Ensure tubing ends are square and burr free.
 - .3 Threaded connections acceptable only where required to match equipment connections.
 - .4 Swagelok tube fittings
 - .4 Valves: Refer to Section 43 40 07.
 - .5 Flexible Hoses: Refer to Article 2.4.
- .4 Medium Pressure Systems – (Test Pressure: Up to 1000 psi)
 - .1 Application:
 - .1 Engine Oil
 - .2 Automatic transmission fluid
 - .2 Tubing:
 - .1 Fully annealed 316/316L (dual-certified) stainless steel seamless tubing, ASTM A269 & A213, Hardness not to exceed 90 HRB, minimum nickel content at 12%, maximum carbon content at 0.035%. Tubing to be free of scratches and suitable for bending.
 - .2 Choose tubing wall thickness based on test pressure.
 - .3 Swagelok tubing.
 - .3 Joints:

- .1 Tube fittings: 316 stainless steel four piece (nut, rear ferrule, front ferrule, body), mechanical grip-type with hinging-colleting rear ferrule action, 1" and under ferrules with SAT12 hardening process, over 1" ferrules with PFA coating.
- .2 Ensure tubing ends are square and burr free.
- .3 Threaded connections acceptable only where required to match equipment connections
- .4 Swagelok tube fittings.
- .4 Valves: Refer to Section 43 40 07.
- .5 Flexible hoses: Refer to Article 2.4.

2.3

FLEXIBLE HOSES FOR CONNECTION TO EQUIPMENT

- .1 Requirements common to all flexible hose, unless specified otherwise.
 - .1 All flexible hoses supplied from single manufacturer.
 - .2 Banded clamp end and gear clamp connection fittings are not permitted for use.
 - .3 Each complete hose assembly (including hose and end connections) shall bear a Canadian Registration Number (CRN), or to SAE J343.
 - .4 Length: to suit installation arrangements shown on contract drawings unless noted otherwise. Excessive lengths not permitted. Sufficient length to achieve minimum required bend radius and installation as recommended by manufacturer.
 - .5 Hose size and end fittings to suit equipment/tube connections.
 - .6 Burst pressure minimum four times working pressure.
- .2 Hoses shall bear manufacturer's identification and labelling as follows:
 - .1 SAE 100R classification or CRN.
 - .2 Working pressure.
 - .3 Manufacturer and model number.
 - .4 Date of fabrication.

2.4

HANGERS AND SUPPORTS

- .1 In accordance with Section 23 05 29 or as per tubing manufacturer recommendations.

2.5

PRESSURE GAUGES

- .1 Conform to Section 43 40 05 and supplemented as specified below.
- .2 Dial type, 90 mm diameter, self-indicating, liquid-filled.
- .3 Accuracy: 0.5% over full range.
- .4 Range: 1.5 times operating working pressure as shown on Contract Drawings.
- .5 Accessories
 - .1 Shut-off valve: To suit operating pressure.

3

Execution

3.1

INSTALLERS

- .1 Installation performed by certified pipe fitters and tube fitters.

3.2 PREPARATION

- .1 Lay out Work in accordance with lines and grades as indicated.
- .2 Verify lines, levels, dimensions as indicated against established benchmarks. Report discrepancies to Owner's Representative and obtain written instruction.
- .3 Adjust pipe route and/or equipment location to avoid conflicts with new and/or existing.
- .4 Provide sufficient clearance for routine maintenance of new and/or existing equipment.
- .5 Where pipe/equipment is installed which obstructs maintenance access to other services relocate as instructed by Owner's Representative at no additional cost to the Owner.

3.3 INSPECTIONS

- .1 It is required that contractor register WWF and fuel piping systems with the TSSA and successfully complete the required inspections.
- .2 Leave joints in piping systems uncovered until tests completed and system inspected and accepted by Owner's Representative.
- .3 Radiograph repaired joints to ANSI/ASME B31.1M.
- .4 Perform magnetic particle tests on welded slip-on flanges.
- .5 Submit results of radiographs, together with copy of welder's license and description of procedures used, to TSSA inspector.
- .6 Owner's Representative and authority having jurisdiction to inspect new piping prior to hydrostatic pressure tests for compliance with accepted Drawings and Specifications.
- .7 TSSA's certified inspector to inspect installation where province has accepted the Drawings.
- .8 Obtain from Owner's Representative requirements for inspection and testing of system modifications, design changes and repairs performed in-house.
- .9 Pay all costs for inspections performed by jurisdictional authority.
- .10 Perform, at no additional cost to the Owner, radiographic or ultrasonic testing of all welds failing visual inspection by TSSA.
- .11 Coordinate installation and testing activities with inspection requirements of TSSA. At minimum:
 - .1 Schedule regular TSSA inspection of any system component before installation.
 - .2 Schedule regular TSSA inspection of all welds and joints as they are made.
 - .3 Provide TSSA with credentials of all workers.
 - .4 Conduct all tests required by TSSA to prove welder qualified to perform applicable welding procedure(s).
 - .5 Provide TSSA with any additional documentation requested to demonstrate piping system components are suitably rated.
 - .6 Schedule with TSSA to witness all pressure tests performed.
 - .7 Correct noted TSSA construction deficiencies to satisfaction of the TSSA at no additional cost to the Owner.
 - .8 Retest any system to satisfaction of TSSA at no additional cost to the Owner.
 - .9 Put no system governed by Boilers and Pressure Vessels Act into service until acceptance granted by TSSA and Owner's Representative.

3.4 INSTALLATION - GENERAL

- .1 Install all systems required governed by the Boilers and Pressure Vessels Act to latest requirements of CSA B51 – Boiler, Pressure Vessel, and Pressure Piping Code, and all related codes and standards governing selection and installation of piping, fittings, joining methods, welding, valves, etc.
- .2 Clean piping before installation. Remove rust and scale. Deburr pipe after cutting and chips after threading.
- .3 Clearances
 - .1 Maintain clearance around systems, equipment and components and between pipes and structures for operation and maintenance, as directed and to manufacturer's recommendations, for greater of:
 - .1 Observation of operation, inspection, servicing, maintenance.
 - .2 Disassembly, removal of equipment and components without interrupting operation of other system, equipment, components.
 - .2 Where required locate valves to permit installation of thermal insulation of pipes.
- .4 Coordinate location of piping, valves and reels with ductwork, lights, building structure, and all other services. Provide necessary clearance for maintenance. Identify potential interferences to the Owner's Representative for resolution.
- .5 Flanges: Use suitable graphite lubricant on bolts and nuts.
- .6 Drain Valves
 - .1 Install at all low points in piping systems, at equipment, at section isolating valves and elsewhere as required, whether shown on Contract Drawings or not.
- .7 Fire stopping: Make provision for sealing piping passing through walls with accepted fire stopping compatible with surface temperature of pipe or insulation.
- .8 Brace piping securely to building structure, where pipe movement occurs due to valve and/or pump operation. Submit attachment details for acceptance.
- .9 Branch Take-Offs
 - .1 Where reducing tees of proper size are unavailable, use available tees with reducers. Tees with increasers not acceptable.
- .10 Cap open ends of piping during installation. Remove foreign material from inside piping.
- .11 Flanges: Tighten bolts evenly with torque wrench.
- .12 Revisions to location of piping require acceptance of Owner's Representative. Prepare and submit Drawings of all proposed revisions.
- .13 Connections to equipment: Provide pressure-rated unions where hose assembly does not include a swivel joint.

3.5 **HOUSEKEEPING**

- .1 Maintain good housekeeping of all materials, and take every precaution necessary to ensure products not inadvertently mixed between systems.
- .2 Protect all product certification markings from soiling and damage during handling and installation. Install and orient all equipment, piping, fittings, hoses, and valves so certification markings remain visible for inspection.
- .3 Do not paint stainless steel tubing and valves.
- .4 Do not paint, cover or conceal system piping, valves, hoses, fittings, and especially certification markings until all inspections and pressure tests conducted successfully and system accepted for operation by TSSA.

3.6 PIPE SUPPORTS

- .1 In strict accordance with Section 23 05 29, and requirements of this section.
- .2 Provide to details as indicated on Contract Drawings.
- .3 Submit shop drawings for acceptance before fabrication and installation.
- .4 Percussion type inserts not permitted unless shown otherwise.
- .5 Power driven fasteners not permitted unless shown otherwise.
- .6 Neatly arrange piping on common trapeze type hanger, and route piping to avoid interference with other mechanical services, electrical lights and wiring and building structure. Provide equal spacing between each pipe. Allow sufficient space on hanger system for other mechanical piping (domestic hot and cold water, tempered water, non-potable water) and co-ordinate to provide neatest possible piping routing through garage.
- .7 Install to manufacturer's recommendations.
- .8 Install to details indicated on Contract Drawings.
- .9 Provide and install additional structural steel to support piping located between truss lines. Submit details of attachment to building prior to proceeding with work. Arrange and pay for qualified trades.

3.7 VALVES

- .1 Supply and install valves in accordance with Section 43 40 07 – Valves – Pressure Piping.
- .2 Install isolation valve at each lubricatorium.
- .3 Install additional valves as required to isolate all branch lines.
- .4 Install only steel valves for all flammable and combustible fluids.
- .5 Install isolating valves at branch take-offs, at pieces of equipment and elsewhere as indicated.
- .6 Install in accordance with manufacturer's recommendations.
- .7 Install in accessible locations.
- .8 Depending upon piping configuration and ease of operation, on horizontal pipes install with stem horizontal or above.
- .9 Valves accessible for maintenance without removing adjacent piping.

3.8 STRAINERS

- .1 Install in locations to allow easy access for removal of screen.
- .2 Install before inlets to all meters, in suction line of pump.

3.9 PRESSURE TESTS

- .1 Hydrostatic Pressure Test at 1.5 times the operating (working pressure) for:
 - .1 Engine Oil – EO
 - .2 Waste Engine Anti-freeze Fluid - WEAFF
 - .3 Waste Engine Oil - WO
 - .4 Compressed air - CA
 - .5 Any other system governed by the Boilers and Pressure Vessels Act and Code.
- .2 Conduct tests in presence of Owner's Representative and as required by the TSSA's inspector.

- .3 Give Owner's Representative and TSSA minimum of five working days' notice of intention to perform pressure tests.
- .4 After installation and before concealing, perform hydrostatic pressure tests to 1.5 times maximum operating (working) pressure and maintain test pressure without loss or leaks for twenty-four hours.
- .5 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or test media and indicate in test report.
- .6 Bear costs for tests, for repairs or replacement, retesting, making good.
- .7 Insulate or conceal work after acceptance and certification of tests by Owner's Representative.
- .8 Use test media indicated on Contract Drawings, and unless indicated otherwise, use fluid intended to be carried by each piping system.
- .9 Supply new high quality accurately calibrated pressure gauges to verify test pressures, as specified under this Section. Submit bill of sale as proof gauges are new.
- .10 Test gauges not new: Submit calibration certificate dated within one month of test date.
- .11 Replace all pressure gauges suspected to be faulty or out of calibration.
- .12 Provide equipment that will safely and accurately generate test pressures, under controlled conditions, and without potential for human error. Submit proposed test equipment to Owner's Representative for acceptance.
- .13 In accordance with above, test pressures may be generated as follows:
 - .1 Hydraulic hand-pump (preferred).
 - .2 Piston pump controlled by regulated air supply.
 - .3 Electric pump with unloader or relief set to test pressure.
 - .4 Methods using on/off control of equipment to limit pressure not permitted.
- .14 Any pressure test procedure found unsafe, in opinion of TSSA inspector, will be cancelled and rescheduled at the Contractor's expense.
- .15 Upon successful completion of pressure test for each individual pressure piping system, prepare and submit detailed test report.

3.10 **PAINTING**

- .1 Clean, prime and paint all piping in accordance with Sections 09 91 00 and 23 05 53.
- .2 Do not paint stainless steel tubing and valves.
- .3 All painting performed by qualified trades.
- .4 Do not cover pipe identification markings until the Owner's Representative and TSSA inspector have inspected them.

3.11 **IDENTIFICATION**

- .1 In accordance with Section 23 05 53.

3.12 **FLUSHING AND CLEANING**

- .1 Cleaning Solutions

System	Clean/Flush with:
Engine Oil	Water/Air
Compressed Air	Water/Air

Waste Engine Antifreeze Fluid	Water/Air
Waste Oil	Water/Air

- .2 Timing: Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .3 Install products such as flow meters and dispensing valves only after cleaning certified as complete.
- .4 Conditions at Time of Cleaning
 - .1 Systems to be free from construction debris, dirt and other foreign material.
 - .2 Isolation valves to be operational, fully open to ensure terminal units can be cleaned properly.
- .5 Antifreeze and Compressed Air
 - .1 Flush system with non-potable water supply connected to valve at delivery pump.
 - .2 Run water through each hose reel assembly with control handle removed. Operate isolation valves at hose reel inlet as required.
 - .3 Sample flushed water into white bucket. Continue flushing until sampled water is clean.
 - .4 Blow water out of system with compressed air. Connect control handles.
 - .5 For compressed air system, blow out water from hydrostatic testing as follows:
 - .1 At all drip legs and dirt pockets (at air hose stations and air regulators).
 - .2 At all hose reels.
 - .3 At all automatic drains.
 - .6 Immediately charge system with respective fluid.
 - .7 Flush minimum of 200 L of fresh respective fluid through system, equally divided at each control handle.
 - .8 Discard flushed fluid at accepted waste treatment facility.
- .6 Engine Oil and Transmission Fluid:
 - .1 Remove dispensers and meters from hose reels. Use isolation valve at each hose reel.
 - .2 For bulk stored products in ASTs, disconnect suction hose from pipe.
 - .3 Use water to flush each system.
 - .4 Charge each system with water.
 - .5 Dispense, at maximum flow, 100 L of water from each reel, working from closest to furthest reel from pump.
 - .6 At each reel, upon completion of flushing, sample water into bucket or strainer. If debris present, repeat flushing.
 - .7 Filter water of debris, reuse for other systems.
 - .8 Upon completion of flushing, blow piping dry with compressed air.
 - .9 Final priming: Charge systems with respective products.
- .7 Waste Oil

- .1 Remove dispensers and meters from hose reels. Use isolation valve at each hose reel.
- .2 For bulk stored products in ASTs, disconnect suction hose from pipe.
- .3 Use water to flush each system.
- .4 Charge each system with water.
- .5 Dispense, at maximum flow, 100 L of water from each reel, working from closest to furthest reel from pump.
- .6 At each reel, upon completion of flushing, sample water into bucket or strainer. If debris present, repeat flushing.
- .7 Filter water of debris, reuse for other systems.
- .8 Upon completion of flushing, blow piping dry with compressed air.
- .9 Final priming: Charge systems with respective products.

3.13 **PRODUCTS FOR TESTING, FLUSHING AND CHARGING**

- .1 Purchase and supply all fluid products required for flushing of each system.
- .2 Arrange for bulk/drum delivery of products as required to suit system and activity.
- .3 Allow for disposal and/or recycling of waste product for each system.
- .4 Where directed by Owner's Representative, reserve waste products for priming and testing of waste oil and/or waste antifreeze systems.

3.14 **COMMISSIONING**

- .1 Verify operational performance in general conformance with the following outline:
 - .1 Compressed air system (low pressure piping and fittings):
 - .1 Flushing and cleaning.
 - .2 Pressure test.
 - .3 Inspection of piping for excessive vibration.
 - .4 Flow rate achieved at each dispenser.
 - .5 Set-point at each pressure relief valve.
 - .2 Engine antifreeze (low pressure piping and fittings):
 - .1 Flushing and cleaning.
 - .2 Pressure test.
 - .3 Inspection of piping for excessive vibration.
 - .4 Flow rate achieved at each dispenser.
 - .5 Set-point of each pressure relief valve.
 - .6 Set-points of pump air supplies.
 - .3 Engine oil, automatic transmission fluid (medium pressure piping and fittings):
 - .1 Flushing and cleaning.
 - .2 Pressure test.
 - .3 Inspection of piping for excessive vibration.
 - .4 Flow rate achieved at each dispenser.

- .5 Set-point of each pressure relief valve.
 - .6 Set-points of pump air supplies.
 - .4 Waste oil (low pressure piping and fittings):
 - .1 Flushing and cleaning.
 - .2 Pressure test.
 - .3 Inspection of piping for excessive vibration.
 - .4 Flow rate achieved at each dispenser.
 - .5 Set-point of each pressure relief valve.
 - .6 Set-points of pump air supplies.
 - .5 Flow meters
 - .1 Flow rate achieved at each dispenser.
 - .2 Commissioning method shall include:
 - .1 Instrumentation: Verify accuracy of pressure gauges by comparison with calibrated test instruments.
 - .2 Full scale tests:
 - .1 Upon completion, conduct full scale tests at specified operating pressure and air regulator set points.
 - .3 Dispense product at each dispenser for thirty seconds. Measure product dispensed. Calculate flow rate. If product flow excessive or inadequate, adjust air supply pressure.
 - .4 Reports.
- 3.15 **START- UP OF PRESSURE SYSTEMS**
 - .1 Timing: After
 - .1 Cleaning is completed.
 - .2 Pressure tests are completed.
 - .3 Painting and identification is complete.
 - .2 Provide continuous supervision during start-up.
 - .3 Set pressure controls.
 - .4 Ensure air is removed and piping is fully charged.
 - .5 Clean out strainers where installed.
 - .6 Check pressurization to ensure proper operation and flow at all dispensers.
 - .7 Check for leaks.
 - .8 Eliminate pipe vibration. Provide additional bracing to acceptance of Owner's Representative.
 - .9 Perform TAB as specified in Section 23 08 16. Adjust operating pressure to achieve specified flow rates at all dispensers.
 - .10 Adjust pipe supports, hangers and springs as necessary.
 - .11 Monitor pipe movement, performance of anchors.
 - .12 Check operation of relief valves.

- .13 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.
 - .14 Test operation of operating, limit and safety controls.
 - .15 Record pressure of air supply, pump supply and relief setting for each system.
 - .16 Fasten loose items of equipment to ensure quiet operation of system.
- 3.16 **TRAINING**
- .1 Provide training as noted below.
 - .2 Operation Training
 - .1 Allow for minimum of eight hours of total on-site time to train in all aspects of equipment and system(s) operation(s), per group to be trained.
 - .2 Schedule separate training sessions for each group on separate days:
 - .1 Bus maintenance personnel: two groups of maximum six persons per group.
 - .3 Maximum duration of each training session: eight hours.
 - .3 Maintenance Training
 - .1 Plant Maintenance – Plumbers:
 - .1 Allow for minimum of twelve hours of total in-class and on-site time to train in all aspects of equipment and system(s) operation(s), repair and maintenance, per group to be trained.
 - .2 Schedule separate training sessions for three groups of maximum seven persons per group, on separate days.
 - .3 Maximum duration of each training session: eight hours.
 - .4 Tube Fitting Installation Training:
 - .1 Tube Fitting Installers
 - .1 Certified Swagelok Eight-hour Tube Fitting Installation course must be completed prior to installing tube fittings
 - .5 Training to include but not limited to:
 - .1 Setting normal operating pressure of system, with respect to operating ratio of associated pump.
 - .2 Explanation of maximum allowable operating pressure of each system; hazards associated with exceeding maximum.
 - .3 Function of pressure relief devices.
 - .4 Calibration of pressure relief devices.
 - .5 Hazards working with and around high pressure systems.
 - .6 Routine inspection of equipment, parts, hoses, guns, etc. to prevent catastrophic failures and personal injuries.
 - .1 Proper selection, installation and reassembly of tube fittings.
- 3.17 **CERTIFICATES**
- .1 Complete and submit TSSA form "Piping Systems Installation and Test Data Report".
- End Of Section

Appendix A1

Pre-Reno Designated Substance Survey
For

Upgrade Works for Toronto Paramedic
Services Fleet Maintenance Station
1116 King Street West (Building 8 & 9)
Toronto, ON

Issued June 2, 2025 by Fisher Engineering Limited



ENGINEERING



LABORATORY



PRE-RENO DESIGNATED SUBSTANCE SURVEY

**Upgrade Works for Toronto Paramedic
Services Fleet Maintenance Station**
1116 King Street West (Building 8 & 9)
Toronto, ON



Prepared for:
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Corporate Real Estate Management
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Project No. FE-25-14756

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EXECUTIVE SUMMARY

Fisher Engineering Limited ('Fisher') was retained by the City of Toronto, Corporate Real Estate Management, to carry out a pre-renovation Designated Substances Survey (DSS) for the Upgrade Works for Toronto Paramedic Services Fleet Maintenance Station in Buildings 8 and 9, located at 1116 King Street West, Toronto, Ontario (hereinafter referred to as the "Site").

The scope of the DSS consisted of a review of existing environmental reports (where available); visual inspection for the presence of Designated Substances within the scope of the work areas; collection and analysis of the materials suspected to contain hazardous building materials, particularly asbestos and lead; and to provide recommendations for the safe handling or abatement of these materials prior to any renovation work. The location names and numbers are referenced from the Site's most recent annual Designated Substance report (under separate cover). Mr. Muhammad Junayed and Iqbal Fattah conducted the fieldwork on May 13, 2025.

A summary of the Designated Substances identified during the survey is presented below:

Asbestos

Sampling was conducted of building materials suspected to contain asbestos and expected to be impacted by planned construction activities. A total of eighty-one (81) bulk samples were collected and submitted to Fisher Environmental Laboratories for Polarized Light Microscopy (PLM) analysis, as outlined in NIOSH Method 9002.

- ☐ Asbestos was not found in any of the samples collected for analysis as part of the current survey.
- ☐ A trace amount (<0.5%) of chrysotile asbestos was found in the red fire-stop around the HVAC duct in the Truck Repair Area (Loc. 1-17). According to the definition of an asbestos-containing material in O. Reg. 278/05, the red fire-stop is considered non-asbestos-containing.
- ☐ Asbestos-containing parging cement (50-75% Chrysotile) on pipe fittings was identified in the Truck Repair Area (Loc. 1-17), Stairwell (Loc. 1-18), Washroom (Loc. 1-19), Stairwell (Loc. 1-24), IT Room (Loc. 2-02), and Stairwell (Loc. 2-07), during the previous survey.
- ☐ Asbestos-containing air-cell (50-75% Chrysotile) on pipe straights was identified in the Truck Repair Area (Loc. 1-17), Stairwell (Loc. 1-18), Washroom (Loc. 1-19), Stairwell (Loc. 1-24), and Stairwell (Loc. 2-07), during the previous survey.
- ☐ Asbestos-containing grey caulking (hard) was identified along the joints of the exterior window frames and the walls on the 2nd floor (Loc. 2-01 to Loc. 2-07).

If work activities for the Upgrade Works for Toronto Paramedic Services Fleet Maintenance Station project may disturb any of the above-listed asbestos-containing materials, the material should be removed by the following operations:

- ☐ Removal of parging cement insulation from the pipe fittings will require Type 2 Glove Bag asbestos abatement procedures, as per O. Reg. 278/05.
- ☐ Removal of straight pipe air-cell insulation will require Type 2 Glove Bag asbestos abatement procedures, as per O. Reg. 278/05.
- ☐ Removal of grey caulking will require Type 1 asbestos abatement procedures, as per O. Reg. 278/05.

Lead

Nine (9) bulk samples were collected and submitted to Fisher Environmental Laboratories for inductively coupled plasma (ICP) analysis, as outlined in NIOSH method 7300.

- ☐ Elevated concentrations of lead were identified in the following paints during this survey:
 - Black paint on the handrail in the Stairwell (Loc. 1-24);
 - White paint on the door and overhead door frames in the Truck Repair Area (Loc. 1-17), overhead door frames in the Truck Maintenance Area (Loc. 1-25), and Stairwell (Loc. 1-24);
 - White paint on the walls in Storage (Loc. 1-21) and Locker Room (Loc. 1-22);
 - White paint on the wall and ceiling in Parts Storage (Loc. 1-16), Truck Repair Area (Loc. 1-17), Washroom (Loc. 1-19), Office (Loc. 1-20), Washroom (Loc. 1-23), Truck Maintenance Area (Loc. 1-25), and Storage (Loc. 1-26);
 - Light Green paint on the brick walls in the Stairwell (Loc. 1-18), Stairwell (Loc. 1-24), and Stairwell (Loc. 2-07);
 - Grey paint on the walls in the Office Area on the 2nd floor (Loc. 2-01 to 2-07) and handrail in the Stairwell (Loc. 1-18 and 2-07);
 - Light Cream paint on the wood deck in the Truck Repair Area (Loc. 1-17); and
 - Blue paint (multiple layers) on the lower portions of the brick walls in the Truck Repair Area (Loc. 1-17).
- ☐ Elevated concentrations of lead were identified in the following paints during the previous survey:

- Light cream paint on the exterior of the window frames on the 2nd floor Office Area (Loc. 2-01 to 2-07); and
- Off-White paint on the skylight window frames on the 1st Level and 2nd Level roofs.
- ❑ Measurable lead concentrations were identified in the following paints, but are below the action limit.
 - Yellow paint collected from the pipes on the 2nd-level roof;
 - Yellow paints on the overhead door frames as marking in the Truck Repair Area (Loc. 1-17) were collected during the previous survey;
 - Blue paint on the hoists in the Truck Repair Area (Loc. 1-17); and
 - Black paints on the overhead door frames in the Truck Repair Area (Loc. 1-17).

Removal of any lead-containing materials shall be carried out in accordance with the following regulations and guidelines:

- Guideline: Lead on Construction Projects (issued by Ontario Ministry of Labour);
- Designated Substances Regulation, O. Reg. 490/09; and
- Regulation for Construction Projects, O. Reg. 213/91

Mercury

- ❑ Mercury is present as a vapour in fluorescent light bulbs.
- ❑ Mercury-containing thermostats were observed in the Truck Repair Area (Loc. 1-17).
- ❑ No immediate recommendations are warranted with regard to mercury.

If the work activities of the project affect the fluorescent light bulbs and thermostats, Fisher recommends that the presumed mercury-containing fluorescent light tubes and thermostats be removed and disposed of in accordance with O. Reg. 558/00.

Silica

- ❑ Crystalline silica is a constituent of all concrete and masonry products at the Site.

Renovation works that are likely to generate silica-containing dust shall be carried out in accordance with the following regulations and guidelines:

- Guideline: Silica on Construction Projects (issued by Ontario Ministry of Labour);
- Designated Substances Regulation, O. Reg. 490/09; and
- Regulation for Construction Projects, O. Reg. 213/91.

Other Designated Substances

- ☐ The other designated substances (acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride) would not be expected to be present at the Site and were not observed during the current survey.
- ☐ No recommendations are warranted with regard to these other designated substances.

Inspection of Wall Cavity

Inspections were conducted by drilling into the block walls to determine the presence of vermiculite or other suspected wall insulation. Wall core drilling was performed at various locations in the Truck Repair (Loc. 1–17) and Truck Maintenance (Loc. 1–25) areas of Buildings 8 and 9. No insulation or other suspect building materials were observed within the inspected areas at the Site.

1.0. INTRODUCTION

Fisher Engineering Limited ('Fisher') was retained by the City of Toronto, Corporate Real Estate Management, to carry out a pre-renovation Designated Substances Survey (DSS) for the Upgrade Works for Toronto Paramedic Services Fleet Maintenance Station in the Building 8 and 9, located at 1116 King Street West, Toronto, Ontario (hereinafter referred to as the "Site").

The scope of the DSS consisted of a review of existing environmental reports (where available); visual inspection for the presence of Designated Substances within the scope of the work areas; collection and analysis of the materials suspected to contain hazardous building materials, particularly asbestos and lead; and to provide recommendations for the safe handling or abatement of these materials prior to any renovation work.

The assessment scope did not include all buildings at the Site. Rather, the assessment was limited to areas where renovation activities are proposed (in Buildings 8 and 9), as demonstrated to Fisher. The location names and numbers are referenced from the Site's most recent annual Designated Substance report (under separate cover). The fieldwork was conducted by Mr. Muhammad Junayed and Mr. Iqbal Fattah on May 13, 2025.

The following work areas were included in the current survey:

- ✓ Roofs of Buildings 8 and 9;
- ✓ All locations on the ground floor and 2nd floor of Buildings 8 and 9.

DSS reports are required prior to any construction, demolition or restoration project that can take place in Ontario. As per Section 30 of the Ontario Occupational Health and Safety Act (OHSA), designated substances and other potentially hazardous building materials must be identified prior to any work being done that may disturb these materials and result in unnecessary exposure of workers and building occupants. The designated substances include:

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

2.0. METHODOLOGY

Fisher followed the protocols outlined in Ontario OHSA for collecting and analyzing bulk samples of materials suspected to contain asbestos or lead. Visual assessment of the material was the primary method of identification, with occasional physical contact to collect bulk samples or examine for underlying layers.

Representative bulk samples were collected of materials suspected of containing asbestos or lead. The tools used by the investigator to collect the bulk samples were cleaned after each sample was collected to avoid cross-contamination. Samples were placed in plastic sealable containers, marked with a unique sample number and transported to an independent accredited laboratory for analysis.

Where applicable, samples of suspect materials were collected to establish asbestos or lead content. Samples were grouped according to the similarity of appearance (“homogeneous” materials). The frequency at which the samples were collected was sufficient to obtain a general representation of the presence of these materials at the Site. Samples collected are presumed to be representative of the respective building materials in place at the Site. However, due to potential past renovations, alterations, repairs, or phases of construction, individual materials may not be representative of the samples collected.

The laboratory certificate of analysis is included in Appendix A. Site plans to indicate the project scope of work areas; bulk sample locations and the locations of the asbestos-containing building materials and elevated concentration of lead-containing paints are included in Appendix B. Representative photos of Site conditions encountered at the time of the current survey are included in Appendix C. A room-by-room survey sheet for the project scope of work areas is included in Appendix D.

3.0. DOCUMENT AND REPORT REVIEW

As part of this survey, the following reports were reviewed:

- ☐ RFP document # CREM-PMO-25-C1-001, Prepared by the Corporate Real Estate Management – Project Management Office, City of Toronto,
- ☐ Building Condition Assessment, King Street West Yard – Building 8, 1116 King Street West, Toronto, ON, Prepared by Facility Management Division – Project Management Office, City of Toronto, dated February 2019,
- ☐ Building Condition Assessment, King Street West Yard – Building 9, 1116 King Street West, Toronto, ON, Prepared by Facility Management Division – Project Management Office, City of Toronto, dated February 2019,

- ❑ City of Toronto Building Condition Assessment Accessibility Audit Report, King Street Yard – Buildings 8 and 9, Prepared by Read Jones Christoffersen, dated April 20, 2018,
- ❑ Building Accessibility Audit Validation Report, Prepared by IBI Group, Version 2, dated February 07, 2023,
- ❑ Designated Substances Sampling Report, 1116 King Street West, Toronto, ON, prepared by Fisher Environmental Ltd. (Fisher Project No. FE-20-10141, dated March 11, 2020, and
- ❑ Annual Designated Substances and Hazardous Materials Survey, King Street Yard, 1116 King Street West, Toronto, ON, prepared by Fisher Engineering Limited (Fisher Project No. FE-24-14180, dated November 28, 2024.

The findings from the previous report are discussed in Section 4.0 of this report.

4.0. FINDINGS

Asbestos-Containing Materials

Sampling was conducted of building materials suspected to contain asbestos and expected to be impacted by planned construction activities. A total of eighty-one (81) bulk samples were collected and submitted to Fisher Environmental Laboratories for Polarized Light Microscopy (PLM) analysis, as outlined in NIOSH Method 9002. The results of the PLM analysis are summarized in Table 1 below.

Table 1 - Summary of Bulk Asbestos Sample Analysis (PLM)

Sample No.	Sample Description	Sample Location	Asbestos Content (% by Weight/Type)
25-4589-1 to 3	Roofing Material	Roof, 3 rd Level	None Detected
25-4589-4 to 6	Roofing Materials	Roof, 2 nd Level	None Detected
25-4589-7 to 9	Roofing Materials	Roof, 1 st Level	None Detected
25-4589-10 to 12	Light Grey Caulking	Roof, 2 nd Level, Along Joints of Exhaust	None Detected
25-4589-13 to 15	Red Caulking	Roof, 2 nd Level, Along Joints of Exhaust	None Detected
25-4589-16	Dark Grey Caulking	Roof, 1 st Level, Along Joints of Flashing and Wall	None Detected
25-4589-17	Dark Grey Caulking	Roof, 2 nd Level, Around Chimney Base	None Detected

Sample No.	Sample Description	Sample Location	Asbestos Content (% by Weight/Type)
25-4589-18	Dark Grey Caulking	Roof, 2 nd Level, Along Joints of Flashing and Wall	None Detected
25-4589-19	Mortar	Roof, Along Joints of the Bricks	None Detected
25-4589-20	Mortar	Truck Maintenance, Loc. 1-25, North Wall, Along Joints of the Bricks	None Detected
25-4589-21	Mortar	Truck Repair Area, Loc. 1-17, Wall, Along Joints of the Bricks	None Detected
25-4589-22 to 24	Light Brown Mortar	Roof, Chimney, Along Joints of the Bricks	None Detected
25-4589-25, 26	Ceiling Tile 1, 2' x 4' Random Pinhole	Office Area, Loc. 2-01, Ceiling	None Detected
25-4589-27	Ceiling Tile 1, 2' x 4' Random Pinhole	IT Room, Loc. 2-02, Ceiling	None Detected
25-4589-28 to 30	Grey Caulking	Office Area, Loc. 2-01, Interior, Along Joints of the Wall and Window Frames	None Detected
25-4589-31	Drywall Joint Compound	IT Room, Loc. 2-02, Wall	None Detected
25-4589-32, 33	Drywall Joint Compound	Office Area, Loc. 2-01, Wall	None Detected
25-4589-34 to 36	Straight Pipe Insulation	IT Room, Loc. 2-02, Pipe	None Detected
25-4589-37 to 39	Cream Caulking	Stairwell, Loc. 1-18, Interior, Along Joints of the Wall and Window Frames	None Detected
25-4589-40 to 42	Plaster	Truck Repair Area, Loc. 1-17, Ceiling	None Detected
25-4589-43 to 45	Red Fire Stop	Truck Repair Area, Loc. 1-17, HVAC Duct	Trace: <0.5% Chrysotile
25-4589- 46 to 48	Vinyl Floor Tile 2, 12"x12" Grey Mosaic	Storage, Loc. 1-21, Floor	None Detected
25-4589-49 to 51	Brown Mastic	Storage, Loc. 1-21, Floor, Under VFT-2	None Detected
25-4589-52 to 54	Yellow Fibre Board	Stairwell, Loc. 1-18, Stair Treads	None Detected
25-4589-55 to 57	Black Caulking	Stairwell, Loc. 1-18, Doors, Around Door Frames	None Detected
25-4589-58 to 60	Grey Sealant	Truck Repair Area, Loc. 1-17, Door, Between Glass and Frame	None Detected

Sample No.	Sample Description	Sample Location	Asbestos Content (% by Weight/Type)
25-4589-61, 62	Off-White Caulking	Locker Room, 1-22, Window Interior, Along Joints of Window Frame & Wall	None Detected
25-4589-63	Off-White Caulking	Truck Maintenance, 1-25, Window Interior, Along Joints of Window Frame & Wall	None Detected
25-4589-64, 65	Grey Mortar	Locker Room, 1-22, Block Wall	None Detected
25-4589-66	Grey Mortar	Storage Room, 1-21, Block Wall	None Detected
25-4589-67 to 69	Light Grey Caulking	Truck Repair Area, Loc. 1-17, Door Interior, Around Door Frame	None Detected
25-4589-70 to 72	Tan Putty	Truck Repair Area, Loc. 1-17, Panel Windows on Walls, Along Joints of Glass and Frame	None Detected
25-4589-73, 74	Drywall Joint Compound	Washroom, Loc. 1-23, Ceiling	None Detected
25-4589-75	Drywall Joint Compound	Office, Washroom, Loc. 1-20, Ceiling	None Detected
25-4589-76 to 78	Grey Caulking	Truck Repair Area, Loc. 1-17, Door Exterior, Around Door Frame	None Detected
25-4589-79 to 81	Black Expansion Materials	Truck Repair Area, Loc. 1-17, Concrete Floor, Along Joints of Concrete Slabs	None Detected

Ontario Regulation 278/05 - Asbestos on Construction Projects and in Buildings and Repair Operations (O. Reg. 278/05) defines an “asbestos-containing” material with an asbestos content equal to or greater than 0.5% by weight.

Based on the laboratory analysis by the PLM method, asbestos was not found in the collected samples during the current survey.

A trace amount (<0.5%) of chrysotile asbestos was found in the red fire-stop around the HVAC duct in the Truck Repair Area (Loc. 1-17). According to the definition of an asbestos-containing material in O. Reg. 278/05, the red fire-stop is considered non-asbestos-containing.

- ❑ Asbestos-containing paring cement (50-75% Chrysotile) on pipe fittings was identified in the Truck Repair Area (Loc. 1-17), Stairwell (Loc. 1-18), Washroom (Loc. 1-19), Stairwell (Loc. 1-24), IT Room (Loc. 2-02), and Stairwell (Loc. 2-07), during the previous survey.
- ❑ Asbestos-containing air-cell (50-75% Chrysotile) on pipe straights was identified in the Truck Repair Area (Loc. 1-17), Stairwell (Loc. 1-18), Washroom (Loc. 1-19), Stairwell (Loc. 1-24), and Stairwell (Loc. 2-07), during the previous survey.

- ☐ Asbestos-containing grey caulking (hard) was identified along the joints of the exterior of the window frames and the walls on the 2nd floor (Loc. 2-01 to Loc. 2-07).
- ☐ Flexible duct connectors were observed in the duct system at the Site during the survey. These materials are made of polyester with Polyvinyl Chloride (PVC) coating, and rubber, and are considered not asbestos-containing materials.
- ☐ Fibreglass insulation was observed on the pipes and mechanical units in the building; this material is non-asbestos-containing.
- ☐ PVC pipes were observed within specified work areas; this material does not contain asbestos.

Based on the findings of the current and previous surveys conducted within the scope of the work areas, asbestos was not identified in the following building materials:

- Roofing materials on all levels of roofs.
- Light Grey caulking along the joints of the window frame and window sill on the exterior of the 2nd floor, along the joints of the exhaust on the 2nd level roof, and around the interior side of the door frames in the Truck Repair Area (Loc. 1-17).
- Tan caulking (hard) along the joints of the glass and frames of the panel windows of the skylights on the roof.
- Brown caulking along the joints of the window frames and metal panels of the skylights on the roof, and along the joints of the metal roof flashing and walls on the lower and 2nd level roofs.
- Red caulking along the joints of the exhaust on the 2nd level roof.
- Dark Grey caulking along the joints of the flashing and wall on the lower and 2nd level roofs, and around the chimney base on the 2nd level roof.
- Mortar along the joints of the bricks on the exterior and interior walls.
- Grey mortar along the joints of the blocks on the interior walls.
- Light brown mortar along the joints of the bricks on the chimney walls.
- Ceiling tiles -1 (2'x4' Random Pinhole) on the ceiling in all rooms on the 2nd floor (Loc. 2-01 to 2-06).
- Grey caulking along the interior joints of the window frames and walls on the 2nd floor (Loc. 2-01 to 2-06) and around the exterior of the door frames in the Truck Repair Area (Loc. 1-17).

- Drywall joint compound on the walls in all locations on the 2nd floor (Loc. 2-01 to 2-06).
- Drywall joint compound on the ceiling in the Washrooms (Loc. 1-20 and Loc. 1-23).
- Straight pipe insulation in the IT Room (Loc. 2-02).
- Cream caulking along the joints of the interior of the window frames and walls in the Stairwell (Loc. 1-18).
- Plaster on the ceiling in the Truck Repair Area (Loc. 1-17).
- Vinyl floor tiles 2 (12"x12" Grey Mosaic) in the Storage (Loc. 1-21).
- Brown mastic under VFT-1 in the Storage (Loc. 1-21).
- Yellow fibre boards as treads in the Stairwell (Loc. 1-18).
- Black caulking around the door frames in the Stairwell (Loc. 1-18).
- Grey sealant around the glass panels on the door in the Truck Repair Area (Loc. 1-22).
- Off-White caulking along the interior joint of the window frames and the walls in the Truck Maintenance Area (Loc. 1-22).
- Tan putty along the joints of the glass and frames of the panel windows on the walls in the Truck Repair Area (Loc. 1-17).
- Black expansion joints along the joints of the concrete slabs on the floor in the Truck Repair Area (Loc. 1-17).

Inspection of Wall Cavity

Inspections were conducted by drilling into the block walls to determine the presence of vermiculite or other suspected wall insulation. Wall core drilling was performed at various locations in the Truck Repair (Loc. 1–17) and Truck Maintenance (Loc. 1–25) areas of Buildings 8 and 9. No insulation or other suspect building materials were observed within the inspected areas at the Site.

Following the inspection of the wall cavities, the drill locations were sealed with sealant. Besides, the sampling locations at the windows and doors, where caulking samples were collected, were also repaired using caulking/sealant.

In addition to the above findings and by reviewing the previous survey reports for the Site, the following observations were noted.

ACM may be present at the Site that is not identified in this report. Should additional suspected ACM not outlined in this report be discovered, it should be presumed as ACM until sample analysis determines asbestos content. Precautions should be taken when dismantling solid wall or ceiling finishes, or any other building surfaces which may conceal potential ACM. Such precautions include, but are not limited to, isolation measures and appropriate personal protective equipment.

Lead-Containing Materials

Nine (9) bulk samples were collected and submitted to Fisher Environmental Laboratories for inductively coupled plasma (ICP) analysis, as outlined in NIOSH method 7300. The results of the sample analysis are summarized in Table 2, below.

Table 2 - Summary of Lead Paint Sample Analysis (ICP)

Sample No.	Sample Description	Sample Location	Lead Content (ppm and % by Weight)
25-4589-82	Yellow Paint	Roof, 2 nd Level, Pipe	36 ppm (0.003%)
25-4589-83	Black Paint	Stairwell, Loc. 1-24, Handrail	4,058 ppm (0.406%)
25-4589-84	White Paint	Stairwell, Loc, 1-24, Ground Floor, Door Frame	6,497 ppm (0.649%)
25-4589-85	Light Green Paint	Stairwell, Loc, 1-24, Ground Floor, Brick Wall	5,081 ppm (0.508%)
25-4589-86	Grey Paint	Office Area, Loc.2-01, Wall	5,019 ppm (0.502%)
25-4589-87	Blue Paint	Truck Repair Area, Loc. 1-17, Hoist	47 ppm (0.004%)
25-4589-88	Light Cream Paint	Truck Repair Area, Loc. 1-17, Wood Deck	3,109 ppm (0.311%)
25-4589-89	Grey Paint	Stairwell, Loc. 1-18, Handrail	2,650 ppm (0.265%)
25-4589-90	Blue Paint (Multi layers)	Truck Repair, Loc. 1-17, Brick Wall	8,732 ppm (0.873%)

The Ontario Ministry of Labour (MOL) has not prescribed criteria defining “lead-containing” materials. Further, the MOL has not established a lower limit for concentrations of lead in paint, below which precautions do not need to be considered during construction projects. However, except for aggressive disturbance of painted finishes, (e.g., abrasive blasting, torch cutting, or grinding), Fisher believes that a lead content below 0.1% by weight (1,000 ug/g or 1000 ppm)

represents a concentration in which lead content is not the limiting hazard for construction hygiene purposes.

- ❑ Elevated concentrations of lead were identified in the following paints during this survey:
 - Black paint on the handrail in the Stairwell (Loc. 1-24);
 - White paint on the door and overhead door frames in the Truck Repair Area (Loc. 1-17), overhead door frames in the Truck Maintenance Area (Loc. 1-25), and Stairwell (Loc. 1-24);
 - White paint on the walls in Storage (Loc. 1-21) and Locker Room (Loc. 1-22);
 - White paint on the wall and ceiling in Parts Storage (Loc. 1-16), Truck Repair Area (Loc. 1-17), Washroom (Loc. 1-19), Office (Loc. 1-20), Washroom (Loc. 1-23), Truck Maintenance Area (Loc. 1-25), and Storage (Loc. 1-26);
 - Light Green paint on the brick walls in the Stairwell (Loc. 1-18), Stairwell (Loc. 1-24), and Stairwell (Loc. 2-07);
 - Grey paint on the walls in the Office Area on the 2nd floor (Loc. 2-01 to 2-07) and handrail in the Stairwell (Loc. 1-18 and 2-07);
 - Light Cream paint on the wood deck in the Truck Repair Area (Loc. 1-17); and
 - Blue paint (multiple layers) on the lower portions of the brick walls in the Truck Repair Area (Loc. 1-17).
- ❑ Elevated concentrations of lead were identified in the following paints during the previous survey:
 - Light cream paint on the exterior of the window frames on the 2nd floor Office Area (Loc. 2-01 to 2-07); and
 - Off-White paint on the skylight window frames on the 1st Level and 2nd Level roofs.
- ❑ Measurable lead concentrations were identified in the following paints, but are below the action limit.
 - Yellow paint collected from the pipes on the 2nd-level roof;
 - Yellow paints on the overhead door frames as marking in the Truck Repair Area (Loc. 1-17) were collected during the previous survey;
 - Blue paint on the hoists in the Truck Repair Area (Loc. 1-17); and
 - Black paints on the overhead door frames in the Truck Repair Area (Loc. 1-17).

Other Designated Substances

During the current survey, no sampling for mercury was conducted. However, fluorescent light tubes (known to contain mercury) were observed at the Site. Mercury-containing thermostats were observed in the Truck Repair Area (Loc. 1-17). No other building materials or components suspected to contain mercury were noted during the building survey.

Crystalline silica is a constituent of all concrete and masonry products present at the Site. While the cutting, grinding, or demolition of materials containing silica is not anticipated at the Site, these activities should be completed in accordance with Ontario MOL Guidelines for Silica on Construction projects. Specifically, the Guideline prescribes respiratory protection, site isolation, and the use of wetting to control dust emissions during the cutting, grinding, drilling, or demolition of silica-containing materials. Please refer to the Guideline for details concerning Silica on Construction Projects.

No other designated substances or other potentially hazardous building materials were identified in the proposed project scope areas. If additional suspected designated substances or other potentially hazardous building materials not identified in this report pertaining to the Site are discovered, work should be stopped, and the material(s) in question should be sampled for determination of content.

5.0. RECOMMENDATIONS

Based on the observations and findings outlined above, Fisher recommends the following:

Asbestos:

- ☐ Removal of parging cement insulation from the pipe fittings will require Type 2 Glove Bag asbestos abatement procedures as per O. Reg. 278/05.
- ☐ Removal of straight pipe air-cell insulation will require Type 2 glove bag asbestos abatement procedures as per O. Reg. 278/05.
- ☐ Removal of grey caulking will require Type 1 asbestos abatement procedures, as per O. Reg. 278/05.

Lead:

- ☐ Removal of lead-containing materials shall be carried out in accordance with the following regulations and guidelines:
 - Guideline: Lead on Construction Projects (issued by Ontario MOL);
 - Designated Substances Regulation, O. Reg. 490/09; and
 - Regulation for Construction Projects, O. Reg. 213/91.

Mercury:

- ☐ No immediate recommendations are warranted with regard to mercury.
- ☐ However, if the disturbance of the identified mercury-containing thermostats and fluorescent light tubes presumed to contain mercury is planned as part of the anticipated construction activities, Fisher recommends that these items be removed and disposed of in accordance with O. Reg. 558/00.

Silica:

- ☐ Renovations and/or demolition operations that are likely to generate silica-containing dust shall be carried out in accordance with the following requirements:
 - Guideline: Silica on Construction Projects (issued by Ontario MOL);
 - Designated Substances Regulation, O. Reg. 490/09; and
 - Regulation for Construction Projects, O. Reg. 213/91.

6.0. LIMITATIONS

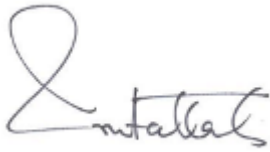
Fisher Engineering Limited accepts responsibility for the competent performance of its duties in executing this assignment within the normal standards of the profession, but disclaims responsibility for consequential damages, if any.

The scope of the survey is based on prior agreement with the client and the rationale given in this report. The building survey findings rely on the professional interpretation of selective sampling and analysis. Sample analysis results have been applied to homogeneous materials in unsampled locations; it was not within the scope of work to carry out an exhaustive sampling and analysis program.

This report was prepared for the City of Toronto, Corporate Real Estate Management. The scope of services performed may not be appropriate for the purposes of other users, and any use or reuse of this document or its findings or recommendations represented herein is at the sole risk of any other user.

We trust that the information provided in the report meets your current requirements. If you have any questions or concerns, please do not hesitate to contact the undersigned.

Prepared by:



Iqbal Fattah, M. Sc.
Project Manager

Reviewed by:



Muhammad Junayed, B.Sc., EP
Senior Project Manager

APPENDIX A – LABORATORY CERTIFICATE OF ANALYSIS



FISHER ENVIRONMENTAL LABORATORIES

FULL RANGE ANALYTICAL SERVICES • SOIL/WATER/AIR TESTING • ENVIRONMENTAL
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Client: City of Toronto
Facilities Management
Address: 2nd Floor, Metro Hall
55 John Street, Toronto, ON
M5V 3C6
Tel.:
E-mail:
Attn:

F.E. Job #: 25-4589
Project Name: DSS
Project ID: FM 25-14756
Date Sampled: 13-May-2025
Date Received: 15-May-2025
Date Reported: 16-May-2025
Location: 1116 King Street West
Toronto, ON

Certificate of Analysis

Analysis Requested:	Asbestos, Lead
Sample Description:	90 Bulk Sample(s) (<i>Rush</i>)

Sample Matrix and Client Sample Description	Client Sample Location	Lab Sample ID	Asbestos Content and Fibre Type
1A - Roofing Material	3 rd Level Roof (Roof on the 2 nd Floor)	25-4589-1	Not Detected
1B - Roofing Material	3 rd Level Roof (Roof on the 2 nd Floor)	25-4589-2	Not Detected
1C - Roofing Material	3 rd Level Roof (Roof on the 2 nd Floor)	25-4589-3	Not Detected
2A - Roofing Materials	2 nd Level Roof	25-4589-4	Not Detected
2B - Roofing Materials	2 nd Level Roof	25-4589-5	Not Detected
2C - Roofing Materials	2 nd Level Roof	25-4589-6	Not Detected
3A - Roofing Materials	1 st Level Roof	25-4589-7	Not Detected
3B - Roofing Materials	1 st Level Roof	25-4589-8	Not Detected
3C - Roofing Materials	1 st Level Roof	25-4589-9	Not Detected

Certificate of Analysis

Analysis Requested:	Asbestos, Lead
Sample Description:	90 Bulk Sample(s) (Rush)

Sample Matrix and Client Sample Description	Client Sample Location	Lab Sample ID	Asbestos Content and Fibre Type
4A - Light Grey Caulking	2 nd Level Roof, Along the Joints of the Exhaust	25-4589-10	Not Detected
4B - Light Grey Caulking	2 nd Level Roof, Along the Joints of the Exhaust	25-4589-11	Not Detected
4C - Light Grey Caulking	2 nd Level Roof, Along the Joints of the Exhaust	25-4589-12	Not Detected
5A - Red Caulking	2 nd Level Roof, Along the Joints of the Exhaust	25-4589-13	Not Detected
5B - Red Caulking	2 nd Level Roof, Along the Joints of the Exhaust	25-4589-14	Not Detected
5C - Red Caulking	2 nd Level Roof, Along the Joints of the Exhaust	25-4589-15	Not Detected
6A - Dark Grey Caulking	1 st Level Roof, Along the Joint of the Flashing and the Wall	25-4589-16	Not Detected
6B - Dark Grey Caulking	2 nd Level Roof, Around the Base of the Chimney	25-4589-17	Not Detected
6C - Dark Grey Caulking	2 nd Level Roof, Along the Joint of the Flashing and the Wall	25-4589-18	Not Detected
7A - Mortar	Roof, Along the Joint of the Brick	25-4589-19	Not Detected
7B - Mortar	Truck Maintenance, Loc. 1-25, North Wall, Along the Joints of the Bricks	25-4589-20	Not Detected
7C - Mortar	Truck Repair, Loc. 1-17, Wall, Along the Joint of the Brick	25-4589-21	Not Detected

Certificate of Analysis

Analysis Requested:	Asbestos, Lead
Sample Description:	90 Bulk Sample(s) (Rush)

Sample Matrix and Client Sample Description	Client Sample Location	Lab Sample ID	Asbestos Content and Fibre Type
8A - Light Brown Mortar	Roof, Chimney, Along the Joints of the Bricks	25-4589-22	Not Detected
8B - Light Brown Mortar	Roof, Chimney, Along the Joints of the Bricks	25-4589-23	Not Detected
8C - Light Brown Mortar	Roof, Chimney, Along the Joints of the Bricks	25-4589-24	Not Detected
9A - Ceiling Tile 1, 2'x4' Random Pinhole	Office Area, Loc. 2-01, Ceiling	25-4589-25	Not Detected
9B - Ceiling Tile 1, 2'x4' Random Pinhole	Office Area, Loc. 2-01, Ceiling	25-4589-26	Not Detected
9C - Ceiling Tile 1, 2'x4' Random Pinhole	Utility Room, Loc. 2-02, Ceiling	25-4589-27	Not Detected
10A - Grey Caulking	Office Area, Loc. 2-01, Interior, Along the Joints of the Wall and Window Frames	25-4589-28	Not Detected
10B - Grey Caulking	Office Area, Loc. 2-01, Interior, Along the Joints of the Wall and Window Frames	25-4589-29	Not Detected
10C - Grey Caulking	Office Area, Loc. 2-01, Interior, Along the Joints of the Wall and Window Frames	25-4589-30	Not Detected
11A - Drywall Joint Compound	Utility Room, Loc. 2-02, Wall	25-4589-31	Not Detected
11B - Drywall Joint Compound	Office Area, Loc. 2-01, Wall	25-4589-32	Not Detected
11C - Drywall Joint Compound	Office Area, Loc. 2-01, Wall	25-4589-33	Not Detected

Certificate of Analysis

Analysis Requested:	Asbestos, Lead
Sample Description:	90 Bulk Sample(s) (Rush)

Sample Matrix and Client Sample Description	Client Sample Location	Lab Sample ID	Asbestos Content and Fibre Type
12A - Straight Pipe Insulation	Utility Room, Loc. 2-02, Pipe	25-4589-34	Not Detected
12B - Straight Pipe Insulation	Utility Room, Loc. 2-02, Pipe	25-4589-35	Not Detected
12C - Straight Pipe Insulation	Utility Room, Loc. 2-02, Pipe	25-4589-36	Not Detected
13A - Cream Caulking	Stairwell, Loc. 1-18, Interior, Along the Joints of the Wall and Window Frames	25-4589-37	Not Detected
13B - Cream Caulking	Stairwell, Loc. 1-18, Interior, Along the Joints of the Wall and Window Frames	25-4589-38	Not Detected
13C - Cream Caulking	Stairwell, Loc. 1-18, Interior, Along the Joints of the Wall and Window Frames	25-4589-39	Not Detected
14A - Plaster	Truck Repair, Loc. 1-17, Ceiling	25-4589-40	Not Detected
14B - Plaster	Truck Repair, Loc. 1-17, Ceiling	25-4589-41	Not Detected
14C - Plaster	Truck Repair, Loc. 1-17, Ceiling	25-4589-42	Not Detected
15A - Red Fire Stop	Truck Repair, Loc. 1-17, HVAC Duct	25-4589-43	Trace : <0.5% Chrysotile
15B - Red Fire Stop	Truck Repair, Loc. 1-17, HVAC Duct	25-4589-44	Trace : <0.5% Chrysotile
15C - Red Fire Stop	Truck Repair, Loc. 1-17, HVAC Duct	25-4589-45	Trace : <0.5% Chrysotile

Certificate of Analysis

Analysis Requested:	Asbestos, Lead
Sample Description:	90 Bulk Sample(s) (Rush)

Sample Matrix and Client Sample Description	Client Sample Location	Lab Sample ID	Asbestos Content and Fibre Type
16A - Vinyl Floor Tile 2, 12"x12" Grey Mosaic	Storage, Loc. 1-21, Floor	25-4589-46	Not Detected
16B - Vinyl Floor Tile 2, 12"x12" Grey Mosaic	Storage, Loc. 1-21, Floor	25-4589-47	Not Detected
16C - Vinyl Floor Tile 2, 12"x12" Grey Mosaic	Storage, Loc. 1-21, Floor	25-4589-48	Not Detected
17A - Brown Mastic	Storage, Loc. 1-21, Floor, Under VFT-2	25-4589-49	Not Detected
17B - Brown Mastic	Storage, Loc. 1-21, Floor, Under VFT-2	25-4589-50	Not Detected
17C - Brown Mastic	Storage, Loc. 1-21, Floor, Under VFT-2	25-4589-51	Not Detected
18A - Yellow Fiber Board	Stairwell, Loc. 1-18, Stair Treads	25-4589-52	Not Detected
18B - Yellow Fiber Board	Stairwell, Loc. 1-18, Stair Treads	25-4589-53	Not Detected
18C - Yellow Fiber Board	Stairwell, Loc. 1-18, Stair Treads	25-4589-54	Not Detected
19A - Black Caulking	Stairwell, Loc. 1-18, Doors, Around the Door Frames	25-4589-55	Not Detected
19B - Black Caulking	Stairwell, Loc. 1-18, Doors, Around the Door Frames	25-4589-56	Not Detected
19C - Black Caulking	Stairwell, Loc. 1-18, Doors, Around the Door Frames	25-4589-57	Not Detected

Certificate of Analysis

Analysis Requested:	Asbestos, Lead
Sample Description:	90 Bulk Sample(s) (Rush)

Sample Matrix and Client Sample Description	Client Sample Location	Lab Sample ID	Asbestos Content and Fibre Type
20A - Grey Sealant	Truck Repair, Loc.1-17, Door, Between the Glass and Frame	25-4589-58	Not Detected
20B - Grey Sealant	Truck Repair, Loc.1-17, Door, Between the Glass and Frame	25-4589-59	Not Detected
20C - Grey Sealant	Truck Repair, Loc.1-17, Door, Between the Glass and Frame	25-4589-60	Not Detected
21A - Off-White Caulking	Locker Room, 1-22, Interior of the Windows, Along the Joint of the Window Frame and the Wall	25-4589-61	Not Detected
21B - Off-White Caulking	Locker Room, 1-22, Interior of the Windows, Along the Joint of the Window Frame and the Wall	25-4589-62	Not Detected
21C - Off-White Caulking	Truck Maintenance, 1-25, Interior of the Windows, Along the Joint of the Window Frame and the Wall	25-4589-63	Not Detected
22A - Grey Mortar	Locker Room, 1-22, Block Wall	25-4589-64	Not Detected
22B - Grey Mortar	Locker Room, 1-22, Block Wall	25-4589-65	Not Detected
22C - Grey Mortar	Storage Room, 1-21, Block Wall	25-4589-66	Not Detected
23A - Light Grey Caulking	Truck Repair, Loc. 1-17, Interior of the Door, Around the Door Frame	25-4589-67	Not Detected
23B - Light Grey Caulking	Truck Repair, Loc. 1-17, Interior of the Door, Around the Door Frame	25-4589-68	Not Detected
23C - Light Grey Caulking	Truck Repair, Loc. 1-17, Interior of the Door, Around the Door Frame	25-4589-69	Not Detected

Certificate of Analysis

Analysis Requested:	Asbestos, Lead
Sample Description:	90 Bulk Sample(s) (Rush)

Sample Matrix and Client Sample Description	Client Sample Location	Lab Sample ID	Asbestos Content and Fibre Type
24A - Tan Putty	Truck Repair, Loc. 1-17, Panel Windows on Walls, Along the Joint of the Glass and the Frame	25-4589-70	Not Detected
24B - Tan Putty	Truck Repair, Loc. 1-17, Panel Windows on Walls, Along the Joint of the Glass and the Frame	25-4589-71	Not Detected
24C - Tan Putty	Truck Repair, Loc. 1-17, Panel Windows on Walls, Along the Joint of the Glass and the Frame	25-4589-72	Not Detected
25A - Drywall Joint Compound	Washroom, Loc. 1-23, Ceiling	25-4589-73	Not Detected
25B - Drywall Joint Compound	Washroom, Loc. 1-23, Ceiling	25-4589-74	Not Detected
25C - Drywall Joint Compound	Office, Washroom, Loc. 1-20, Ceiling	25-4589-75	Not Detected
26A - Grey Caulking	Truck Repair, Loc. 1-17, Exterior of the Door, Around the Door Frame	25-4589-76	Not Detected
26B - Grey Caulking	Truck Repair, Loc. 1-17, Exterior of the Door, Around the Door Frame	25-4589-77	Not Detected
26C - Grey Caulking	Truck Repair, Loc. 1-17, Exterior of the Door, Around the Door Frame	25-4589-78	Not Detected
27A - Black Expansion Materials	Truck Repair, Loc. 1-17, Concrete Floor, Along the Joints of the Concrete Slabs	25-4589-79	Not Detected
27B - Black Expansion Materials	Truck Repair, Loc. 1-17, Concrete Floor, Along the Joints of the Concrete Slabs	25-4589-80	Not Detected
27C - Black Expansion Materials	Truck Repair, Loc. 1-17, Concrete Floor, Along the Joints of the Concrete Slabs	25-4589-81	Not Detected

Fisher Engineering Laboratories (Lab ID #: 2745) is accredited by CALA (Canadian Association for Laboratory Accreditation Inc.) for asbestos analysis by PLM.

ANALYTICAL METHOD:

Asbestos has been done in accordance with normal professional standard using the following Fisher Engineering Lab Method: Asbestos by PLM (Polarized Light Microscope) F-26, Rev.2.2.

Certificate of Analysis

Analysis Requested:	Asbestos, Lead
Sample Description:	90 Bulk Sample(s) (Rush)

Sample Matrix and Client Sample Description	Client Sample Location	Lab Sample ID	Lead (ppm)
L1 - Yellow Paint	2 nd Level Roof, Pipe	25-4589-82	36
L2 - Black Paint	Stairwell, Loc. 1-24, Handrail	25-4589-83	4,058
L3 - White Paint	Stairwell, Loc. 1-24, Ground Floor, Door Frame	25-4589-84	6,497
L4 - Light Green Paint	Stairwell, Loc. 1-24, Ground Floor, Brick Wall	25-4589-85	5,081
L5 - Grey Paint	Office Area, Loc. 2-01, Wall	25-4589-86	5,019
L6 - Blue Paint	Truck Repair, Loc. 1-17, Hoist	25-4589-87	47
L7 - Light Cream Paint	Truck Repair, Loc. 1-17, Wood Deck	25-4589-88	3,109
L8 - Grey Paint	Stairwell, Loc. 1-18, Handrail	25-4589-89	2,650
L9 - Blue Paint (Multi Layers)	Truck Repair, Loc. 1-17, Brick Wall	25-4589-90	8,732

< result obtained was below RL (Reporting Limit).

QA/QC Report

Parameter	Blank (ppm)		LCS (%)		CRM (%)	
	Result	RL	Recovery	AR	Recovery	AR
Lead	<10	10	90	80-120	93	70-130

Parameter	Duplicate (%)					
	RPD	AR				
Lead	3	0-30				

LEGEND:

RL - Reporting Limit

LCS - Laboratory Control Sample

MS - Matrix Spike

AR - Acceptable Range

RPD - Relative Percent Difference

ANALYTICAL METHODS:

Metals (Lead) - Method # F-1, Rev. 4.5, Standard Operation Procedure for determination of Metals by the Inductively Coupled Plasma- Optical. Method used by Fisher Environmental Lab complies with the Standard Methods for the Examination of Water and Wastewater, 20th Ed 3120-B.

Authorized by:



Roger Lin, Ph. D., C. Chem.
Laboratory Manager



APPENDIX B – SITE PLANS



Legend

1-01

Location Number



Asbestos Sample Location



Lead Sample Location

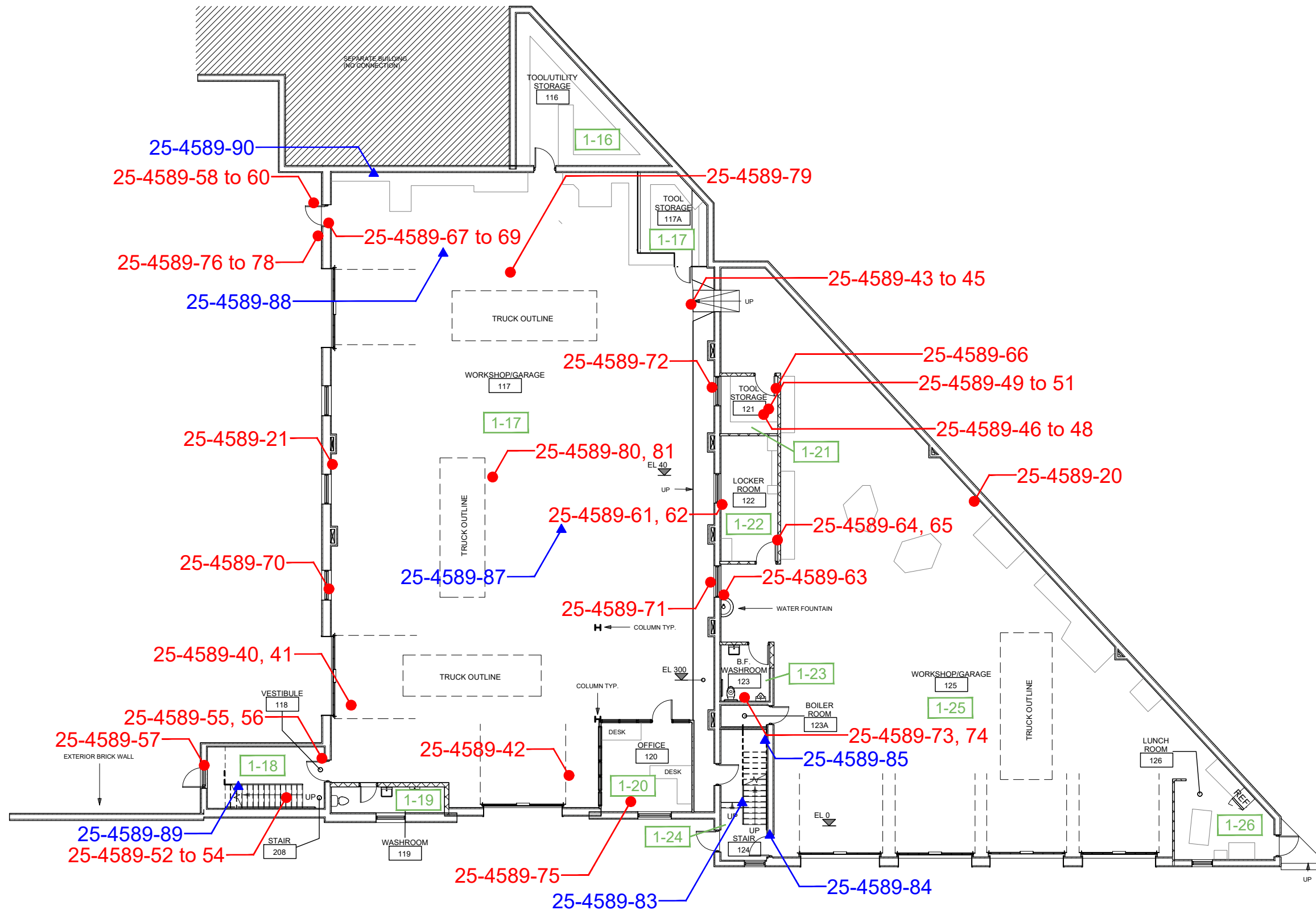


Figure 1

LOCATION:

1116 King Street West,
Toronto, Ontario

BUILDING NAME:

King Street Yard -
Building No. 8 & 9

**Asbestos & Lead Sample Locations -
Ground Floor Plan**

CLIENT: City of Toronto

PROJECT NUMBER: FE 25-14756 DATE: May 2025 DRW BY: T.L.

CAD FILE: FIG1 SCALE: Not to Scale CHK BY: I.F.





Legend

1-01

Location Number



Asbestos Sample Location



Lead Sample Location

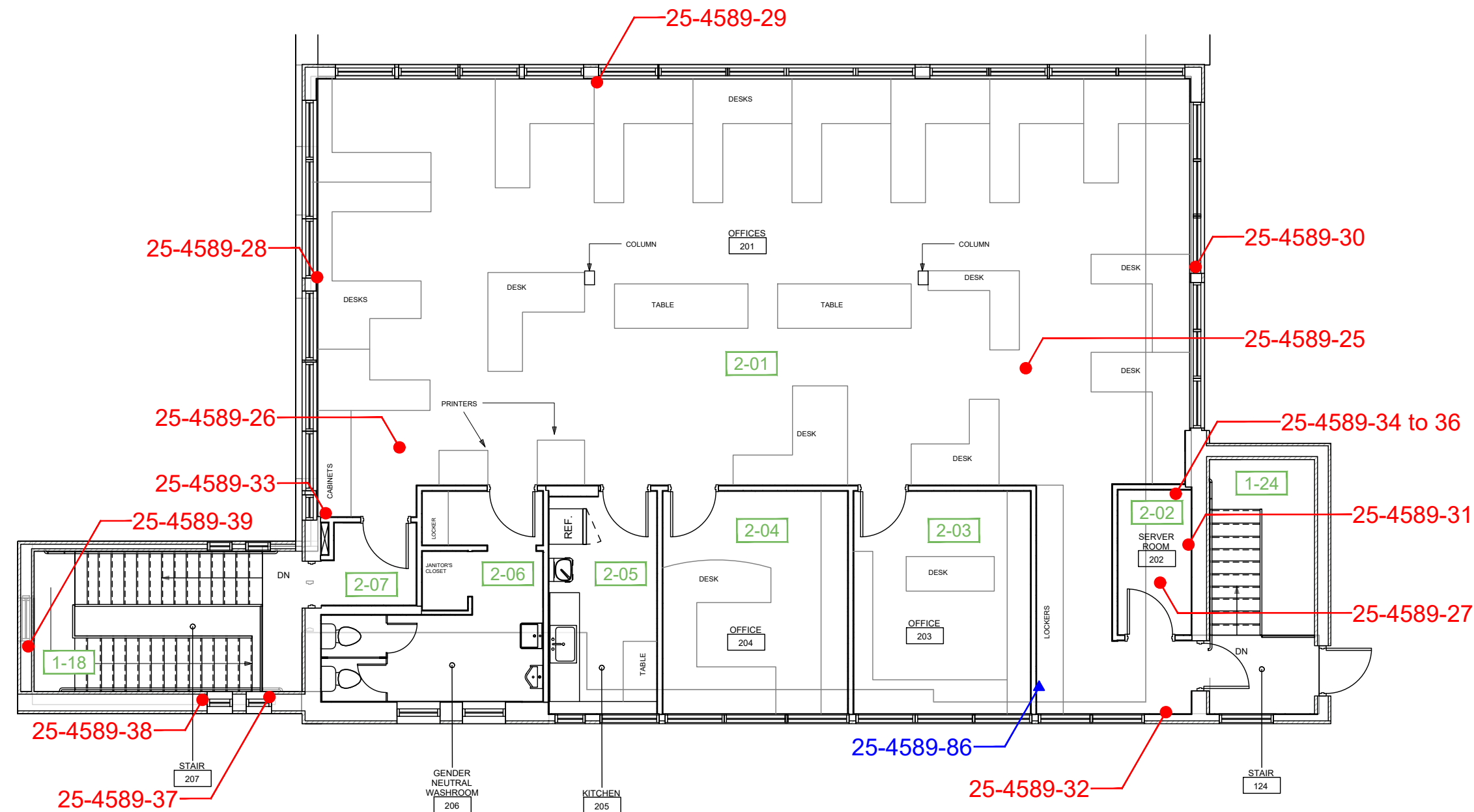


Figure 2

LOCATION:

1116 King Street West,
Toronto, Ontario

BUILDING NAME:

King Street Yard -
Building No. 8 & 9

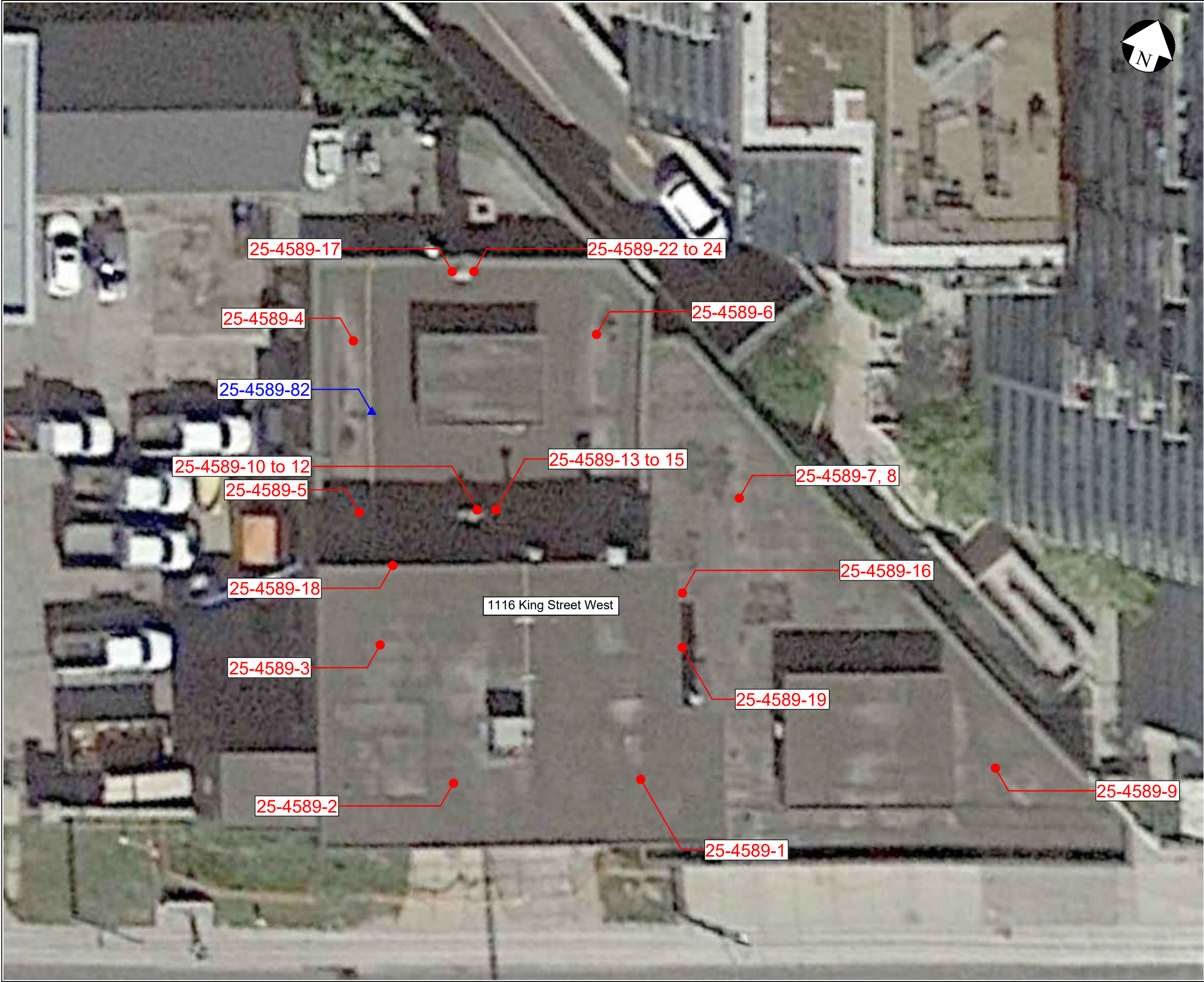
**Asbestos & Lead Sample Locations -
Second Floor Plan**

CLIENT: City of Toronto

PROJECT NUMBER: FE 25-14756 DATE: May 2025 DRW BY: T.L.

CAD FILE: FIG2 SCALE: Not to Scale CHK BY: I.F.





Legend

1-01

Location Number

●

Asbestos Sample Location

▲

Lead Sample Location

Figure 3

LOCATION:


1116 King Street West,
Toronto, Ontario

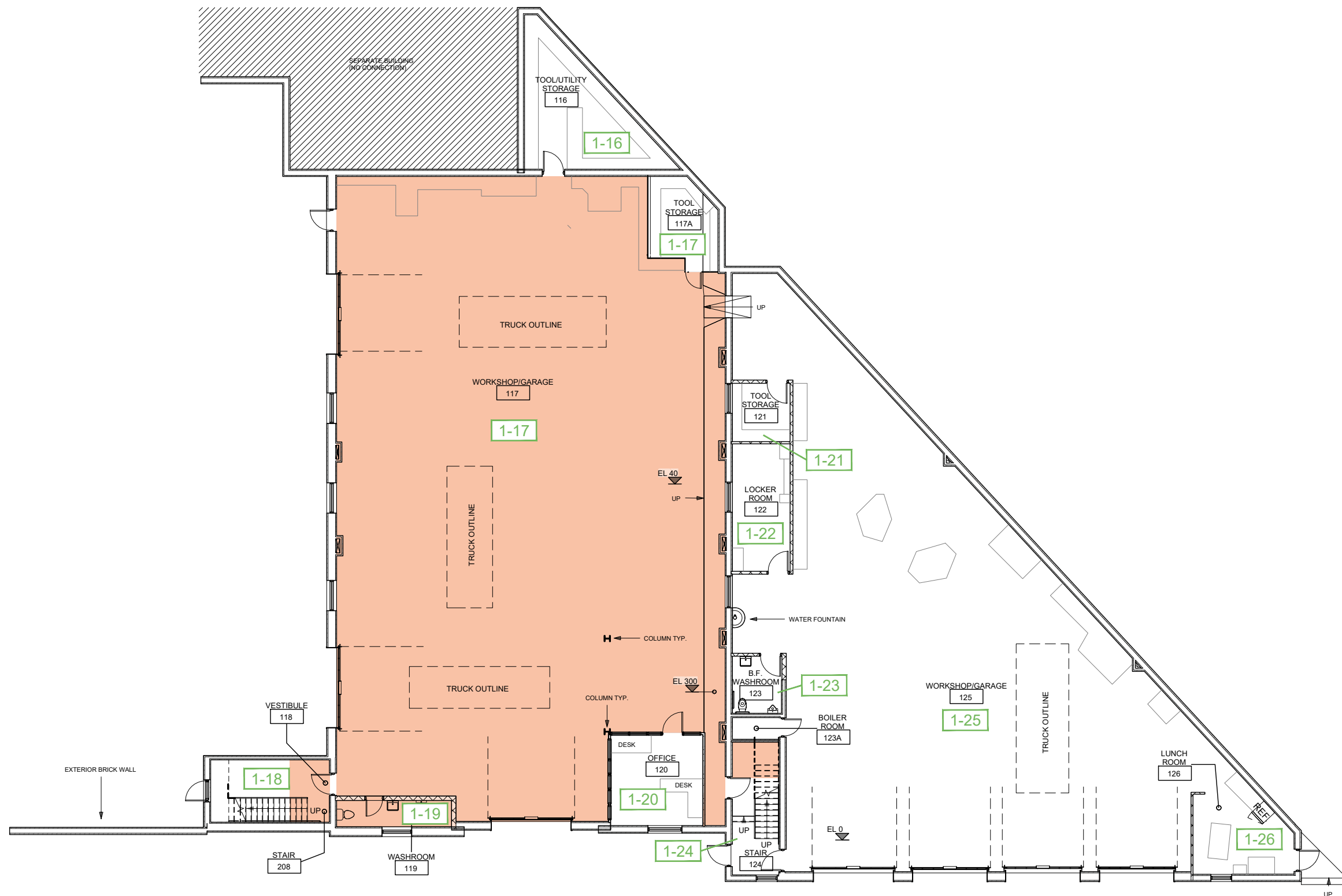
BUILDING NAME:

King Street Yard -
Building No. 8 & 9

Asbestos & Lead Sample Locations -
Roof Floor Plan

CLIENT: City of Toronto		
PROJECT NUMBER: FE 25-14756	DATE: May 2025	DRW BY: T.L.
CAD FILE: FIG3	SCALE: Not to Scale	CHK BY: I.F.

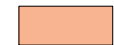
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Legend

1-01

Location Number



Asbestos-Containing Pipe Insulation
(Air-cell on Pipe Straight &
Parging Cement on Pipe Fillings)

Figure 4

LOCATION:

1116 King Street West,
Toronto, Ontario

BUILDING NAME:

King Street Yard -
Building No. 8 & 9

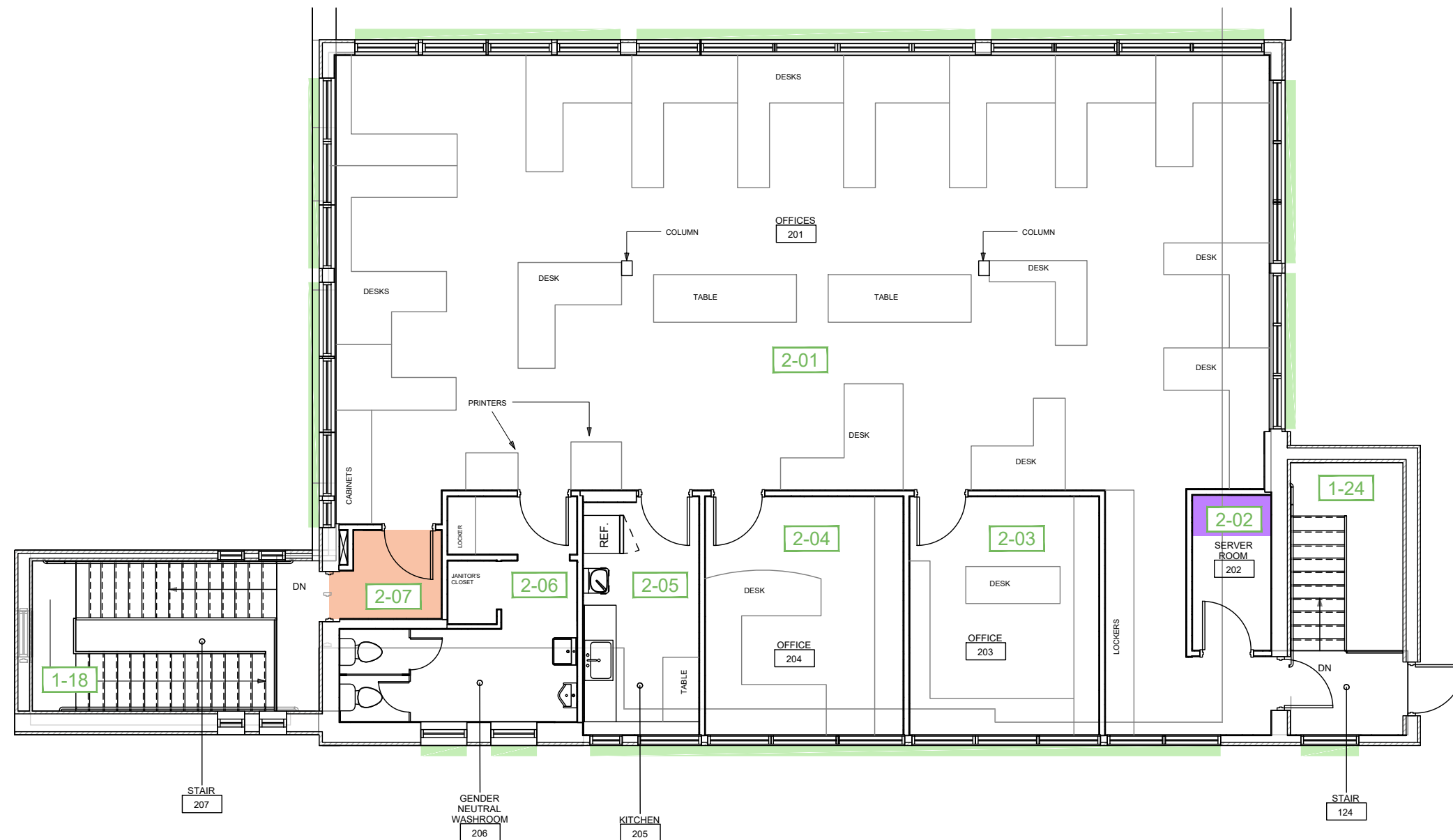
**Asbestos-Containing Materials Location -
Ground Floor Plan**

CLIENT: City of Toronto

PROJECT NUMBER: FE 25-14756 DATE: May 2025 DRW BY: T.L.

CAD FILE: FIG4 SCALE: Not to Scale CHK BY: I.F.





Legend

- 1-01 Location Number
- Asbestos-Containing Pipe Insulation (Air-cell on Pipe Straight & Parging Cement on Pipe Fillings)
- Asbestos-Containing Parging Cement on Pipe Fillings
- Asbestos-Containing Grey Caulking (Hard)

Figure 5

LOCATION: 1116 King Street West,
Toronto, Ontario

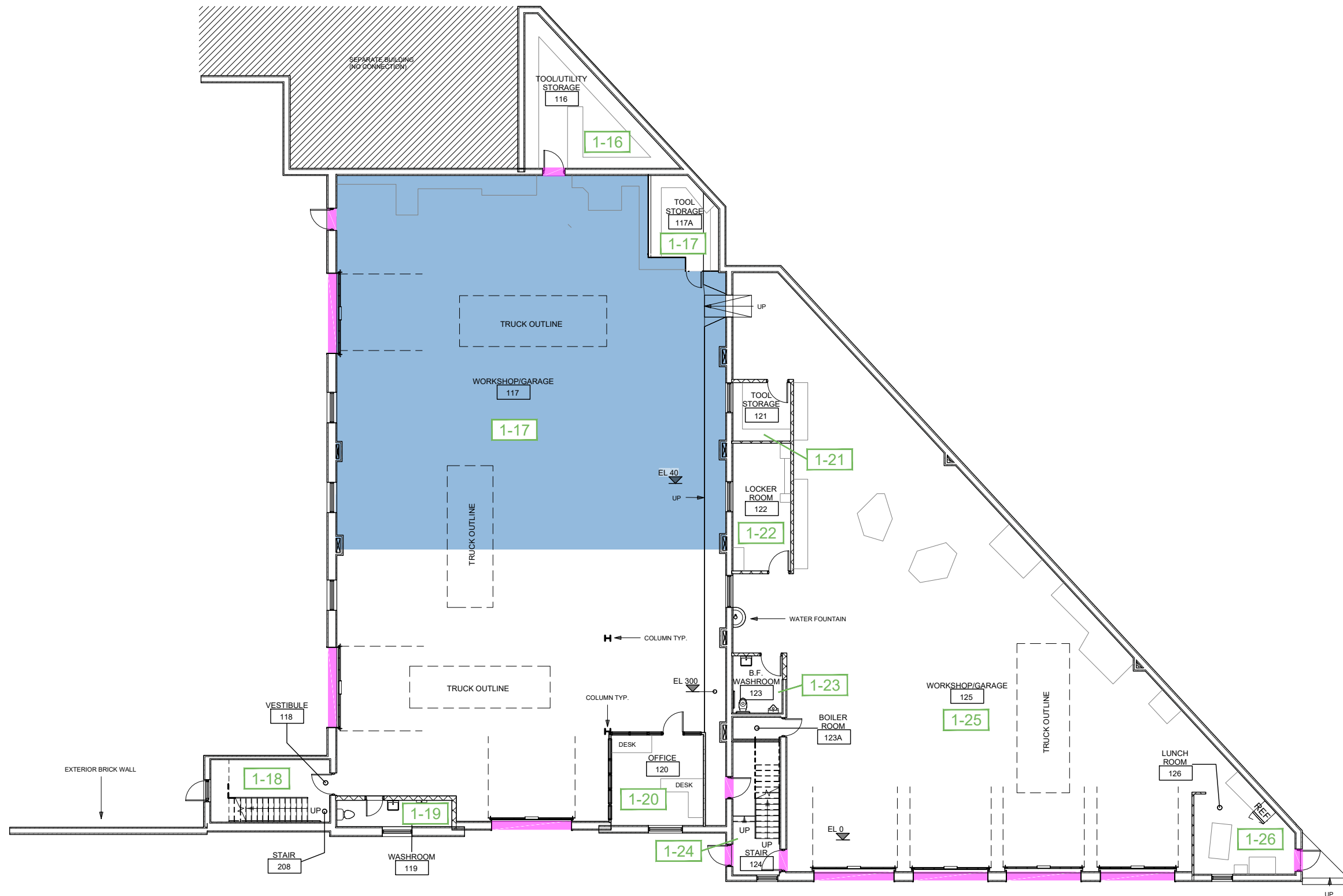
BUILDING NAME: King Street Yard -
Building No. 8 & 9

Asbestos-Containing Materials Location - Second Floor Plan

CLIENT: City of Toronto

PROJECT NUMBER: FE 25-14756	DATE: May 2025	DRW BY: T.L.
CAD FILE: FIG5	SCALE: Not to Scale	CHK BY: I.F.





Legend

- 1-01 Location Number
- Light Cream Paint on Wood Deck
- White Paint on Door Frame

Figure 6

LOCATION: 1116 King Street West,
Toronto, Ontario

BUILDING NAME: King Street Yard -
Building No. 8 & 9

Lead-Containing Paint Location - Ground Floor Plan

CLIENT: City of Toronto		
PROJECT NUMBER: FE 25-14756	DATE: May 2025	DRW BY: T.L.
CAD FILE: FIG6	SCALE: Not to Scale	CHK BY: I.F.





Legend

- 1-01 Location Number
- Blue Paint on Lower Portion of Wall
- White Paint on Wall and Ceiling
- White Paint on Wall
- Light Green Paint on Walls
- Black and Grey Paint on Hand Railing
- Grey Paint on Walls

Figure 7

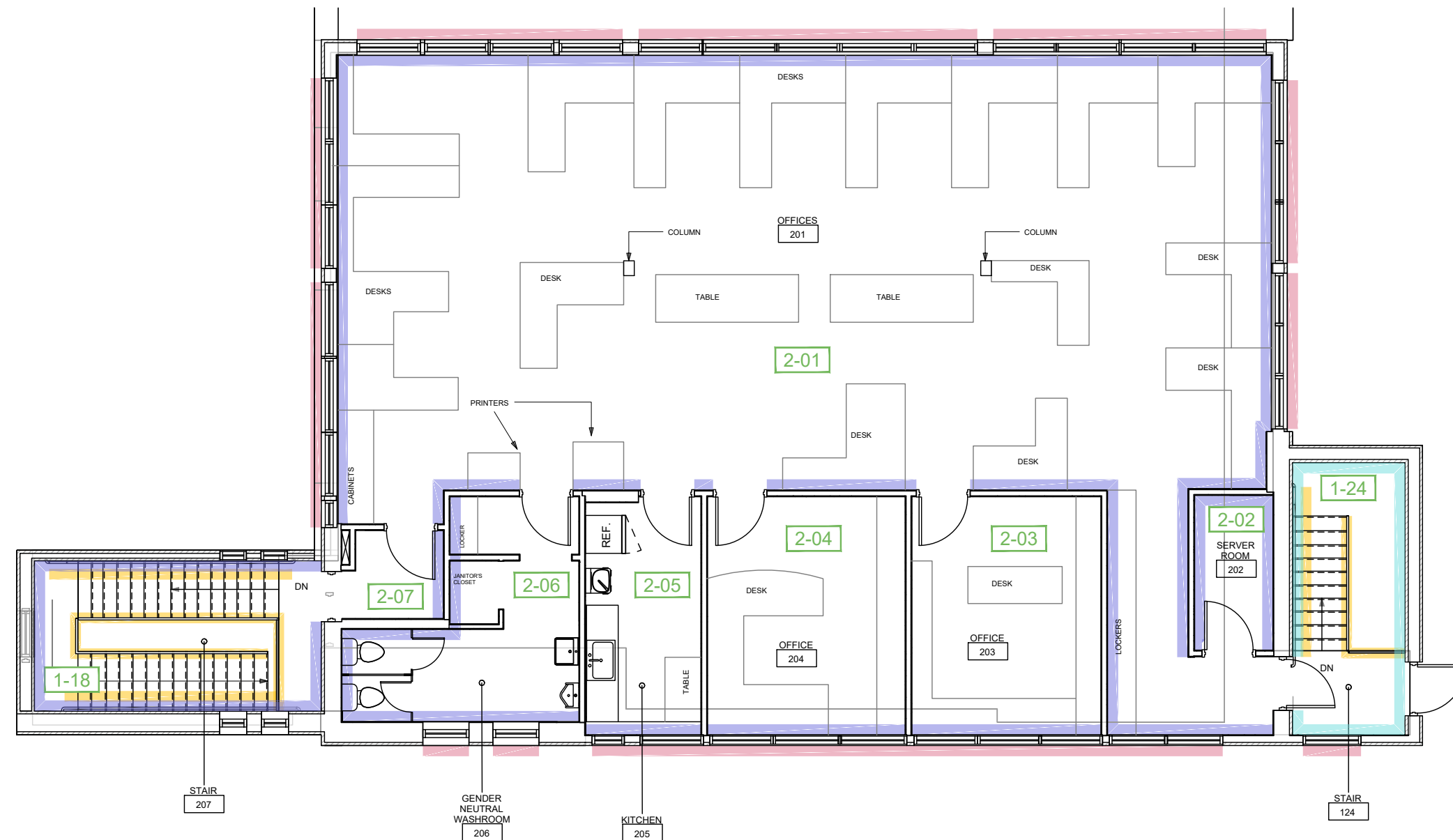
LOCATION: 1116 King Street West,
Toronto, Ontario

BUILDING NAME: King Street Yard -
Building No. 8 & 9

Lead-Containing Paint Location - Ground Floor Plan - 2

CLIENT: City of Toronto		
PROJECT NUMBER: FE 25-14756	DATE: May 2025	DRW BY: T.L.
CAD FILE: FIG7	SCALE: Not to Scale	CHK BY: I.F.





Legend

- 1-01 Location Number
- 1-02 Light Green Paint on the Exterior Window Frame
- 1-03 Light Green Paint on Walls
- 1-04 Black and Grey Paint on Hand Railing
- 1-05 Grey Paint on Walls

Figure 8

LOCATION: 1116 King Street West,
Toronto, Ontario

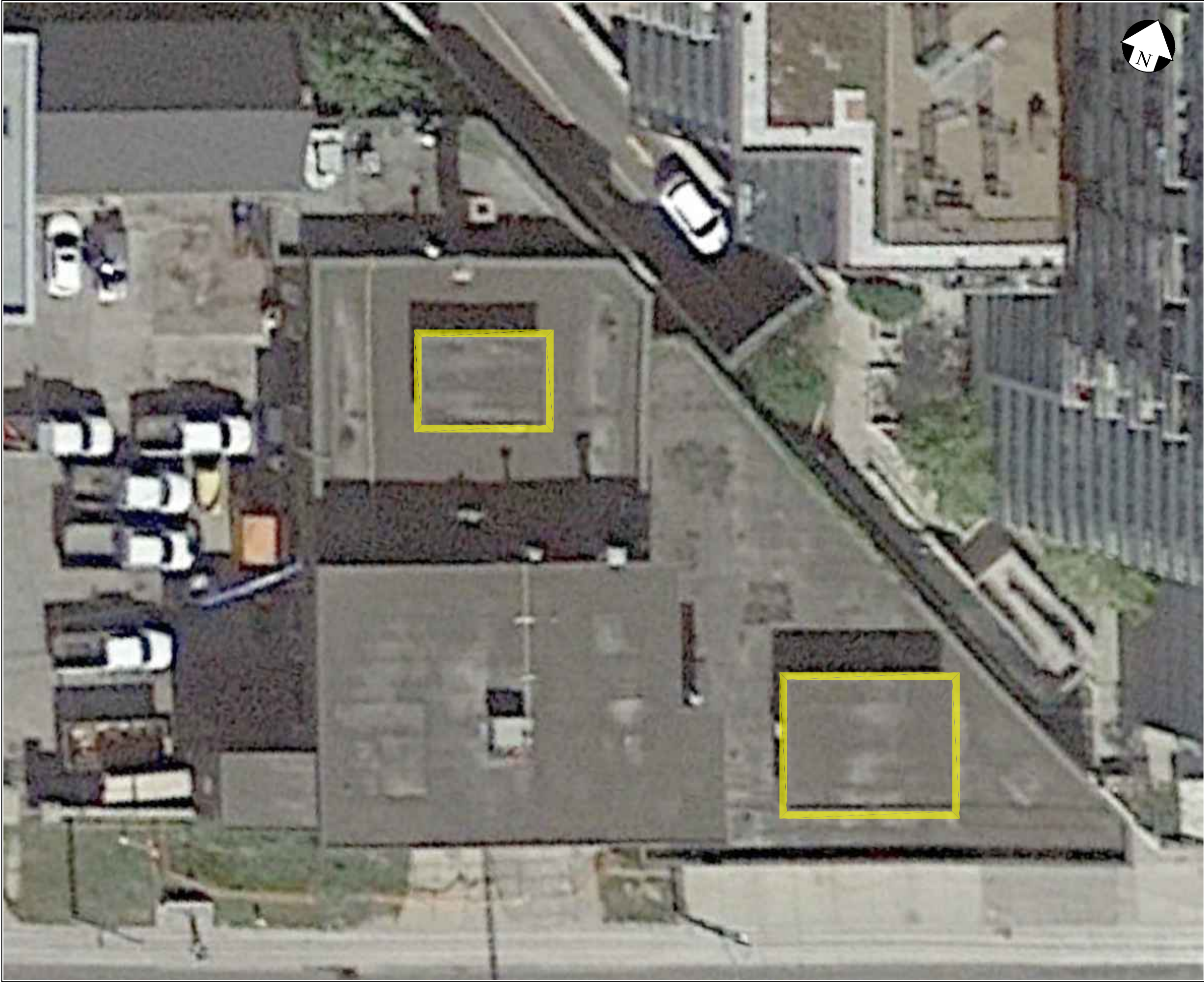
BUILDING NAME: King Street Yard -
Building No. 8 & 9

Lead-Containing Paint Location - Second Floor Plan

CLIENT: City of Toronto

PROJECT NUMBER: FE 25-14756	DATE: May 2025	DRW BY: T.L.
CAD FILE: FIG8	SCALE: Not to Scale	CHK BY: I.F.





Legend

1-01

Location Number

Off-White Paint on the Skylight Window Frame


Figure 9

LOCATION: 1116 King Street West, Toronto, Ontario

BUILDING NAME: King Street Yard - Building No. 8 & 9

Lead-Containing Paint Location - Roof Floor Plan

CLIENT: City of Toronto		
PROJECT NUMBER: FE 25-14756	DATE: May 2025	DRW BY: T.L.
CAD FILE: FIG9	SCALE: Not to Scale	CHK BY: I.F.

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APPENDIX C – SITE PHOTOGRAPHS



Photo 1:

View of asbestos-containing grey caulking (hard) along the joints of the window frame and brick wall on the exterior side of the 2nd floor.



Photo 2:

View of asbestos-containing parging cement on pipe fittings in the ceiling space of the IT Room (Loc. 2-02).



Photo 3:

View of asbestos-containing pipe insulation (parging cement on pipe fittings and air-cell on pipe straights) on the ground floor of the Stairwell (Loc. 1-24).



Photo 4:

View of asbestos-containing pipe insulation (parging cement on pipe fittings and air-cell on pipe straights) on the ground floor of the Stairwell (Loc. 1-18).

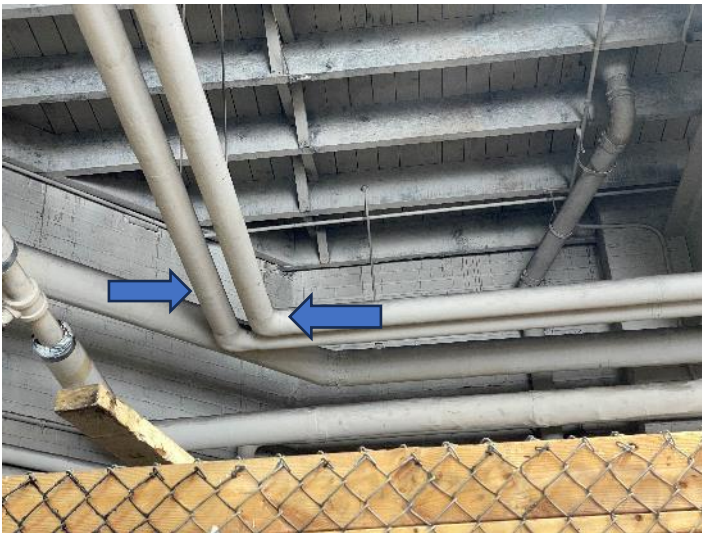


Photo 5:

View of asbestos-containing pipe insulation (parging cement on pipe fittings and air-cell on pipe straights) on the ground floor of the Truck Repair Area (Loc. 1-17).



Photo 6:

View of pipes with asbestos-containing pipe insulation (parging cement on pipe fittings and air-cell on pipe straights) on the ground floor of the Truck Repair Area (Loc. 1-17).



Photo 7:

Additional view of pipes with asbestos-containing pipe insulation (parging cement on pipe fittings and air-cell on pipe straights) on the ground floor of the Truck Repair Area (Loc. 1-17).



Photo 8:

View of open end of an asbestos-containing air-cell insulation on pipe straights in the Washroom (Loc. 1-19).



Photo 9:

Previously identified lead-containing light cream paint surfaces were painted with white paint (vertical trims) on both sides of the windows (Loc. 2-01).



Photo 10:

View of lead-containing off-white paint on the skylight frames on the roof of the building.



Photo 11:

View of lead-containing black paint on the handrail and light green paint on the brick wall in the Stairwell (Loc. 1-24).

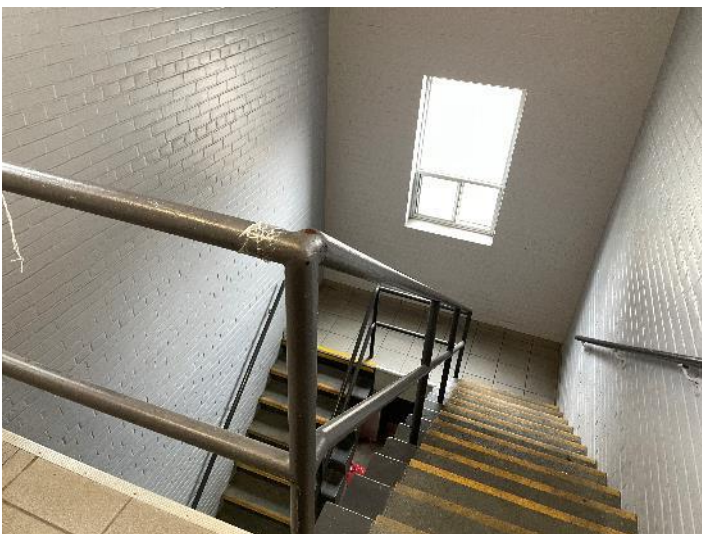


Photo 12:

View of lead-containing grey paint on the handrail and light green paint on the brick wall in the Stairwell (Loc. 1-18).



Photo 13:

View of lead-containing white paint on the door frame at the exterior of the Truck Repair Area (Loc. 1-17).



Photo 14:

View of lead-containing grey paint on the wall in the Office Area (Loc. 2-01).

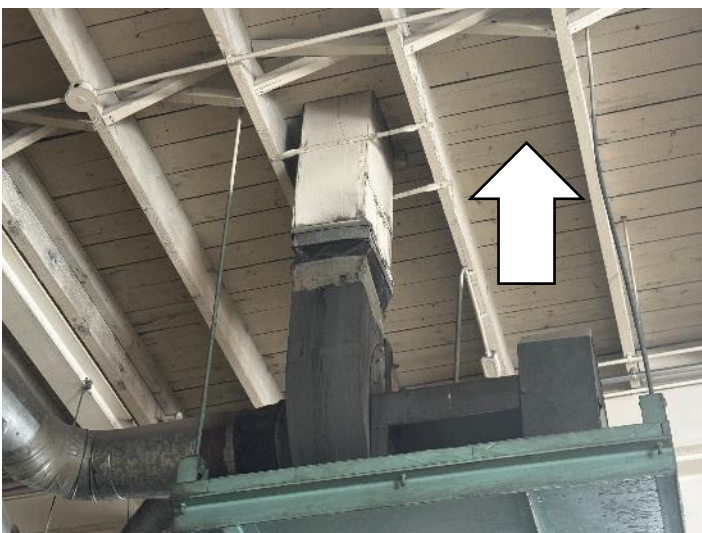


Photo 15:

View of lead-containing light cream paint on the wood deck in the Truck Repair Area (Loc. 1-17).



Photo 16:

View of lead-containing blue paint on the wall in the Truck Repair Area (Loc. 1-17).



Photo 17:

Example view of lead-containing white paint on the walls and ceiling in the Truck Maintenance (Loc. 1-25).



Photo 18:

View of mercury-containing thermostat in the Truck Repair Area (Loc. 1-17).

APPENDIX D – ROOM-BY-ROOM SURVEY SHEET

APPENDIX I - Designated Substances and Hazardous Materials Inventory Sheet

Building Address:	1116 King Street West (Building 8 and 9)	Date(s) of Assessment:	May 13, 2025
Building Name:	Toronto Paramedic Services Fleet Maintenance Station	Organization Completing Assessment:	Fisher Engineering Limited / Project FE 25-14756
Original Survey Conducted By:	Fisher Environmental Ltd.	Name of Surveyor:	Iqbal Fattah & Muhammad Junayed
Date(s) of Original Survey:	August 16, 2006	Signature of Surveyor:	<i>Iqbal Fattah</i>

Summary of Findings

Location Number	Location Name	Building System	Material Observed	Potential Hazardous Material	Sample ID	Analytical Result	Quantity	Condition	Notes/Required Action
0-00	Exterior	Roof	Roofing Material	Asbestos	25-4589-1 to 3*	None Detected	N/A	N/A	Building 8 & 9, Roof on the 2nd Floor *From Fisher Project No. 25-14756, dated May 2025
0-00	Exterior	Roof	Roofing Material	Asbestos	25-4589-4 to 6*	None Detected	N/A	N/A	Building 8 & 9, 2nd Level Roof *From Fisher Project No. 25-14756, dated May 2025
0-00	Exterior	Roof	Roofing Material	Asbestos	25-4589-7 to 9*	None Detected	N/A	N/A	Building 8 & 9, Lower Level Roof *From Fisher Project No. 25-14756, dated May 2025
0-00	Exterior	Roof	Caulking	Asbestos	25-4589-10 to 12*	None Detected	N/A	N/A	Light Grey Building 8 & 9, 2nd Level Roof, Along Joints of Exhaust *From Fisher Project No. 25-14756, dated May 2025
0-00	Exterior	Roof	Caulking	Asbestos	25-4589-13 to 15*	None Detected	N/A	N/A	Red Building 8 & 9, 2nd Level Roof, Along Joints of Exhaust *From Fisher Project No. 25-14756, dated May 2025
0-00	Exterior	Roof	Caulking	Asbestos	25-4589-16 to 18*	None Detected	N/A	N/A	Dark Grey, Building 8 & 9, Lower & 2nd Level Roofs *From Fisher Project No. 25-14756, dated May 2025
0-00	Exterior	Roof	Brick Mortar	Asbestos	25-4589-22 to 24*	None Detected	N/A	N/A	Light Brown (Building 8 & 9), 2nd Level Roof, Chimney *From Fisher Project No. 25-14756, dated May 2025
0-00	Roof	Roof	Caulking	Asbestos	20-4130-40 to 42*	None Detected	N/A	N/A	Tan (Building 8 & 9) Around the glass frames on skylight *From Fisher Project No. 20-10141, Dated Feb. 2020
0-00	Roof	Roof	Caulking	Asbestos	20-4130-43 to 45*	None Detected	N/A	N/A	Brown (Building 8 & 9) Along the joint of window frame and metal panels *From Fisher Project No. 20-10141, Dated Feb. 2020
0-00	Roof	Pipe	Paint	Lead	25-4589-82*	36 ppm	N/A	N/A	Yellow, (Building 8 & 9) *From Fisher Project No. 25-14756, Dated May 2025
0-00	Exterior	Windows	Caulking	Asbestos	20-4130-37 to 39*	None Detected	N/A	N/A	Light Grey, (Building 8 & 9), Along joints of the window frame & the window sill *From Fisher Project No. 20-10141, Dated Feb. 2020
0-00	Exterior	Windows	Paint	Lead	20-4130-46*	4,107 ppm	70 SF	Good	Light Cream, (Building 8 & 9), Exterior window frame & sill *From Fisher Project No. 20-10141, Dated Feb. 2020
0-00	Exterior	Windows	Paint	Lead	20-4130-47*	9,195 ppm	120 SF	Good	Off-White, (Building 8 & 9), Skylight window on the roof *From Fisher Project No. 20-10141, Dated Feb. 2020
0-00	Exterior	Walls	Brick	N/A	N/A	N/A	N/A	N/A	(Building 8 & 9)
0-00	Exterior	Walls	Brick Mortar	Asbestos	25-4589-19*	None Detected	N/A	N/A	(Building 8 & 9), 2nd Level Roof *From Fisher Project No. 25-14756, dated May 2025
0-00	Exterior	Walls	Paint	Lead	20-4130-48*	393 ppm	N/A	N/A	Yellow, (Building 8 & 9), Wall marking on overhead door frames *From Fisher Project No. 20-10141, Dated Feb. 2020
0-00	Exterior	Walls	Paint	Lead	20-4130-49*	421 ppm	N/A	N/A	Black, (Building 8 & 9), wall marking on overhead door frames *From Fisher Project No. 20-10141, Dated Feb. 2020

APPENDIX I - Designated Substances and Hazardous Materials Inventory Sheet

Location Number	Location Name	Building System	Material Observed	Potential Hazardous Material	Sample ID	Analytical Result	Quantity	Condition	Notes/Required Action
0-00	Exterior	Walls	Caulking	Asbestos	20-4130-34 to 36*	0.5-5% Chrysotile	All	Good	Grey (Building 8 & 9) Along the joint of the brick wall and window frame *From Fisher Project No. 20-10141, Dated Feb. 2020
1-16	Parts Storage	Floor	Concrete	N/A	N/A	N/A	N/A	N/A	(Building 8 & 9)
1-16	Parts Storage	Walls	Brick	N/A	N/A	N/A	N/A	N/A	(Building 8 & 9)
1-16	Parts Storage	Walls	Brick Mortar	Asbestos	Homogeneous w/ 25-4589-19 to 21	None Detected	N/A	N/A	(Building 8 & 9)
1-16	Parts Storage	Walls	Paint	Lead	24-3615-6*	14,318 ppm	700 SF	Good	White, (Building 8 & 9) *From Fisher Project No. 24-14180, dated Nov. 2024
1-16	Parts Storage	Ceiling	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	200 SF	Good	White, (Building 8 & 9)
1-16	Parts Storage	Ceiling	Concrete	N/A	N/A	N/A	N/A	N/A	(Building 8 & 9)
1-17	Truck Repair Area	Floor	Concrete	N/A	N/A	N/A	N/A	N/A	(Building 8 & 9)
1-17	Truck Repair Area	Floor	Expansion Joints	Asbestos	25-4589-79 to 81*	None Detected	N/A	N/A	Black, (Building 8 & 9), Along Joints of concrete slabs *From Fisher Project No. 25-14756, dated May 2025
1-17	Truck Repair Area	Walls	Brick	N/A	N/A	N/A	N/A	N/A	(Building 8 & 9)
1-17	Truck Repair Area	Walls	Brick Mortar	Asbestos	25-4589-21*	None Detected	N/A	N/A	(Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-17	Truck Repair Area	Walls	Fire Stop	Asbestos	25-4589-43 to 45*	None Detected	N/A	N/A	Red, HVAC Duct (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-17	Truck Repair Area	Door	Sealant	Asbestos	25-4589-58 to 60*	None Detected	N/A	N/A	Grey, (Building 8 & 9), Between glass and frame *From Fisher Project No. 25-14756, dated May 2025
1-17	Truck Repair Area	Door	Caulking	Asbestos	25-4589-67 to 69*	None Detected	N/A	N/A	Light Grey (Building 8 & 9), Interior, Around Door Frame *From Fisher Project No. 25-14756, dated May 2025
1-17	Truck Repair Area	Windows	Putty	Asbestos	25-4589-70 to 72*	None Detected	N/A	N/A	Tan, (Building 8 & 9), Panel Windows, Along Joints of the glass and frame *From Fisher Project No. 25-14756, dated May 2025
1-17	Truck Repair Area	Door	Caulking	Asbestos	25-4589-76 to 78*	None Detected	N/A	N/A	Grey, (Building 8 & 9), Exterior, Around Door Frame *From Fisher Project No. 25-14756, dated May 2025
1-17	Truck Repair Area	Ceiling	Wood	N/A	N/A	N/A	N/A	N/A	
1-17	Truck Repair Area	Ceiling	Plaster	Asbestos	25-4589-40 to 42*	None Detected	N/A	N/A	(Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-17	Truck Repair Area	Pipe	Parging Cement	Asbestos	Homogeneous w/ 06-3749-10	50-75% Chrysotile	36 Fittings	Good	
1-17	Truck Repair Area	Pipe	Aircell	Asbestos	Homogeneous w/ 06-3749-29	50-75% Chrysotile	100 LF	Good	
1-17	Truck Repair Area	Hoist	Paint	Lead	25-4589-87*	47 ppm	N/A	N/A	Blue (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-17	Truck Repair Area	Wood Deck	Paint	Lead	25-4589-88*	3,109 ppm	1600 SF	Good	Light Cream (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-17	Truck Repair Area	Walls	Paint	Lead	25-4589-90*	8,732 ppm	1,000 SF	Good	Blue, Brick Wall, Lower Portion (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-17	Truck Repair Area	Walls	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	3000 SF	Good	White, Brick Wall, Upper Portion (Building 8 & 9)
1-17	Truck Repair Area	Ceiling	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	1600 SF	Good	White, Plaster Ceiling (Building 8 & 9)

APPENDIX I - Designated Substances and Hazardous Materials Inventory Sheet

Location Number	Location Name	Building System	Material Observed	Potential Hazardous Material	Sample ID	Analytical Result	Quantity	Condition	Notes/Required Action
1-17	Truck Repair Area	Door	Paint	Lead	20-4130-48*	393 ppm	N/A	N/A	Yellow, Marking on the Overhead Door Frame *From Fisher Project No. 20-10141, dated March 11, 2020
1-17	Truck Repair Area	Door	Paint	Lead	20-4130-49*	421 ppm	N/A	N/A	Black, Marking on the Overhead Door Frame *From Fisher Project No. 20-10141, dated March 11, 2020
1-18	Stairwell	Floor	Ceramic/Concrete	N/A	N/A	N/A	N/A	N/A	
1-18	Stairwell	Floor	Fibre Board	Asbestos	25-4589-52 to 54*	None Detected	N/A	N/A	Yellow, Stair Treads (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-18	Stairwell	Walls	Brick	N/A	N/A	N/A	N/A	N/A	
1-18	Stairwell	Walls	Caulking	Asbestos	25-4589-37 to 39*	None Detected	N/A	N/A	Cream, (Building 8 & 9), Along Joints of the Window Frames and Walls *From Fisher Project No. 25-14756, dated May 2025
1-18	Stairwell	Door	Caulking	Asbestos	25-4589-55 to 57*	None Detected	N/A	N/A	Black, (Building 8 & 9), Around Door Frames *From Fisher Project No. 25-14756, dated May 2025
1-18	Stairwell	Ceiling	Concrete	N/A	N/A	N/A	N/A	N/A	
1-18	Stairwell	Pipe	Parging Cement	Asbestos	Homogeneous w/ 06-3749-10	50-75% Chrysotile	12 Fittings	Good	
1-18	Stairwell	Pipe	Aircell	Asbestos	Homogeneous w/ 06-3749-29	50-75% Chrysotile	20 LF	Good	
1-18	Stairwell	Handrail	Paint	Lead	25-4589-89*	2,650 ppm	60 LF	Good	Grey (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-18	Stairwell	Walls	Paint	Lead	Homogenous w/ 25-4589-85*	5,081 PPM	600 SF	Good	Light Green, Brick Wall (Building 8 & 9)
1-19	Washroom	Floor	Ceramic	N/A	N/A	N/A	N/A	N/A	
1-19	Washroom	Walls	Block/Brick	N/A	N/A	N/A	N/A	N/A	
1-19	Washroom	Ceiling	Wood	N/A	N/A	N/A	N/A	N/A	
1-19	Washroom	Pipe	Parging Cement	Asbestos	Homogeneous w/ 06-3749-10	50-75% Chrysotile	1 Fitting	Good	
1-19	Washroom	Pipe	Aircell	Asbestos	Homogeneous w/ 06-3749-29	50-75% Chrysotile	10 LF	Good	
1-19	Washroom	Walls	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	200 SF	Good	White, (Building 8 & 9)
1-19	Washroom	Ceiling	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	50 SF	Good	White, (Building 8 & 9)
1-20	Office	Floor	Ceramic	N/A	N/A	N/A	N/A	N/A	
1-20	Office	Walls	Brick	N/A	N/A	N/A	N/A	N/A	
1-20	Office	Walls	Drywall (DJC)	Asbestos	Homogenous w/ 25-4589-31 to 33	None Detected	N/A	N/A	
1-20	Office	Ceiling	Drywall (DJC)	Asbestos	25-4589-75*	None Detected	N/A	N/A	*From Fisher Project No. 25-14756, dated May 2025
1-20	Office	Walls	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	480 SF	Good	White, (Building 8 & 9)
1-20	Office	Ceiling	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	200 SF	Good	White, (Building 8 & 9)
1-21	Storage	Floor	Vinyl Floor Tile 2	Asbestos	25-4589-46 to 48*	None Detected	N/A	N/A	12" x 12" Grey Mosaic, (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-21	Storage	Floor	Mastic	Asbestos	25-4589-49 to 51*	None Detected	N/A	N/A	Brown, Under VFT-2, (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025

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Location Number	Location Name	Building System	Material Observed	Potential Hazardous Material	Sample ID	Analytical Result	Quantity	Condition	Notes/Required Action
1-21	Storage	Walls	Drywall (DJC)	Asbestos	Homogenous w/ 25-4589-31 to 33	None Detected	N/A	N/A	
1-21	Storage	Walls	Block/Brick	N/A	N/A	N/A	N/A	N/A	
1-21	Storage	Walls	Block Mortar	Asbestos	25-4589-66*	None Detected	N/A	N/A	Grey (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-21	Storage	Ceiling	Not Found	N/A	N/A	N/A	N/A	N/A	Open to Above
1-21	Storage	Walls	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	200 SF	Good	White, (Building 8 & 9)
1-22	Locker Room	Floor	Ceramic	N/A	N/A	N/A	N/A	N/A	
1-22	Locker Room	Walls	Drywall (DJC)	Asbestos	Homogenous w/ 25-4589-31 to 33	None Detected	N/A	N/A	
1-22	Locker Room	Walls	Caulking	Asbestos	25-4589-61, 62*	None Detected	N/A	N/A	Off-White (Building 8 & 9), Along Joints of Interior Window Frames and Walls *From Fisher Project No. 25-14756, dated May 2025
1-22	Locker Room	Walls	Block/Brick	N/A	N/A	N/A	N/A	N/A	
1-22	Locker Room	Walls	Block Mortar	Asbestos	25-4589-64, 65*	None Detected	N/A	N/A	Grey (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-22	Locker Room	Ceiling	Not Found	N/A	N/A	N/A	N/A	N/A	Open to Above
1-22	Locker Room	Walls	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	400 SF	Good	White, (Building 8 & 9)
1-23	Washroom	Floor	Ceramic	N/A	N/A	N/A	N/A	N/A	
1-23	Washroom	Walls	Block/Brick	N/A	N/A	N/A	N/A	N/A	
1-23	Washroom	Ceiling	Drywall (DJC)	Asbestos	25-4589-73, 74*	None Detected	N/A	N/A	*From Fisher Project No. 25-14756, dated May 2025
1-23	Washroom	Walls	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	200 SF	Good	White, (Building 8 & 9)
1-23	Washroom	Ceiling	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	50 SF	Good	White, (Building 8 & 9)
1-24	Stairwell	Floor	Concrete	N/A	N/A	N/A	N/A	N/A	
1-24	Stairwell	Walls	Brick	N/A	N/A	N/A	N/A	N/A	
1-24	Stairwell	Ceiling	Concrete	N/A	N/A	N/A	N/A	N/A	
1-24	Stairwell	Pipe	Parging Cement	Asbestos	Homogeneous w/ 06-3749-10	50-75% Chrysotile	2 Fittings	Good	
1-24	Stairwell	Pipe	Aircell	Asbestos	Homogeneous w/ 06-3749-29	50-75% Chrysotile	6 LF	Good	
1-24	Stairwell	Handrail	Paint	Lead	25-4589-83*	4,058 PPM	120 LF	Good	Black (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-24	Stairwell	Door	Paint	Lead	25-4589-84*	6,497 PPM	40 LF	Good	White, Door Frame (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-24	Stairwell	Walls	Paint	Lead	25-4589-85*	5,081 PPM	1,200 SF	Good	Light Green, Brick Wall (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-25	Truck Maintenance	Floor	Concrete	N/A	N/A	N/A	N/A	N/A	
1-25	Truck Maintenance	Walls	Brick	N/A	N/A	N/A	N/A	N/A	

APPENDIX I - Designated Substances and Hazardous Materials Inventory Sheet

Location Number	Location Name	Building System	Material Observed	Potential Hazardous Material	Sample ID	Analytical Result	Quantity	Condition	Notes/Required Action
1-25	Truck Maintenance	Walls	Brick Mortar	Asbestos	25-4589-20*	None Detected	N/A	N/A	(Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
1-25	Truck Maintenance	Walls	Caulking	Asbestos	25-4589-63*	None Detected	N/A	N/A	Off-White (Building 8 & 9), Along Joints of Interior Window Frames and Walls *From Fisher Project No. 25-14756, dated May 2025
1-25	Truck Maintenance	Ceiling	Wood	N/A	N/A	N/A	N/A	N/A	
1-25	Truck Maintenance	Walls	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	4000 SF	Good	White, Brick Wall, (Building 8 & 9)
1-25	Truck Maintenance	Ceiling	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	2000 SF	Good	White, Plaster Ceiling (Building 8 & 9)
1-26	Storage	Floor	Vinyl Floor Tile 2	Asbestos	Homogenous w/ 25-4589-46 to 48	None Detected	N/A	N/A	12" x 12" Grey Mosaic
1-26	Storage	Walls	Block/Brick	N/A	N/A	N/A	N/A	N/A	
1-26	Storage	Ceiling	Wood	N/A	N/A	N/A	N/A	N/A	
1-26	Storage	Walls	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	480 SF	Good	White, (Building 8 & 9)
1-26	Storage	Ceiling	Paint	Lead	Homogeneous w/ 24-3615-6	14,318 ppm	200 SF	Good	White, (Building 8 & 9)
2-01	Office Area	Floor	Ceramic	N/A	N/A	N/A	N/A	N/A	
2-01	Office Area	Walls	Drywall (DJC)	Asbestos	25-4589-32, 33*	None Detected	N/A	N/A	(Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
2-01	Office Area	Walls	Caulking	Asbestos	25-4589-28 to 30*	None Detected	N/A	N/A	Grey, (Building 8 & 9), Along Joints of the Walls and Window Frames (Interior) *From Fisher Project No. 25-14756, dated May 2025
2-01	Office Area	Ceiling	Ceiling Tile 1	Asbestos	25-4589-25, 26*	None Detected	N/A	N/A	2' x 4' Random Pinhole, (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
2-01	Office Area	Walls	Paint	Lead	25-4589-86*	5,019 ppm	2000 SF	Good	Grey (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
2-02	IT Room	Floor	Ceramic	N/A	N/A	N/A	N/A	N/A	
2-02	IT Room	Walls	Drywall (DJC)	Asbestos	25-4589-31*	None Detected	N/A	N/A	(Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
2-02	IT Room	Ceiling	Ceiling Tile 1	Asbestos	25-4589-27*	None Detected	N/A	N/A	2' x 4' Random Pinhole, (Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
2-02	IT Room	Pipe	Parging Cement	Asbestos	Homogeneous w/ 06-3749-10	50-75% Chrysotile	3 Fittings	Good	Above Ceiling Tile
2-02	IT Room	Pipe	Straight Pipe Insulation	Asbestos	25-4589-34 to 36*	None Detected	N/A	N/A	(Building 8 & 9) *From Fisher Project No. 25-14756, dated May 2025
2-02	IT Room	Walls	Paint	Lead	Homogenous w/ 25-4589-86*	5,019 ppm	2000 SF	Good	Grey (Building 8 & 9)
2-03	Library	Floor	Ceramic	N/A	N/A	N/A	N/A	N/A	
2-03	Library	Walls	Drywall (DJC)	Asbestos	Homogenous w/ 25-4589-31 to 33	None Detected	N/A	N/A	
2-03	Library	Ceiling	Ceiling Tile 1	Asbestos	Homogenous w/ 25-4589-25 to 27	None Detected	N/A	N/A	2' x 4' Random Pinhole
2-03	Library	Walls	Paint	Lead	Homogenous w/ 25-4589-86*	5,019 ppm	2000 SF	Good	Grey (Building 8 & 9)
2-04	Office	Floor	Ceramic	N/A	N/A	N/A	N/A	N/A	

APPENDIX I - Designated Substances and Hazardous Materials Inventory Sheet

Location Number	Location Name	Building System	Material Observed	Potential Hazardous Material	Sample ID	Analytical Result	Quantity	Condition	Notes/Required Action
2-04	Office	Walls	Drywall (DJC)	Asbestos	Homogenous w/ 25-4589-31 to 33	None Detected	N/A	N/A	
2-04	Office	Ceiling	Ceiling Tile 1	Asbestos	Homogenous w/ 25-4589-25 to 27	None Detected	N/A	N/A	2' x 4' Random Pinhole
2-04	Office	Walls	Paint	Lead	Homogenous w/ 25-4589-86*	5,019 ppm	2000 SF	Good	Grey (Building 8 & 9)
2-05	Lunch Room	Floor	Ceramic	N/A	N/A	N/A	N/A	N/A	
2-05	Lunch Room	Walls	Drywall (DJC)	Asbestos	Homogenous w/ 25-4589-31 to 33	None Detected	N/A	N/A	
2-05	Lunch Room	Ceiling	Ceiling Tile 1	Asbestos	Homogenous w/ 25-4589-25 to 27	None Detected	N/A	N/A	2' x 4' Random Pinhole
2-05	Lunch Room	Walls	Paint	Lead	Homogenous w/ 25-4589-86*	5,019 ppm	2000 SF	Good	Grey (Building 8 & 9)
2-06	Washroom	Floor	Ceramic	N/A	N/A	N/A	N/A	N/A	
2-06	Washroom	Walls	Drywall (DJC)	Asbestos	Homogenous w/ 25-4589-31 to 33	None Detected	N/A	N/A	
2-06	Washroom	Walls	Ceramic	N/A	N/A	N/A	N/A	N/A	
2-06	Washroom	Ceiling	Ceiling Tile 1	Asbestos	Homogenous w/ 25-4589-25 to 27	None Detected	N/A	N/A	2' x 4' Random Pinhole
2-06	Washroom	Ceiling	Concrete	N/A	N/A	N/A	N/A	N/A	
2-06	Washroom	Walls	Paint	Lead	Homogenous w/ 25-4589-86*	5,019 ppm	2000 SF	Good	Grey (Building 8 & 9)
2-07	Stairwell	Floor	Ceramic/Concrete	N/A	N/A	N/A	N/A	N/A	
2-07	Stairwell	Walls	Brick	N/A	N/A	N/A	N/A	N/A	
2-07	Stairwell	Ceiling	Concrete	N/A	N/A	N/A	N/A	N/A	
2-07	Stairwell	Pipe	Parging Cement	Asbestos	Homogeneous w/ 06-3749-10	50-75% Chrysotile	10 Fittings	Good	
2-07	Stairwell	Pipe	Aircell	Asbestos	Homogeneous w/ 06-3749-29	50-75% Chrysotile	50 LF	Good	
2-07	Stairwell	Handrail	Paint	Lead	Homogenous w/ 25-4589-89*	2,650 ppm	40 LF	Good	Grey (Building 8 & 9)
2-07	Stairwell	Walls	Paint	Lead	Homogenous w/ 25-4589-85*	5,081 PPM	200 SF	Good	Light Green, Brick Wall (Building 8 & 9)
Surveyor's Field Notes									

Appendix B1

Report Geotechnical Investigation

For

Floor Slab Assessment
City of Toronto King Steet Yard
1116 King Street West, Buildings 8 & 9
Toronto, Ontario

Issued October 17, 2025 by Fisher Engineering Limited

FORWARD ENGINEERING
& ASSOCIATES INC.

Geotechnical, Environmental, Inspection & Material Testing Services
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REPORT
GEOTECHNICAL INVESTIGATION

FLOOR SLAB ASSESSMENT
CITY OF TORONTO KING STREET YARD
1116 KING STREET WEST, BUILDINGS 8 & 9
TORONTO, ONTARIO

PREPARED FOR:
ARCADIS
100 - 175 Galaxy Blvd
Toronto, Ontario
M9W 0C9

October 17, 2025
Ref. No. G7591

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BOREHOLE & TEST PIT LOCATION PLAN - DRAWING NO. 1

LOG OF BOREHOLE SHEET (BH-1 to BH-8) - APPENDIX A

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INTRODUCTION

This report presents the results of the geotechnical investigation carried out by Forward Engineering & Associates Inc. for the City of Toronto King Street Yard located at 1116 King Street West, Buildings 8 & 9, Toronto, Ontario.

The Ground Floor Plan for Buildings 8 & 9 is shown on Drawing No. 1. The approximate locations of the the cores/boreholes conducted during this investigation are also presented on Drawing No. 1.

This investigation was authorized by Mr. Nabil Layoun, Project Manager, of ARCADIS.

PURPOSE AND SCOPE

The objectives (purpose) of this investigation were to determine the following:

- The extent, depth, and properties of the predominant fill/soil strata as they affect the assessment criteria for the existing slab-on-grade.
- The thickness of slab.
- The compressive strength of the concrete of the existing slab.
- The short-term groundwater levels, if encountered.
- Boreholes finding summary/comments
- Ground improvement & remedial work options, if needed
- Determine Coefficient/Modulus of Subgrade Reaction before and after ground improvements application options

On completion of the field and laboratory work, an engineering analysis was carried out, and this summary report was prepared.

PROPOSED DEVELOPMENT

We understand that the development is to upgrade, convert, and renovate existing buildings (Buildings 8 and 9) into a fully functional fleet-maintenance garage for Paramedic Fleet vehicles. The renovated facility will include areas for heavy-vehicle service bays, lifts, exhaust systems, power-wash stations, offices and washrooms.

FIELD AND LABORATORY TESTING

The scope of work will consist of the following:

- 1) Ground Penetration Radar (GPR) scanning for the entire floor to detect any presence of reinforcing steel.
- 2) Coring the slab and carrying out laboratory compressive strength on the retrieved concrete cores.
- 3) Drilling boreholes at the core locations.

Field Works

GPR Scanning

Prior to coring, GPR scanning for the entire floor to detect any presence of reinforcing steel.

Cores/Boreholes Investigation:

The field work for the core/borehole investigation was carried out on October 6, 2025, and it consisted of eight [8] cores/boreholes (C/BH-1 to C/BH-8), carried out under the supervision of a member of our field staff.

The cores/boreholes were located at the approximate locations shown on Drawing No. 1.

The boreholes extended to a depth ranging from about 2.51 to 3.05 m below the Existing Slab Surface Level (ESSL).

Prior to advancing the boreholes, coring was performed to sample concrete to be tested for compressive strength.

Soils were then sampled in the boreholes following the Standard Penetration Test (SPT) method using a Dynamic Ram Sounder equipment.

The samples were logged in the field and appropriately stored in plastic bags and re-examined in more detail in the laboratory.

The samples will be stored for a period of three months and then discarded, unless we are instructed differently.

Groundwater observations were made in the open boreholes, during and upon completion of the drilling operation. The results are recorded on the Log of Borehole sheets.

Laboratory Testing:

Laboratory testing consisted of:

- Determination of the in-situ moisture content of the representative soil samples, and
- Measurement of the compressive strength of retrieved concrete cores.

SITE CONDITIONS

Surface Conditions

The site is located at 1116 King Street West, Buildings 8 & 9, Toronto, Ontario.

The *subject site* (Buildings 8 and 9), where the investigation took place, are separate from the rest of the building at the facility, at the locations shown on Drawing No. 1.

Building 8 consists of single-storey structure, with a partial 2nd floor. Building 9 consists of a single storey structure. Both buildings have no basement.

At the time of our investigation the buildings were occupied.

Subsurface Conditions

GPR Scanning Findings:

The Results of the GPR Scanning by Sonic Soil Ltd., using an Xradar, have indicated the following:

October 06, 2025

- Scanning in the garage of building 8 showed that the thickness of the slab on grade was found to be varying from 5 to 11 inches (about 125 to 275 mm).
- Due to heavy oil saturation of the slab, the scanning signal penetration was limited and targets at the bottom of the slab were unable to be identified.

October 07, 2025

- Scanning in the east and west garage of building 8 & 9 indicated that the slab thickness varied from 90 to 200 mm.
- In the West room, reinforcement was not detected except for the areas of the garage entrance and around columns, where only one layer of wire mesh can be identified.
- Within the East room, the scan detected one layer of wire mesh at a varying depth of 70 to 170 mm with typical 150 mm spacings.

Refer to GPR scanning reports by Sonic enclosed in Appendix B

Borehole Investigation Findings:

The subsurface conditions encountered at the borehole locations are shown on the Log of Borehole sheets, presented in Appendix A and can be summarized as follows:

Table 1 - Observed Subsurface Conditions

Location	Concrete Slab (Thickness)	Void/Gap (thickness)	Granular Base (Thickness)	Fill/Disturbed Soil Type/ Condition	Native Type/ Condition	Ground-water
C/BH-1	(±145 mm)	None observed	Crushed Stones (±75 mm)	Compact, brown, blackish brown, grey, Clayey & Sandy Silt mixed with gravel, fragments of concrete, brick, and charred debris, moist, extending to ±1.07 m below EFFL.	Silt Till extending to ± 2.29 m, Compact to Dense, brown, moist, followed by Sandy Silt Till	Borehole remained open & dry
C/BH-2	(±140 mm)	None observed	Crushed Stones (±75 mm)	Very Loose, brown, blackish brown, grey, Clayey & Sandy Silt mixed with gravel, fragments of concrete, brick, and charred debris, moist, extending to ±0.94 m below EFFL.	Silt Till/Sandy Silt Till Very Loose to Very Dense	Borehole remained open & dry
C/BH-3	(±160 mm)	None observed	Crushed Stones (±65 mm)	Loose, brown, blackish brown, grey, Clayey & Sandy Silt mixed with gravel, fragments of concrete, brick, and charred debris, moist, extending to ±1.70 m below EFFL.	Clayey Silt Till extending to ± 2.29 m, stiff, brown, moist, followed by Sandy Silt Till	Borehole remained open & dry
C/BH-4	(±150 mm)	None observed	Crushed Stones (±180 mm)	Loose, brown, blackish brown, grey, Clayey & Sandy Silt mixed with gravel, fragments of concrete, brick, and charred debris, moist, extending to ±1.68 m below EFFL.	Clayey Silt Till extending to ± 2.29 m, very stiff, brown, moist, followed by Sandy Silt Till	Borehole remained open & dry

Table 1 - Continued

Location	Concrete Slab (Thickness)	Void/Gap (thickness)	Granular Base (Thickness)	Fill Soil Type/ Condition	Native Soil Type/ Condition	Ground-water
C/BH-5	(±170 mm) upper slab (±110 mm) lower slab	Partial Cavity (±280 mm cavity on west side of the Cored Opening/ Borehole	None observed	Very Loose, blackish brown, grey, Clayey & Sandy Silt mixed with gravel, fragments of concrete, brick, and charred debris, very moist, extending to ±0.89 m below EFL, followed by Fill/Disturbed Soil, very loose clayey silt/silty Clay, brown, very moist, extending to ± 1.88 m	Sandy Silt Till extending to End of Borehole dense to very dense, brown & grey, moist	Borehole remained open & dry
C/BH-6	(±155 mm)	None observed	None observed	Loose, blackish brown, grey, Clayey & Sandy Silt mixed with gravel, fragments of concrete, brick, and charred debris, moist, extending to ±1.73 m below EFL.	Clayey Silt Till extending to ± 2.13 m, hard, brown, moist, followed by Sandy Silt Till	Borehole remained open & dry
C/BH-7	(±130 mm)	None observed	None observed	Loose, blackish brown, grey, Clayey & Sandy Silt mixed with gravel, fragments of concrete, brick, and charred debris, moist, extending to ±1.78 m below EFL.	Sandy Silt Till, compact to dense, greyish brown, moist	Borehole remained open & dry
C/BH-8	(±135 mm)	None observed	None observed	Compact to Loose, blackish brown & grey, Clayey & Sandy Silt mixed with gravel, fragments of concrete, brick, and charred debris, moist, extending to ±1.78 m below EFL.	Sandy Silt Till, compact to dense, greyish brown, moist	Borehole remained open & dry

Uniaxial Compressive Strength Results of Tested Concrete Cores' Samples

The uniaxial compressive strength of the retrieved concrete cores at selected locations are presented in the following *Table 2*:

Table 2 – Uniaxial Compressive Strength of Concrete Cores' Samples

Core Location	Compressive Strength (MPa)
C/BH-1	60.4
C/BH-2	54.4
C/BH-3	47.9
C/BH-4	64.4
C/BH-5	31.4
C/BH-6	60.6
C/BH-7	61.6
C/BH-8	34.3

GEOTECHNICAL DISCUSSION AND RECOMMENDATIONS

Borehole Finding Summary

Based on the data obtained at the borehole's locations during this investigation, a mixed fill layer, including assortments of foreign debris, was encountered below the slab and granular fill in all the explored boreholes.

This layer extended to a depth that ranged between 1.73 and 1.88 m below existing finished floor/slab level, at the borehole locations in building 8, and between 0.94 and 1.70 m below finished floor/slab level in building 9.

This mainly blackish brown fill layer was found generally in loose to very loose state of packing, and hence without any proper compaction. Apparently, it had been randomly placed, i.e., not under “controlled conditions” or as “engineered fill”.

Slab-on-Grade Observations and Evidence

Core/Borehole C/BH-5 indicated the presence of two [2] successive concrete slabs on top of each other, with thicknesses of 170 and 110 mm, respectively.

The very loose fill layer is known to undergo long-term settlements under the lightest loading conditions due to changes in external and environmental conditions that eventually resulting in excessive/intolerable uneven settlements and/or apparent/visible slab depressions, and subsequent structural damages and cracking.

The above may explain the need to level things up by casting another slab on top of the locally or massively settled old slab on grade.

Existing Modulus of Vertical Subgrade Reaction (k_s)

Based on the existing subsurface conditions, the Modulus/coefficient of Subgrade Reaction (k_s) value is estimated to be about 13.6 MN/m³ (50 pci).

Remedial Repair Work/Measures

In this section, and based on the above information, we offer/recommend few options to remediate the current problematic condition/situation, such as the following:

Option 1:

This option consists of the application of pressurized grout injection program to remediate the problematic and noticeable voids/gaps under the floor slab. The gaps/voids will have to be filled up, and the very loose fill subgrade itself supporting the slab-on-grade, will have to be densified with pressurized grout injection or polymer material pressured injection to eliminate further settlements.

During the grouting operation, the existing voids, and other invisible cavities/voids, everywhere existed/encountered will have to be filled up by pressurised grout material.

This option should be further discussed with a qualified contractor and/or supplier, who are expected to have the required experience and expertise.

Option 2:

This option consists of the use of rammed aggregates Geopiers, which in addition to providing supporting points for the floor slab, the installation of these Geopiers provide true densifications to any loose fill/soil around those Geopiers.

This option should be further discussed with a qualified contractor and/or supplier, who are expected to have the required experience and expertise.

Option 3:

The existing unsuitable surficial fill/disturbed soil layer, below the floor slab, shall be removed completely until reaching the native subgrade level.

The exposed native subgrade must be proof rolled. Any soft spots revealed during proof-rolling should be sub-excavated, backfilled and adequately compacted.

The fill re-placement shall be conducted in a manner comparable to placement of 'engineered fill', by placing individual layers with a reasonably shallow lifts (not more than 200 mm thick) and applying proper through compaction until reaching a field density that is equivalent to at least 95% of Standard Proctor Maximum Dry Density (SPMDD).

The compacted fill should be advanced until a depth/level where the granular slab base can be placed at the surface as a top final granular fill layer.

Slab Replacement Works Subsequent to Subgrade Remedial Works

The concrete slab replacement works, following the surficial fill/disturbed soil layer remedial works, as described in the previous section, shall be carried out as follows:

1. Construct the granular base and the concrete slab-on-grade as per the Structural Engineer design and recommendations.
2. The granular base layer (Granular A or 19 mm Crusher Run Limestone) shall be adequately compacted to at least 98 percent SPMDD.

Coefficient of Vertical Subgrade Reaction (after Ground improvement)

Considering that the existing subgrade fill will be replaced, stabilized/improved, densified/compacted, proof-rolled, and prepared as per the above recommendations, a Coefficient of Subgrade Reaction ranging (depending on final quality/product) from 34 MN/m³ (125 *pci*) to 40 MN/m³ (150 *pci*) could be used for the structural design of the concrete 'Slab-On-Grade'.

GENERAL COMMENTS

This geotechnical report is provided on the basis of the terms of reference provided above and on the assumption that the design will be in accordance with the applicable codes and standards.

If there is any change in the design features relevant to the geotechnical analyses, or if any questions arise regarding the geotechnical aspects of the codes and standards, this office should be contacted to review the design.

The comments given in this report are intended only for the guidance of design engineers. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results.

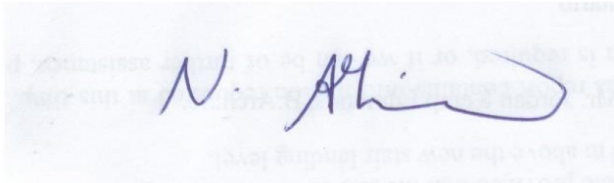
This concern specifically applies to the classification of the fill/organic/topsoil cover and the potential reuse of these soils on/off site.

The prospective contractors must draw their own conclusions as to how the near surface and subsurface conditions may affect them.

We trust this report contains information requested at this time. However, if any clarification is required, or if we can be of further assistance, please contact this office.

Yours truly,

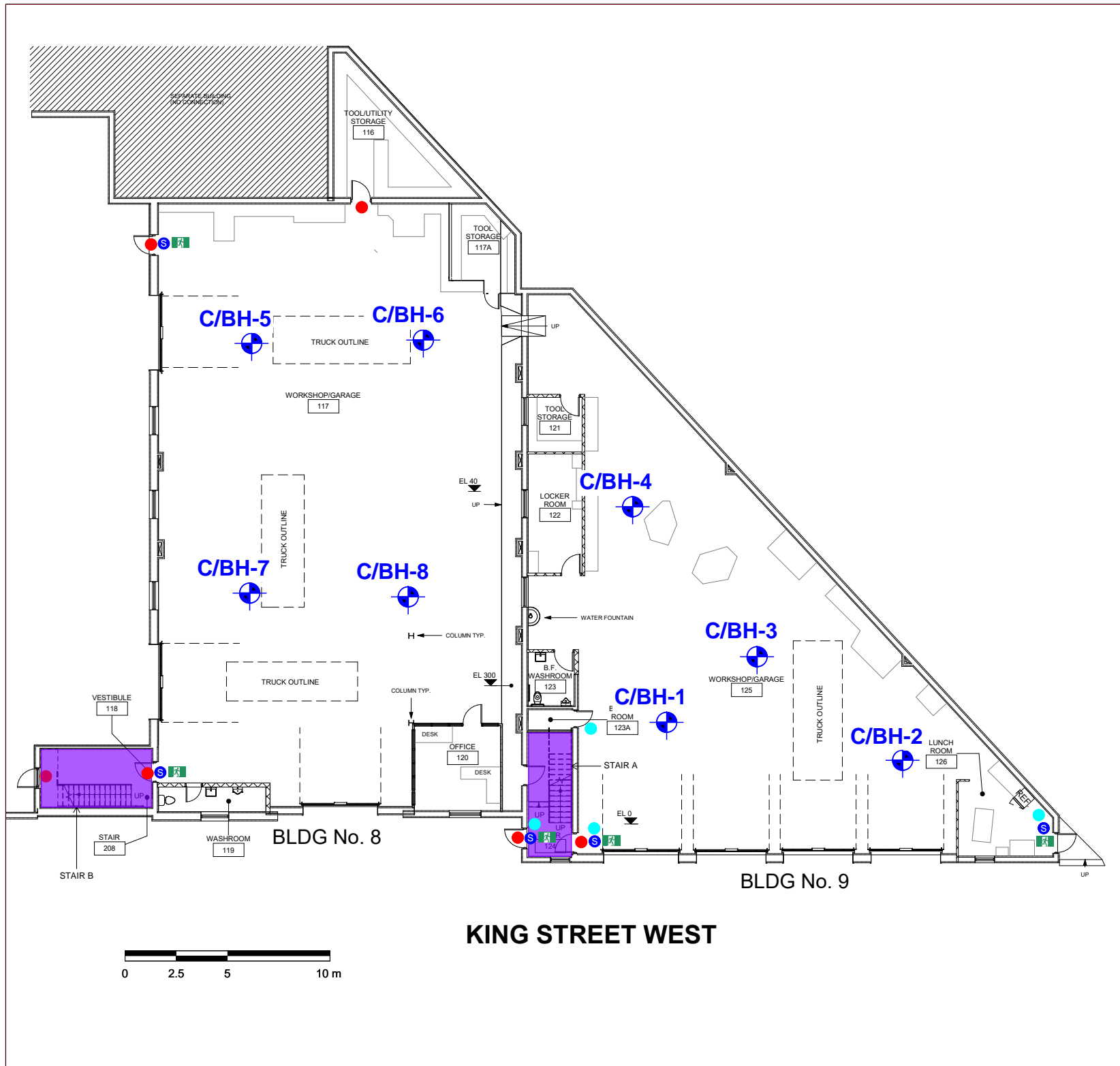
Forward Engineering & Associates Inc.



Nasser Abdelghani, M.Sc., P.Eng.
Project Geotechnical Engineer



G. S. Semaan, M.Eng., P.Eng.
Principal



NOTES:

C/BH = CORE/BOREHOLE LOCATION

DRAWING No. 1
CORE/BOREHOLE LOCATION PLAN

04	
03	
02	
01	
Rev.	DATE REVISION / ISSUE

Project Name: SUBSURFACE INVESTIGATION

Address: 1116 KING STREET WEST
TORONTO, ON.

PROJECT No.	:7591
DRAWING DATE	:OCT. 15, 2025
DRAWN BY:	P.R. PAGE 1 of 1
CHECKED BY:	G.S.

FORWARD ENGINEERING & Associates Inc.

Forward Engineering & Associates Inc.
244 Brockport Drive, Unit 15
Toronto, Ontario M9W 6X9
Tel: 416-798-3500 Fax: 416-798-8481

www.forwardengineering.ca

APPENDIX A

BOREHOLE LOG SHEETS

(1 – 8)

Project No: 7591

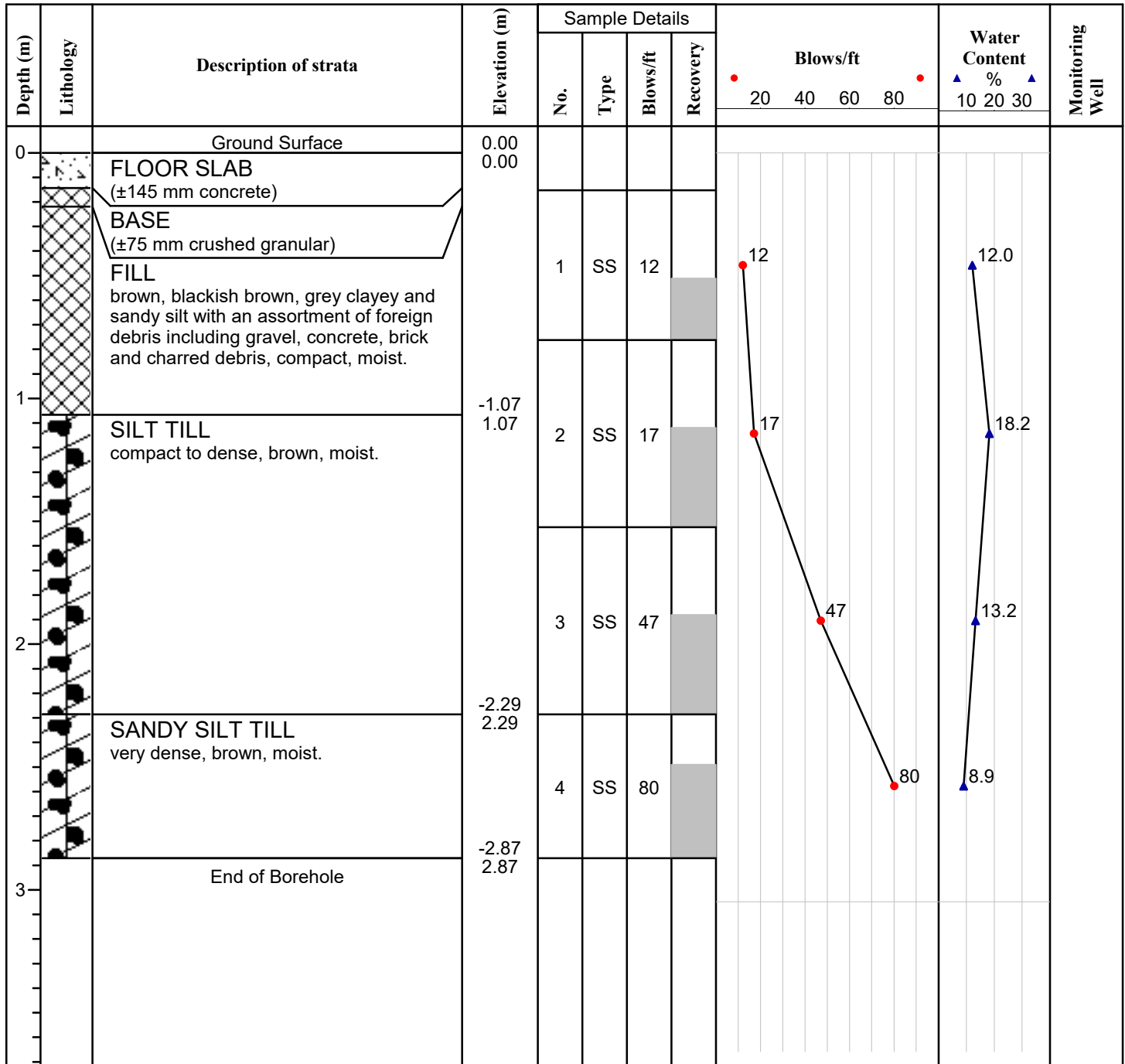
Log of Borehole C/BH-1

Project: SUB-SURFACE INVESTIGATION

Client: ARCADIS

Enclosure: 2

Location: 1116 KING STREET WEST, BUILDINGS 8 & 9, TORONTO, ON.

**Remarks:** -Upon completion of drilling, the borehole was open and dry.

Drill Method: RAM SOUNDER

Drill Date: 7 OCT. 2025

Datum: LOCAL

Engineer: P.R.

Checked by: G.S.

Sheet No. 1 of 1

Project No: 7591

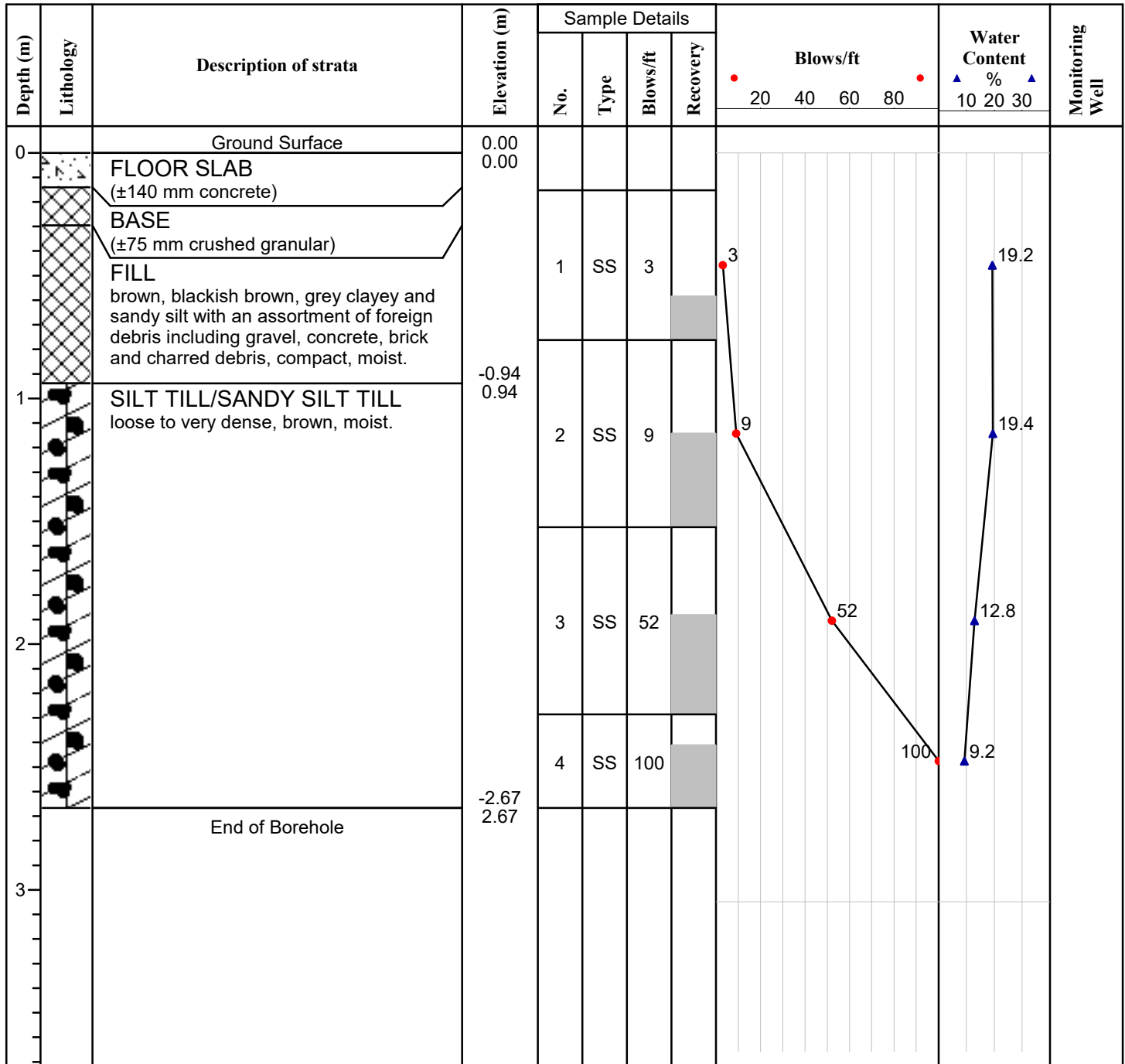
Log of Borehole C/BH-2

Project: SUB-SURFACE INVESTIGATION

Client: ARCADIS

Enclosure: 3

Location: 1116 KING STREET WEST, BUILDINGS 8 & 9, TORONTO, ON.

**Remarks:** -Upon completion of drilling, the borehole was open and dry.

Drill Method: RAM SOUNDER

Drill Date: 7 OCT. 2025

Datum: LOCAL

Engineer: P.R.

Checked by: G.S.

Sheet No. 1 of 1

Project No: 7591

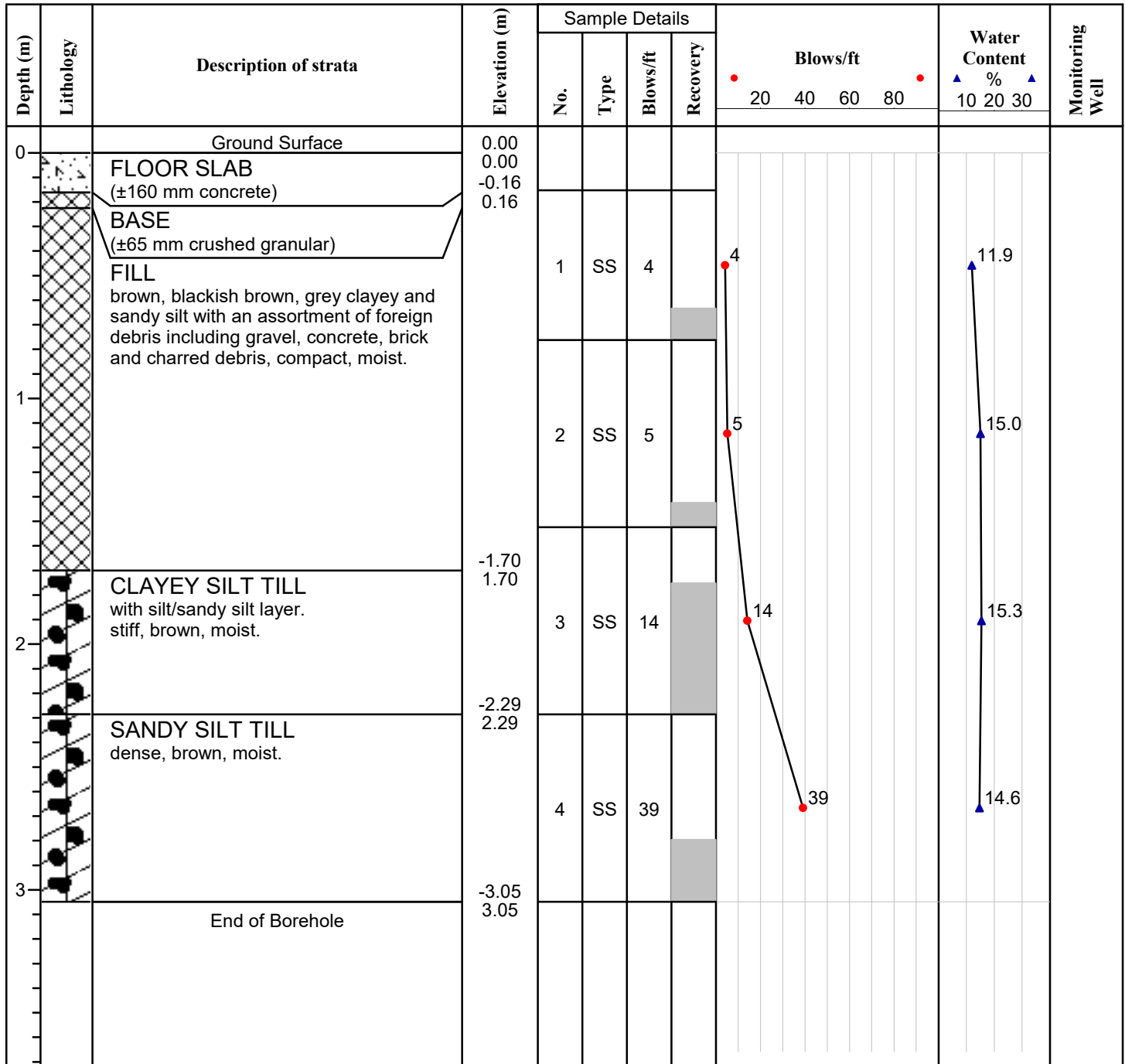
Log of Borehole C/BH-3

Project: SUB-SURFACE INVESTIGATION

Client: ARCADIS

Enclosure: 4

Location: 1116 KING STREET WEST, BUILDINGS 8 & 9, TORONTO, ON.

**Remarks:** -Upon completion of drilling, the borehole was open and dry.

Drill Method: RAM SOUNDER

Drill Date: 7 OCT. 2025

Datum: LOCAL

Engineer: P.R.

Checked by: G.S.

Sheet No. 1 of 1

Project No: 7591

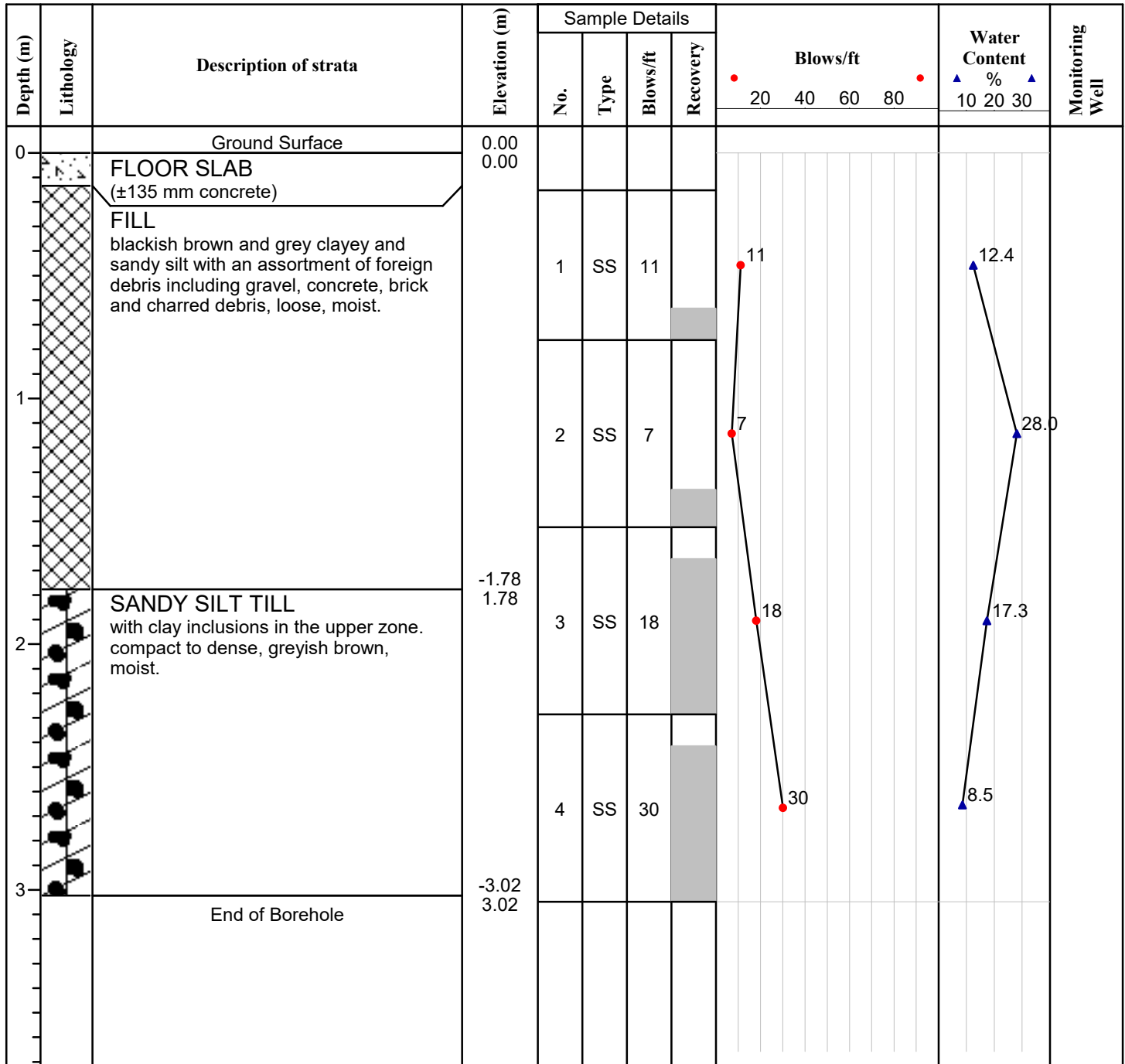
Log of Borehole C/BH-8

Project: SUB-SURFACE INVESTIGATION

Client: ARCADIS

Enclosure: 9

Location: 1116 KING STREET WEST, BUILDINGS 8 & 9, TORONTO, ON.

**Remarks:** -Upon completion of drilling, the borehole was open and dry.

Drill Method: RAM SOUNDER

Drill Date: 6 OCT. 2025

Datum: LOCAL

Engineer: P.R.

Checked by: G.S.

Sheet No. 1 of 1

Project No: 7591

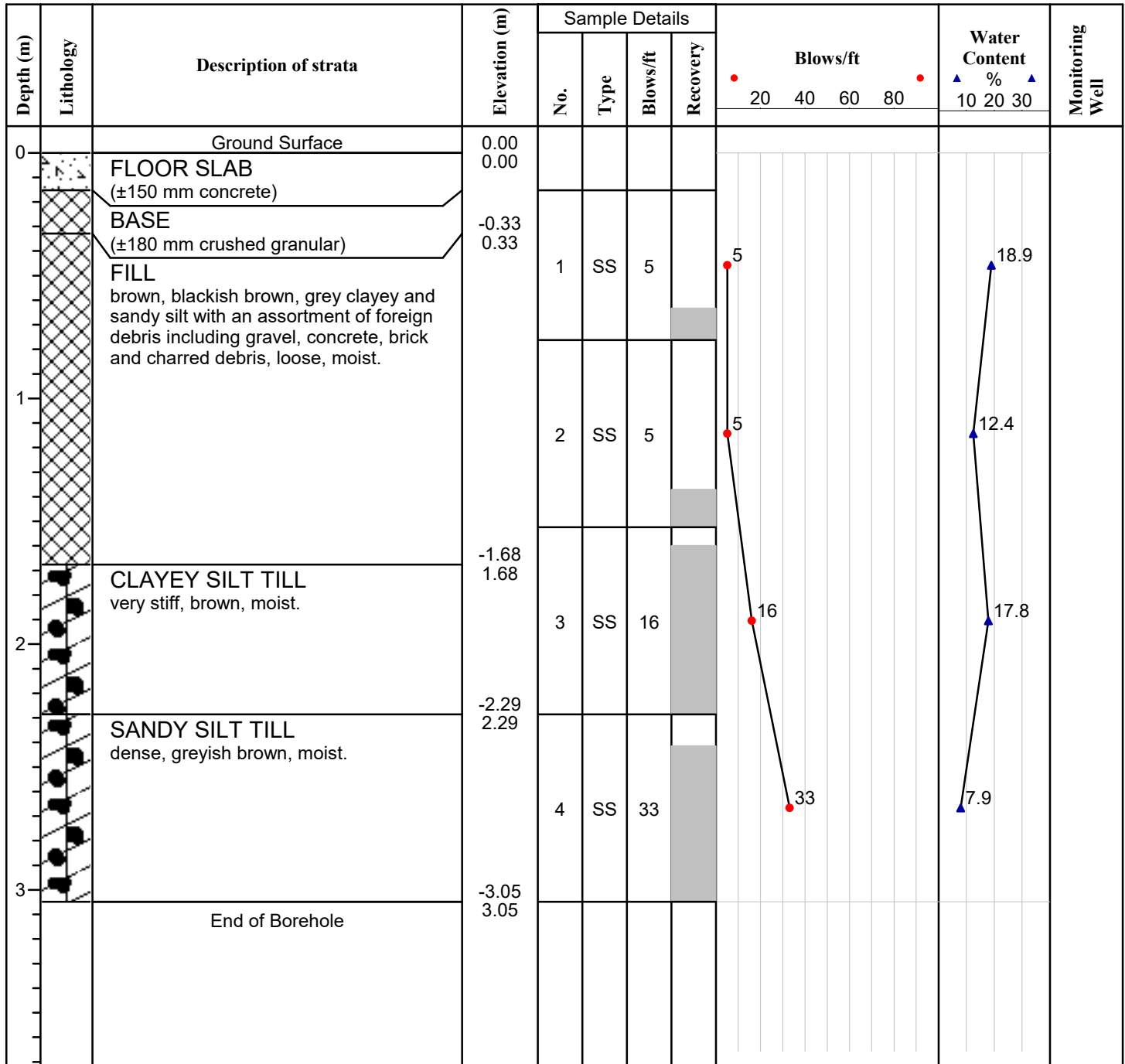
Log of Borehole C/BH-4

Project: SUB-SURFACE INVESTIGATION

Client: ARCADIS

Enclosure: 5

Location: 1116 KING STREET WEST, BUILDINGS 8 & 9, TORONTO, ON.

**Remarks:** -Upon completion of drilling, the borehole was open and dry.

Drill Method: RAM SOUNDER

Drill Date: 6 OCT. 2025

Datum: LOCAL

Engineer: P.R.

Checked by: G.S.

Sheet No. 1 of 1

Project No: 7591

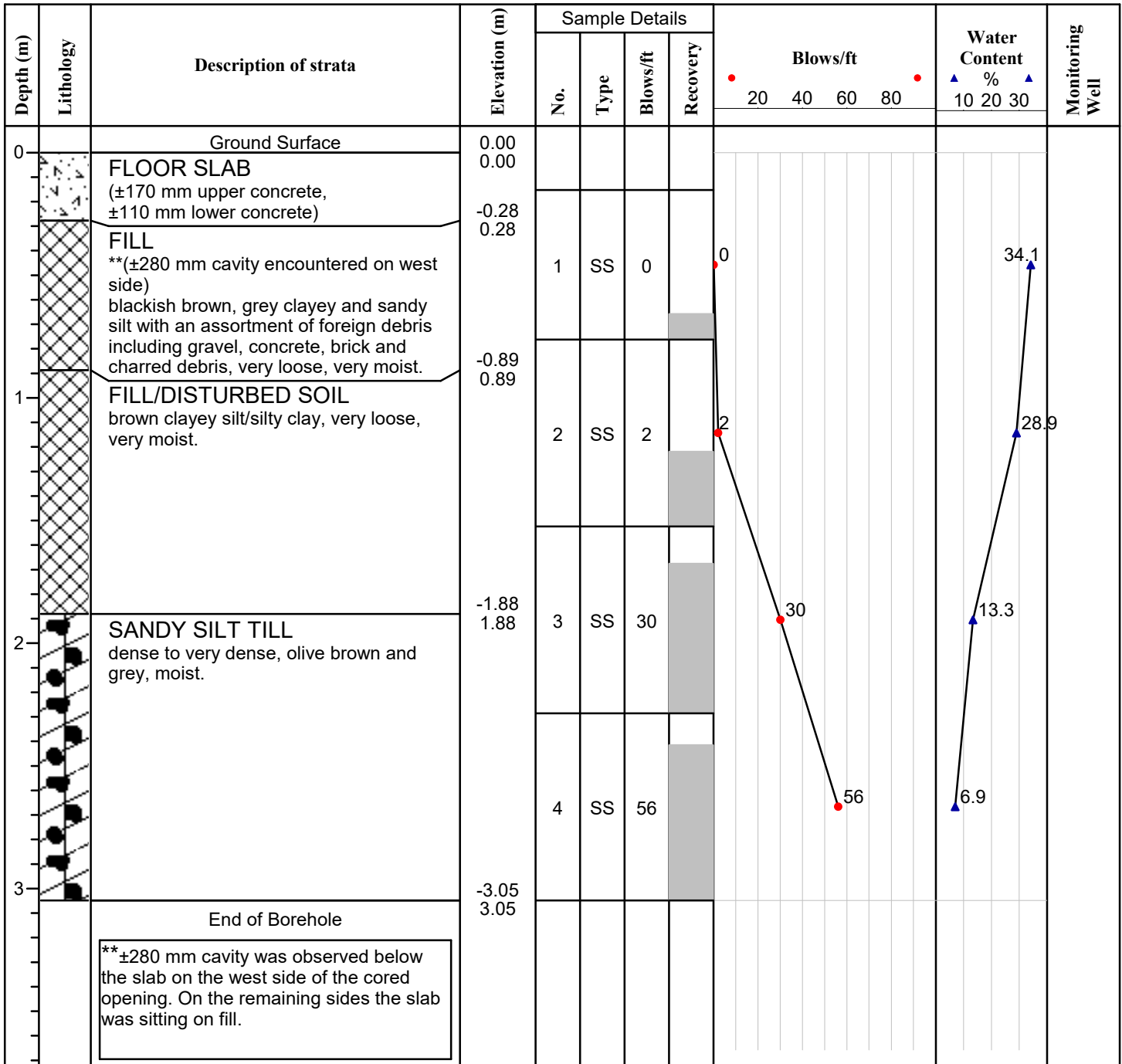
Log of Borehole C/BH-5

Project: SUB-SURFACE INVESTIGATION

Client: ARCADIS

Enclosure: 6

Location: 1116 KING STREET WEST, BUILDINGS 8 & 9, TORONTO, ON.



Remarks: -Two slabs were encountered at the surface.
-Upon completion of drilling, the borehole was open and dry.

Drill Method: RAM SOUNDER

Drill Date: 6 OCT. 2025

Datum: LOCAL

Engineer: P.R.

Checked by: G.S.

Sheet No. 1 of 1

Project No: 7591

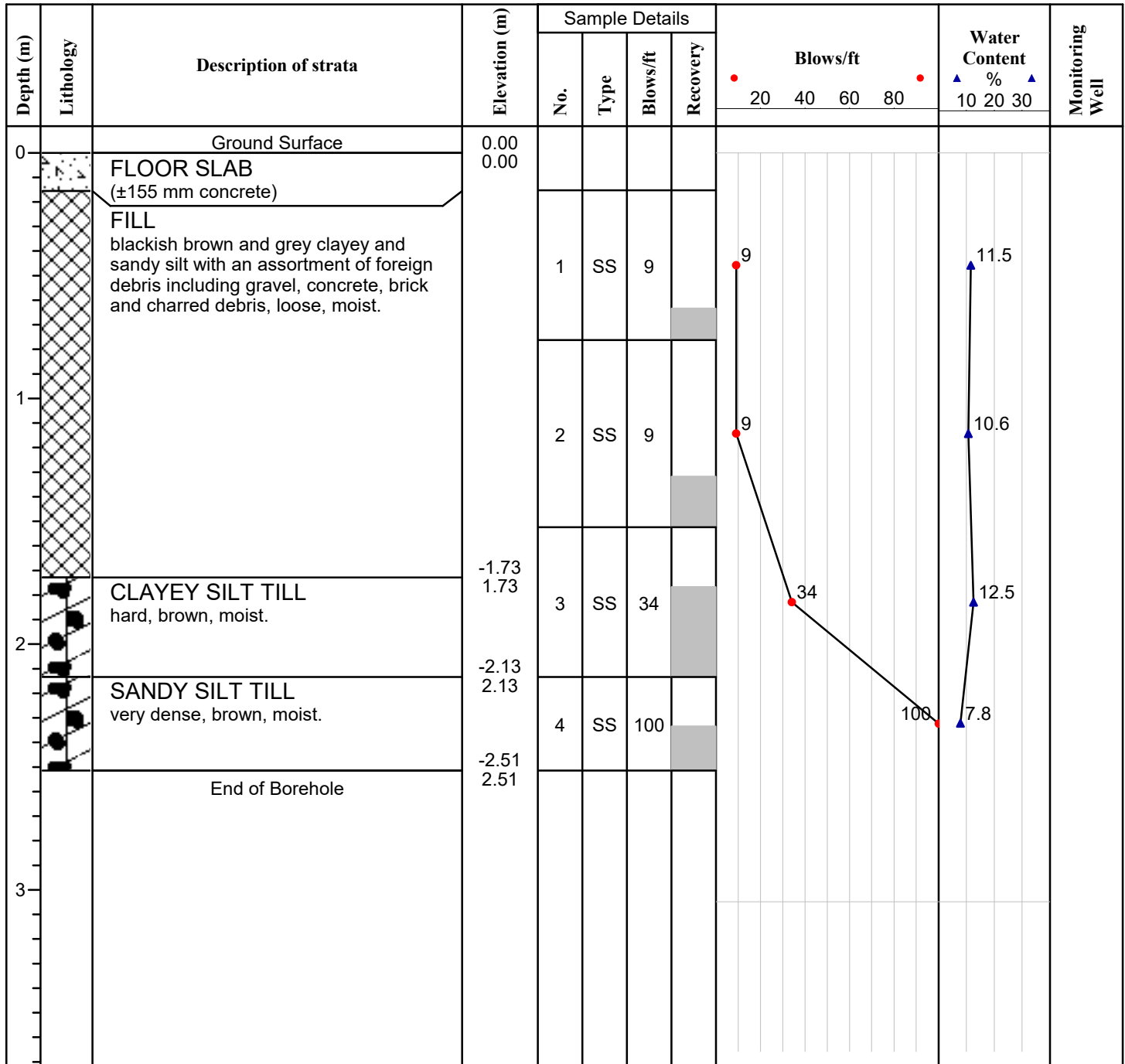
Log of Borehole C/BH-6

Project: SUB-SURFACE INVESTIGATION

Client: ARCADIS

Enclosure: 7

Location: 1116 KING STREET WEST, BUILDINGS 8 & 9, TORONTO, ON.

**Remarks:** -Upon completion of drilling, the borehole was open and dry.

Drill Method: RAM SOUNDER

Drill Date: 6 OCT. 2025

Datum: LOCAL

Engineer: P.R.

Checked by: G.S.

Sheet No. 1 of 1

Project No: 7591

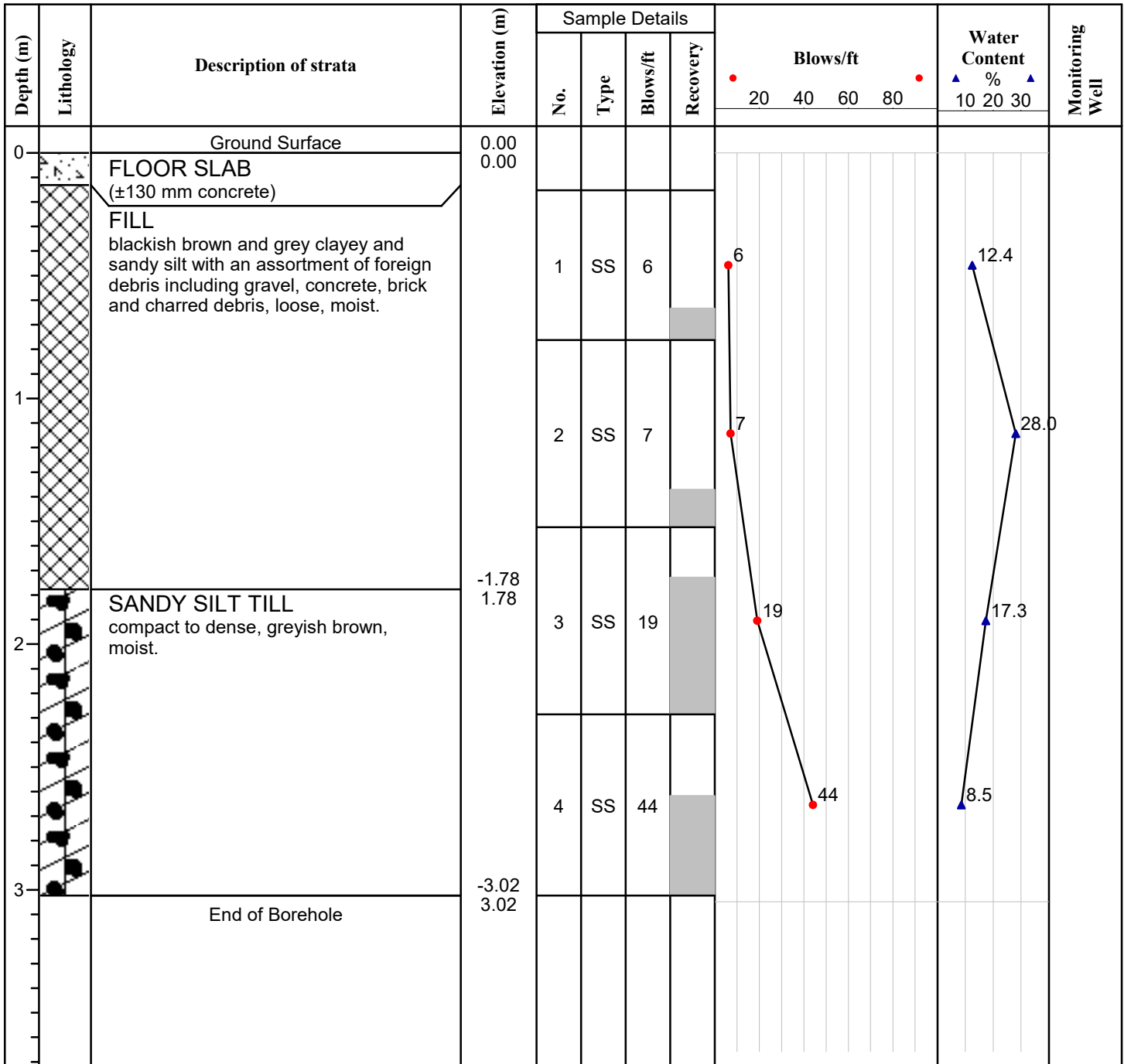
Log of Borehole C/BH-7

Project: SUB-SURFACE INVESTIGATION

Client: ARCADIS

Enclosure: 8

Location: 1116 KING STREET WEST, BUILDINGS 8 & 9, TORONTO, ON.

**Remarks:** -Upon completion of drilling, the borehole was open and dry.

Drill Method: RAM SOUNDER

Drill Date: 6 OCT. 2025

Datum: LOCAL

Engineer: P.R.

Checked by: G.S.

Sheet No. 1 of 1

APPENDIX B

GPR RESULTS



Toronto

3045 Southcreek Drive, Unit 34, Mississauga, Ontario L4X 2E9
(416) 476-8325

www.xradar.ca



Xradar Summary Report

Xradar Reference: XCA-TOR-20288-1

Site Address: 1116 King St W M6K 1E6,
Toronto












Inspection Date: 2025-10-06

Client: SL Sonic Soil Limited

Job Summary	
	Details
Xradar Services Provided:	Concrete Scanning
Job Summary:	<p>XRADAR began scanning the garage of building 8</p> <p>The slab was found to slab on grade with a varying thickness of 5-11"</p> <p>Due to heavy saturation likely due to years of oil seeping through the concrete, signal penetration towards the bottom of the slab was limited and targets that are directly below or at the bottom of the slab are unable to be identified.</p> <p>No labels or borders have been placed as the scan area is considered incomplete.</p>
Client Representative:	AndrewRober
Client Representative Present on Site:	Yes
Client Representative was consulted before starting work:	Yes
Client Representative was consulted after finishing work:	Yes
Quoted Job:	No
Job complete:	No
Notes:	Xradar will return to continue scanning
Xradar Structural Report Recommended:	No

Xradar Concrete Scanning Details

	Details
Xradar Lead Technician:	Nickolas Fernandes
Time on Site Scanning:	13:30 - 15:45
Lunch break:	N/A
Additional Xradar personnel:	
Name:	Katrina Montes
Role:	Technician
Time on Site Scanning:	14:30 – 16:00
Lunch break:	N/A

Concrete Scanning Data	
	Details
Number of concrete slab types:	1
Legend	
	Top Rebar
	Bottom Rebar
	Conduit
	PT Cable
	Scan Boundary – Full extent of slab
	Scan Boundary – Limited extent of slab
	Targets on underside of slab
	Slab Band/Wall/Q-Deck Valleys/Hollow Cores
	Rebar Ends
	Nelson Studs
	Ducts/Vents

Slab Type - Building 8	
Type of concrete slab:	Slab On Grade
Number of locations:	1

Slab Specific Details

Slab Specific and Technology Limitations
<ul style="list-style-type: none">▪ Unable to scan within 3 inches (70mm) of an obstruction. The presence and location of targets in the slab/wall within 3 inches (70mm) of an object or obstruction on the surface cannot be confirmed.
<ul style="list-style-type: none">▪ Xradar does not guarantee identification of 1 inch diameter and smaller metallic conduits in structures with steel reinforcement of similar size.
<ul style="list-style-type: none">▪ The stated depths are accurate to approximately 15% of their true depth. The accuracy is dependent on several factors including the homogeneity of the concrete mixture.
<ul style="list-style-type: none">▪ Xradar has marked the center of embedded targets, it is recommended to allow 2 inches (50mm) of clearance when cutting, coring or drilling.
<ul style="list-style-type: none">▪ Yellow and black scan boundaries indicate completed scans. If no yellow or black scan boundary is present, scanning of the locations have not been fully completed. Please note - Black boundaries, whilst complete, indicate depth limited scans. Not all embedded have been marked.

Survey Locations:

Location: 1

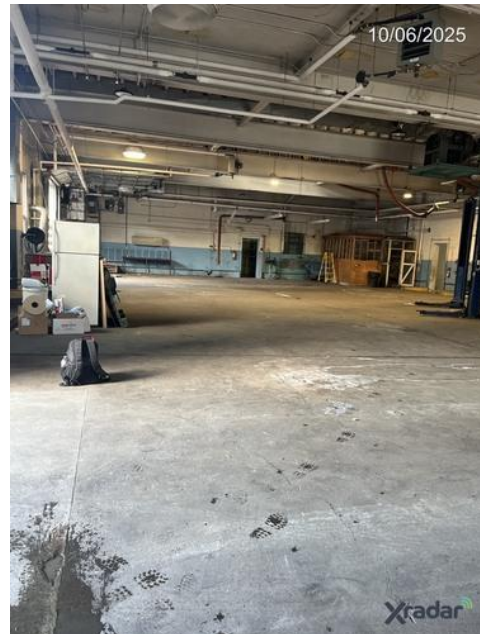
Scan Boundary Notes: Area is considered incomplete

Slab Thickness: 5-11"

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power sweep N/A.

-



Location: 1

Scan Boundary Notes: Area is considered incomplete

Slab Thickness: 5-11"

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power sweep N/A.

-



General Limitations

- Xradar is not responsible for the decision to cut structural components. Xradar will not cut structural components without written confirmation from the structural engineer or the site superintendent.
- Where markings on the slab have faded, are no longer visible, or tape has been removed a new Xradar concrete scan of the location is required
- Due to the physical characteristics of the slab and the below grade material, Xradar is only able to guarantee that objects embedded within the concrete have been identified on site. Any below grade excavation is recommended to be completed by hand.

Disclaimer

Where:

1. The Presence and/or location and/or depth of targets in the slab/wall cannot be confirmed due to any of the limitations set out above;
2. The recommendations set out above are not followed;
3. The markings on the slab indicating the locations of targets are no longer present; and/or
4. The scan has not been completed,

Xradar shall not be liable for any loss or damage caused in respect of any such targets hit when drilling, coring or cutting the slab/wall.

Xradar Now Guarantee Scan Accuracy

At Xradar™, we're so confident in our technicians ability to scan with accuracy, that we guarantee you will not hit an unforeseen target when following our guidance.

We will guarantee that the results of our scan will not lead to damaging an unforeseen target – or we will pay for the repair, up to the value of \$10,000*

**For more information and for our guarantee terms, please visit www.xradar.ca/blog/xradar-guarantee-scan-accuracy, or speak to our team.*

Thank you for your business!

This is a standard Xradar™ summary report.

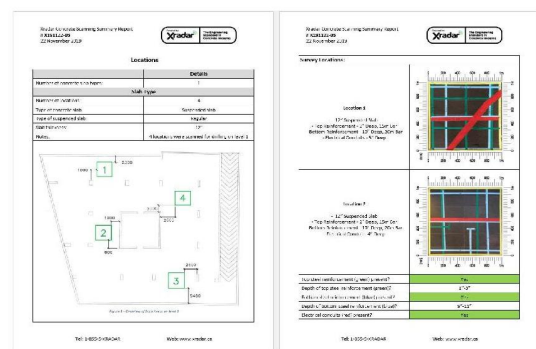
Additional reporting options are available for Xradar™
Concrete Scanning & Structural Surveys.



Our Additional Report Services:

Xradar™ Core Approval Report

- Presented in the same format as the Summary Report
- Ideal for engineering review of each scan location
- Scaled images of each scan location provided
- Overview map displaying the location of each scan (Drawing to be provided)
- Typically 24 hour turnaround for these reports



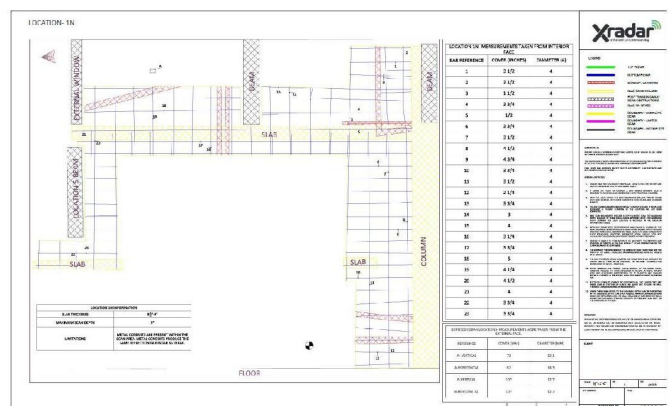
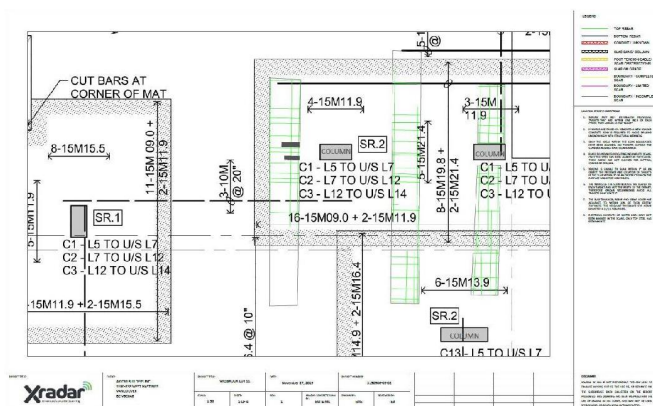
Xradar™ Concrete Scanning CAD Report

- Most comprehensive report
- Delivered in CAD .dwg format
- Also available as a 3D point cloud model



Xradar™ Structural Investigation

- Map slab thicknesses, reinforcement cover & size, spacing presence and location of beams, slab thickenings and more...
- Create as-builts for the concrete slab for structural analysis, load bearing calculations and design considerations.
- Deliverables include AutoCAD drawing & 3D point cloud model



Xradar™ help clients all over Canada
mitigate risk and plan projects effectively.

Get in touch for more information on the
other services we offer.



Other Xradar™ Services:

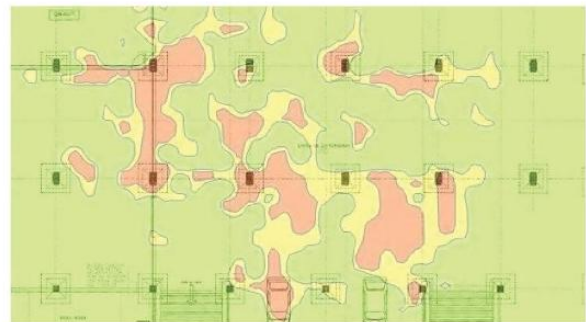


Void, Crack & Defect Detection

- Map and detect voids, honeycombs, cracks and defects within the concrete
- Highlight exact location and size
- Multiple report formats including AutoCAD drawing and 3D models
- State of the art non-destructive testing equipment including Ultrasound Pulse Echo and Xradar.

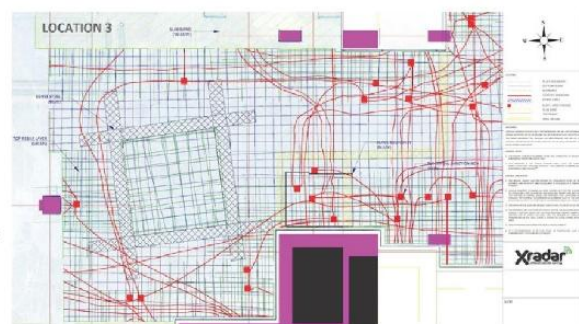
Pre-Design Concrete Scanning

- Smart space planning for designers and engineers
- Ideal for Design & Build Contractor
- Cost savings of approximately \$3.50 for every \$1.00 spent on Pre-Design Scanning
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Concrete Corrosion Mapping

- Identify & map the corrosion of concrete at the reinforcement level
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Toronto

3045 Southcreek Drive, Unit 34, Mississauga, Ontario L4X 2E9
(416) 476-8325

www.xradar.ca



Xradar Summary Report

Xradar Reference: XCA-TOR-20288-2

Site Address: 1116 King St W,
Toronto

Inspection Date: 2025-10-07

Client: SL Sonic Soil Limited












Job Summary

	Details
Xradar Services Provided:	Concrete Scanning
Job Summary:	<p>Xradar was on site to scan the east and west garage of building 8&9 for the purpose of detecting structural reinforcement.</p> <p>Within the WEST and EAST room, a radar sweep of the main room was performed to confirm the presence of reinforcement; a markup was only performed within scan boundaries.</p> <p>The WEST room was divided into sections A-F; reinforcement was not detected within this room except for cutout areas at the garage entrance and around columns which contained one layer of wire mesh (not marked on-site). Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary.</p> <p>The slab on grade within the WEST room consisted of ~90mm-200mm thickness with no reinforcement. Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond this stated slab depths.</p> <p>Within the EAST room, sample scan areas around core sample locations were performed, highlighted with a YELLOW boundary indicating a COMPLETE scan. Note that outside these scan boundaries, it was found that the construction details (wire mesh and slab thickness) were consistent (with an exception to existing slab thickenings and dowels surrounding embedded utilities; these areas were not scanned).</p> <p>The slab on grade thickness within the EAST room consisted of ~90mm-200mm thickness with one layer of wire mesh (blue) at a varying depth of ~70mm-170mm, typical 150mm average spacing.</p> <p>Note that reinforcement and embedded utilities were not marked outside the scan boundaries.</p>
Client Representative:	Andrew Rober; Paulo
Client Representative Present on Site:	Yes
Client Representative was consulted before starting work:	Yes

Client Representative was consulted after finishing work:	Yes
Quoted Job:	Yes
Quote number:	IL/JY
Job complete:	Yes
Xradar Structural Report Recommended:	No

Xradar Concrete Scanning Details

	Details
Xradar Lead Technician:	Kevin Galleta
Time on Site Scanning:	07:00 - 14:15
Lunch break:	15 Min
Notes:	Includes report time
Additional Xradar personnel:	
Name:	Katrina Montes
Role:	Technician
Time on Site Scanning:	07:00 – 13:15
Lunch break:	15 Min

Concrete Scanning Data	
	Details
Number of concrete slab types:	2
Legend	
	Top Rebar
	Bottom Rebar
	Conduit
	PT Cable
	Scan Boundary – Full extent of slab
	Scan Boundary – Limited extent of slab
	Targets on underside of slab
	Slab Band/Wall/Q-Deck Valleys/Hollow Cores
	Rebar Ends
	Nelson Studs
	Ducts/Vents

Slab Type - West room	
Type of concrete slab:	Slab On Grade
Number of locations:	6

Slab Specific Details

Slab Specific and Technology Limitations
<ul style="list-style-type: none">▪ Unable to scan within 3 inches (70mm) of an obstruction. The presence and location of targets in the slab/wall within 3 inches (70mm) of an object or obstruction on the surface cannot be confirmed.
<ul style="list-style-type: none">▪ Xradar does not guarantee identification of 1 inch diameter and smaller metallic conduits in structures with steel reinforcement of similar size.
<ul style="list-style-type: none">▪ The stated depths are accurate to approximately 15% of their true depth. The accuracy is dependent on several factors including the homogeneity of the concrete mixture.
<ul style="list-style-type: none">▪ Xradar has marked the center of embedded targets, it is recommended to allow 2 inches (50mm) of clearance when cutting, coring or drilling.
<ul style="list-style-type: none">▪ Yellow and black scan boundaries indicate completed scans. If no yellow or black scan boundary is present, scanning of the locations have not been fully completed. Please note - Black boundaries, whilst complete, indicate depth limited scans. Not all embedded have been marked.

Survey Locations:

Location: Section A

Location Notes:

Contains core#5

A second concrete slab was detected below the main slab; the slab change was marked with a marked yellow dashed line.

Scan Boundary Notes:

A radar sweep of the main room was performed to confirm the presence of reinforcement, A markup was only performed within scan boundaries.

Reinforcement was not detected within this room except for cutout areas at the garage entrance and around columns which contained one layer of wire mesh (not marked on-site).

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary.

Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

Slab Thickness: 90mm-200mm

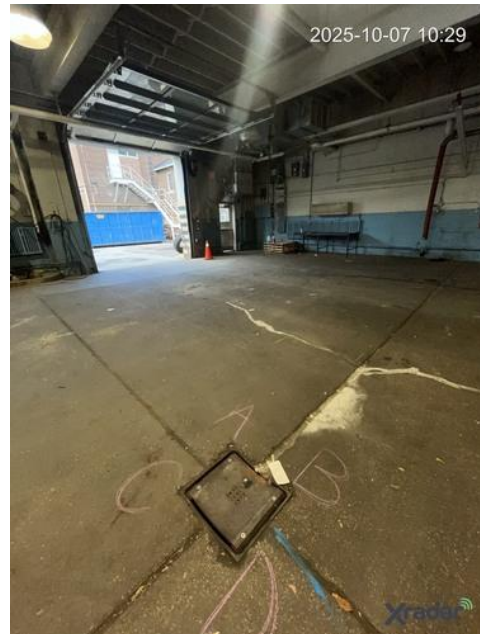
- 270mm-280mm within dashed yellow line

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as “live” unless they are under load at the time of survey.



Location: Section B

Location Notes:
Contains core#6

Scan Boundary Notes:
A radar sweep of the main room was performed to confirm the presence of reinforcement, A markup was only performed within scan boundaries.

Reinforcement was not detected within this room except for cutout areas at the garage entrance and around columns which contained one layer of wire mesh (not marked on-site).

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary.

Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

Slab Thickness: 90mm-200mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Section C

Scan Boundary Notes:

A radar sweep of the main room was performed to confirm the presence of reinforcement, A markup was only performed within scan boundaries.

Reinforcement was not detected within this room except for cutout areas at the garage entrance and around columns which contained one layer of wire mesh (not marked on-site).

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary.

Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

Slab Thickness: 110mm-160mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Section C

Scan Boundary Notes:

A radar sweep of the main room was performed to confirm the presence of reinforcement, A markup was only performed within scan boundaries.

Reinforcement was not detected within this room except for cutout areas at the garage entrance and around columns which contained one layer of wire mesh (not marked on-site).

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary.

Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

Slab Thickness: 110mm-160mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: section D

Location Notes:
Contains core#8

Scan Boundary Notes:
A radar sweep of the main room was performed to confirm the presence of reinforcement, A markup was only performed within scan boundaries.

Reinforcement was not detected within this room except for cutout areas at the garage entrance and around columns which contained one layer of wire mesh (not marked on-site).

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary.

Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

Slab Thickness: 100mm-190mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Section D

Location Notes:
Contains core#8

Scan Boundary Notes:
A radar sweep of the main room was performed to confirm the presence of reinforcement, A markup was only performed within scan boundaries.

Reinforcement was not detected within this room except for cutout areas at the garage entrance and around columns which contained one layer of wire mesh (not marked on-site).

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary.

Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

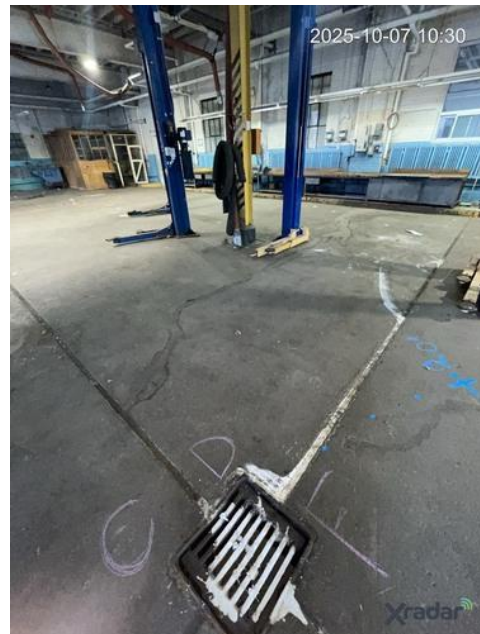
Slab Thickness: 100mm-190mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Section E

Location Notes:
Contains core#7

Scan Boundary Notes:
A radar sweep of the main room was performed to confirm the presence of reinforcement, A markup was only performed within scan boundaries.

Reinforcement was not detected within this room except for cutout areas at the garage entrance and around columns which contained one layer of wire mesh (not marked on-site).

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary.

Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

Slab Thickness: 100mm-150mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Section F

Scan Boundary Notes:

A radar sweep of the main room was performed to confirm the presence of reinforcement, A markup was only performed within scan boundaries.

Reinforcement was not detected within this room except for cutout areas at the garage entrance and around columns which contained one layer of wire mesh (not marked on-site).

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary.

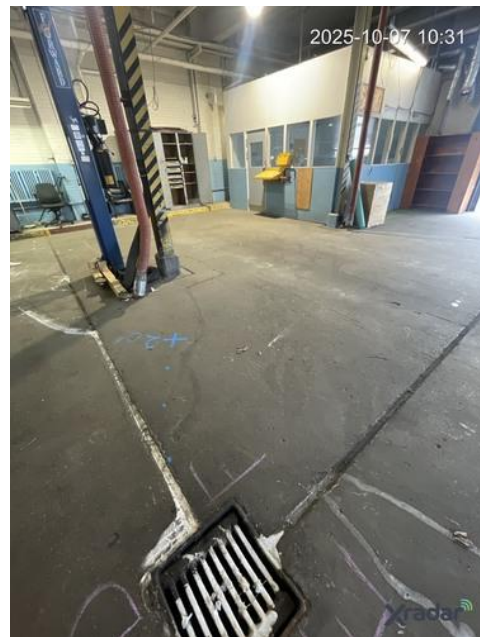
Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

Slab Thickness: 100mm-150mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Core#5**Location Notes:**

A second concrete slab was detected below the main slab; the slab change was marked with a marked yellow dashed line.

Scan Boundary Notes:

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary. No reinforcement detected.

Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

Slab Thickness: 90mm-200mm

- Second slab 270mm-280mm (depth)

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Core#6

Scan Boundary Notes:

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary.

No reinforcement detected.

Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

Slab Thickness: 90mm-200mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Core#7

Scan Boundary Notes:

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary. No reinforcement detected.

Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

Slab Thickness: 100mm-150mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Core#8**Scan Boundary Notes:**

Sample scan areas around core sample locations were performed for reinforcement mark-up, highlighted with a PINK boundary. No reinforcement detected.

Note that poor signal penetration was present at the bottom of the slab, suspected from significant voids and saturation. As a result, only objects above the stated slab thickness have been identified. Caution is recommended for any drilling beyond the stated slab depths.

Slab Thickness: 100mm-190mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Slab Type - East room	
Type of concrete slab:	Slab On Grade
Number of locations:	4

Slab Specific Details

Slab Specific and Technology Limitations
<ul style="list-style-type: none">▪ Unable to scan within 3 inches (70mm) of an obstruction. The presence and location of targets in the slab/wall within 3 inches (70mm) of an object or obstruction on the surface cannot be confirmed.
<ul style="list-style-type: none">▪ Xradar does not guarantee identification of 1 inch diameter and smaller metallic conduits in structures with steel reinforcement of similar size.
<ul style="list-style-type: none">▪ The stated depths are accurate to approximately 15% of their true depth. The accuracy is dependent on several factors including the homogeneity of the concrete mixture.
<ul style="list-style-type: none">▪ Xradar has marked the center of embedded targets, it is recommended to allow 2 inches (50mm) of clearance when cutting, coring or drilling.
<ul style="list-style-type: none">▪ Yellow and black scan boundaries indicate completed scans. If no yellow or black scan boundary is present, scanning of the locations have not been fully completed. Please note - Black boundaries, whilst complete, indicate depth limited scans. Not all embedded have been marked.

Survey Locations:

Location: Core#1**Location Notes:**

The SE section was highlighted with a black boundary indicating a LIMITED scan. A slab thickening was present for the nearby utility and a maximum scan depth of 190mm was achieved (reinforcement was detected at 85mm, green).

Wire mesh (blue):

- depth: 80mm-150mm
- average spacing: 150mm

This is a Complete Scan highlighted by the Yellow scan boundary.

Slab Thickness: 160mm-200mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Core#2

Location Notes:

Wire mesh (blue):

- depth: 70mm-150mm
- average spacing: 150mm

Embedded utility (red) detected at ~350mm, dives toward NW

Slab cutout (lighter surface) scanned to 200mm depth

This is a Complete Scan highlighted by the Yellow scan boundary.

Slab Thickness: 90mm-160mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Top Steel Reinforcement (Green)

- Depth: 30mm-60mm (dowels)
- Spacing: 350mm-450mm

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Core#3

Location Notes:

Yellow hatches indicate slab thickenings (not scanned)

Wire mesh (blue):

- depth: 110mm-150mm
- average spacing: 150mm

This is a Complete Scan highlighted by the Yellow scan boundary.

Slab Thickness: 150mm-170mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Core#4

Location Notes:

Wire mesh (blue):

- depth: 90mm-170mm
- average spacing: 150mm

The control joint was highlighted with a BLACK boundary indicating a LIMITED scan. Poor signal penetration was present around the joint. A max scan depth of ~100mm was achieved.

This is a Complete Scan highlighted by the Yellow scan boundary.

Slab Thickness: 140mm-200mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Overview of EAST room - facing NW

Scan Boundary Notes:

A radar sweep of the main room was performed to confirm the presence of reinforcement; a markup was only performed within scan boundaries.

Within the EAST room, sample scan areas around core sample locations were performed, highlighted with a YELLOW boundary indicating a COMPLETE scan. Note that outside these scan boundaries, it was found that the construction details (wire mesh and slab thickness) were consistent (with an exception to existing slab thickenings and dowels surrounding embedded utilities; these areas were not scanned).

Slab Thickness: ~90mm-200mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as "live" unless they are under load at the time of survey.



Location: Overview of EAST room - facing S

Scan Boundary Notes:

A radar sweep of the main room was performed to confirm the presence of reinforcement; a markup was only performed within scan boundaries.

Within the EAST room, sample scan areas around core sample locations were performed, highlighted with a YELLOW boundary indicating a COMPLETE scan. Note that outside these scan boundaries, it was found that the construction details (wire mesh and slab thickness) were consistent (with an exception to existing slab thickenings and dowels surrounding embedded utilities; these areas were not scanned).

Slab Thickness: ~90mm-200mm

Please avoid ALL targets by 2 inches when coring, drilling or cutting unless otherwise stated in location image notes or the slab specific limitations.

Live power was NOT detected using an EM power sweep.

-

Electrical conduits cannot be confirmed as “live” unless they are under load at the time of survey.



General Limitations

- Where we have marked out a specific point on the slab/wall in which coring or drilling should take place please ensure that coring or drilling takes place within this point. Xradar will not be liable for any targets hit where coring or drilling takes place outside of the specified location.
- Where markings on the slab have faded, are no longer visible, or tape has been removed a new Xradar concrete scan of the location is required
- Scanning has been carried out for the purpose of anchoring in the slab at a specific depth. Based on this we have not cleared the entire extent of the slab and have only marked targets down to the anchor depth. Xradar will not be liable where drilling takes place deeper than the allowed depth.
- Due to the physical characteristics of the slab and the below grade material, Xradar is only able to guarantee that objects embedded within the concrete have been identified on site. Any below grade excavation is recommended to be completed by hand.

Disclaimer

Where:

1. The Presence and/or location and/or depth of targets in the slab/wall cannot be confirmed due to any of the limitations set out above;
 2. The recommendations set out above are not followed;
 3. The markings on the slab indicating the locations of targets are no longer present; and/or
 4. The scan has not been completed,
- Xradar shall not be liable for any loss or damage caused in respect of any such targets hit when drilling, coring or cutting the slab/wall.

Xradar Now Guarantee Scan Accuracy

At Xradar™, we're so confident in our technicians ability to scan with accuracy, that we guarantee you will not hit an unforeseen target when following our guidance.

We will guarantee that the results of our scan will not lead to damaging an unforeseen target – or we will pay for the repair, up to the value of \$10,000*

**For more information and for our guarantee terms, please visit www.xradar.ca/blog/xradar-guarantee-scan-accuracy, or speak to our team.*

Thank you for your business!

This is a standard Xradar™ summary report.

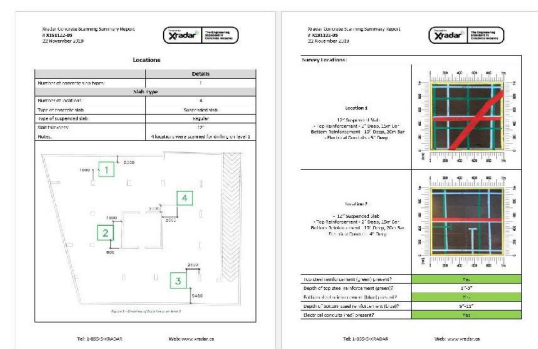
Additional reporting options are available for Xradar™
Concrete Scanning & Structural Surveys.



Our Additional Report Services:

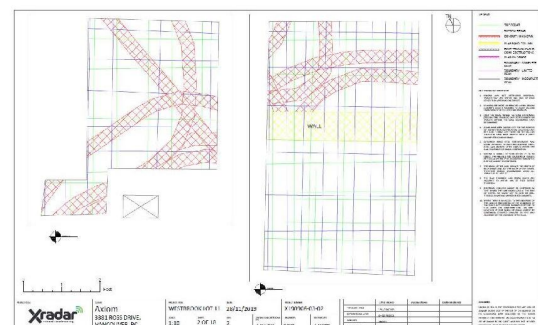
Xradar™ Core Approval Report

- Presented in the same format as the Summary Report
- Ideal for engineering review of each scan location
- Scaled images of each scan location provided
- Overview map displaying the location of each scan (Drawing to be provided)
- Typically 24 hour turnaround for these reports



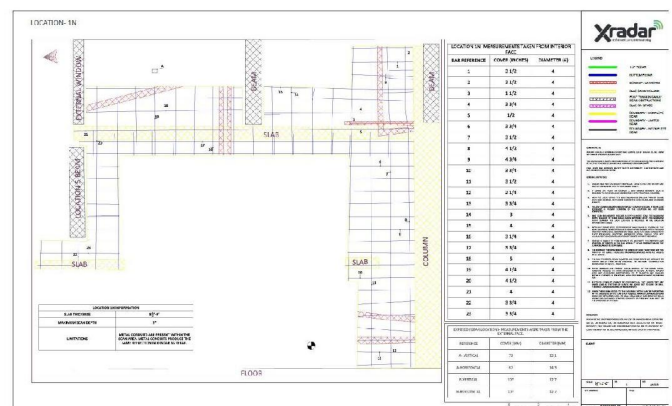
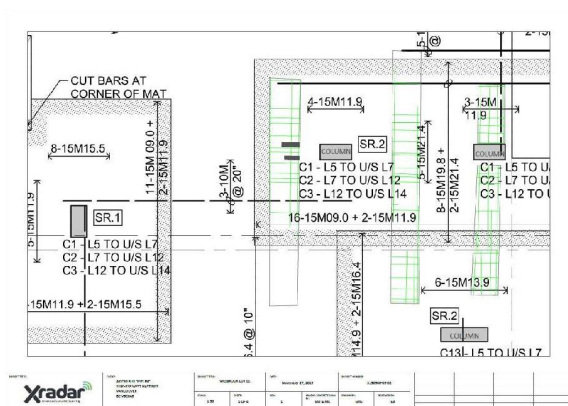
Xradar™ Concrete Scanning CAD Report

- Most comprehensive report
- Delivered in CAD .dwg format
- Also available as a 3D point cloud model



Xradar™ Structural Investigation

- Map slab thicknesses, reinforcement cover & size, spacing presence and location of beams, slab thickenings and more...
- Create as-builts for the concrete slab for structural analysis, load bearing calculations and design considerations.
- Deliverables include AutoCAD drawing & 3D point cloud model



Xradar™ help clients all over Canada
mitigate risk and plan projects effectively.

Get in touch for more information on the
other services we offer.



Other Xradar™ Services:

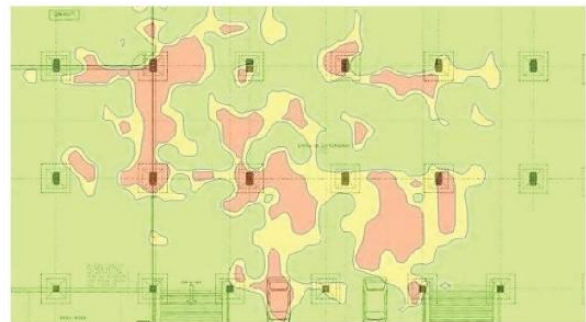


Void, Crack & Defect Detection

- Map and detect voids, honeycombs, cracks and defects within the concrete
- Highlight exact location and size
- Multiple report formats including AutoCAD drawing and 3D models
- State of the art non-destructive testing equipment including Ultrasound Pulse Echo and Xradar.

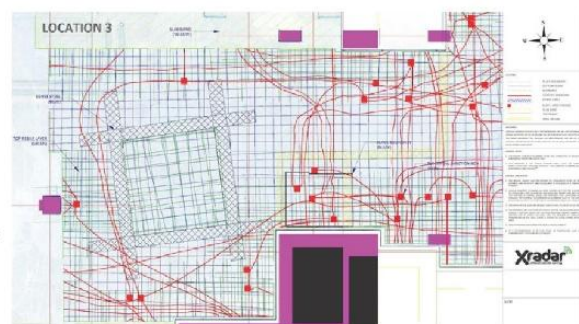
Pre-Design Concrete Scanning

- Smart space planning for designers and engineers
- Ideal for Design & Build Contractor
- Cost savings of approximately \$3.50 for every \$1.00 spent on Pre-Design Scanning
- Detailed floor plans featuring all embedded objects, lay-out your space 100% conflict free
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Concrete Corrosion Mapping

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