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SPECIFICATIONS

SURGENOR TRUCK CENTRE ADDITION & RENOVATIONS

1571 LIVERPOOL COURT,
OTTAWA, ONTARIO.
K1B 4L1.

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TENDER

VOLUME 1

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END OF SECTION

1.1 General

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

.2 These instructions apply to all mechanical trades employed on this project.

1.2 Documents Required

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

.1 Contract drawings
.2 Specifications
.3 Addenda
.4 Reviewed shop drawings
.5 Change orders
.6 Other modifications to contract
.7 Field test reports
.8 Copy of approved work schedule
.9 Manufacturer's installation and application instructions.

1.3 Construction Drawings & Specifications

.1 Following execution of the contract, an “Issued for Construction” revision of the drawings and specifications, which incorporates all addenda issued during the tender period, will be prepared by the Engineer and provided to the contractor for their review. The contractor shall review the “Issued for Construction” drawings and specifications to confirm that all addenda are included and confirm the contractor’s acceptance in writing back to the Engineer.

.2 The “Issued for Construction” drawings and specifications will be provided to the contractor for his initial review following execution of the contract. No claims for delays by the contractor will be considered relating to the issuance of Construction documents.

.3 Following acceptance of the “Issued for Construction” drawings and specifications by the contractor, the Engineer will supply the following items to the Prime Consultant for distribution to the contractor:

.1 Email electronic (PDF) files of the entire set of “Issued for Construction” drawings and specifications.

.2 One (1) CD containing the entire set of “Issued for Construction” drawings and specifications in electronic (PDF) files.

1.4 Work Schedule

.1 Prior to first application for payment, provide a schedule showing anticipated progress stages and final completion of work.

.2 Work schedule shall be in sufficient detail to allow cross referencing to the progress claim breakdown.

.3 Submit and updated schedule monthly with the progress payment claim.

1.5 Cost Breakdown

.1 Before submitting the first progress payment claim, submit detailed breakdown of contract price for review and approval of the Engineer and Owner aggregating to the total contract value. Submit breakdown not less than 14 days prior to making first progress claim, and arrange to have a review meeting with Engineer. Make revisions to breakdown as agreed with Engineer prior to submitting first claim.

.2 The breakdown shall be in sufficient detail to identify the labour, material, and start-up for each system, sub system and equipment on a floor by floor basis and area basis, to easily allow verification of progress of work. The information contained herein shall be consistent with the monthly Contractor Status Report information using the same categories expanded and in greater detail where required to identify the value of work executed, and to meet the criteria outlined herein. The breakdown shall include named sub-trades such as the insulating contractor (for piping and ductwork), air balancing contractor, water balancing contractor and major equipment suppliers (those supplying equipment requiring a delivery timeline of more than 2 weeks after shop drawing review).

.3 Each line item shall include for the contractors over head and profit such that the aggregate amount totals to the contract value without applying multipliers.

.4 Multiple pieces of equipment that are supplied from one source, shall be broken down into logical categories consistent with the construction and required delivery schedule to meet this criteria.

.5 The breakdown shall identify separately the testing, adjusting and balancing work, the stipulated commissioning amount, and all cash allowances contained in the contract documents.

.6 The Engineer reserves the right to request copies of the quotations from suppliers or sub-contractors to verify the cost of materials or services shown in the detailed breakdown where in his opinion there is any doubt as to the adequacy of the amount shown.

.7 Not withstanding the above, the Engineer may, in his sole discretion, authorize payment against a progress draw prior to final approval of the cost breakdown where in the Engineer's opinion the contractor has made reasonable efforts to provide supplementary information and to revise the breakdown in accordance with the discussions with the Engineer. Such authorization for payment shall not be deemed to give approval of the cost breakdown for future payments and every effort shall be made by the contractor to provide the breakdown satisfactory to the Engineer before any subsequent payment requests

1.6 Contractor's Use of Site

.1 Do not unreasonably encumber site with materials or equipment.

.2 Move stored products or equipment which interferes with operations of Engineer or other Contractors.

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

1.7 Codes and Standards

.1 Perform work in accordance with the Ontario Building Code (OBC), the Ontario Electrical Code, and any other code of provincial or local application provided that in any case of conflict or discrepancy the more stringent requirements shall apply.

.2 Meet or exceed requirements of contract documents, specified standards, codes and referenced documents.

1.8 Location of Equipment and Fixtures

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

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

.3 Inform Engineer of impending installation and obtain his approval for actual location.

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

1.9 Cutting, Fitting and Patching

.1 The Mechanical Contractor shall x-ray floors and structural walls before cutting to locate existing rebar and conduits and to obtain owner's approval for proposed cutting.

.2 Execute cutting (including excavation), fitting and patching required to make work fit properly.

.3 Where new work connects with existing and where existing work is altered, cut, patch and make good to match existing work.

.4 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.

.5 Fit work airtight to pipes, sleeves, ducts and conduits.

1.10 Existing Services

.1 Where work involves breaking into or connecting to existing services, carry out work at times directed by governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.

.2 Before commencing work, establish location and extent of service lines in area of work and notify Engineer of findings.

.3 Submit schedule to and obtain approval from Engineer for any shut-down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.

.4 Where unknown services are encountered, immediately advise Engineer and confirm findings in writing.

.5 Remove abandoned service lines within 2 metres of structures. Cap or otherwise seal lines at cut-off points as directed by Engineer.

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

1.11 Alterations, Additions or Repairs to Existing Building

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

.2 Where security has been reduced by work of Contract, provide temporary means to maintain security.

.3 Where elevators, dumbwaiters, conveyors or escalators exist in building, only those assigned for Contractor's use may be used for moving men and materials within building. Protect walls of passenger elevators, to approval of Engineer before use. Accept liability for damage, safety of equipment and overloading of existing equipment.

.4 Provide temporary dust screens, barriers, warning signs in locations where renovation and alteration work is adjacent to areas used by public or government staff.

1.12 Additional Drawings

.1 Engineer may furnish additional drawings to assist proper execution of work. These drawings will be issued for clarification only. Such drawings shall have same meaning and intent as if they were included with plans referred to in contract documents.

1.13 Taxes

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

1.14 Fees, Permits Certificates

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

1.15 Explosive Actuated Devices

.1 Do not employ power guns using explosives, unless permitted expressly by the Engineer; comply with fastening requirement of CSA Z-166 (Safety Code for Explosive Actuated Tools).

1.16 Examination

.1 Examine site and conditions likely to affect work. Submissions of tender deemed confirmation that tenderer has inspected site and is conversant with conditions.

.2 Extras will not be considered based on situations which could reasonably have been foreseen by a close inspection of the site.

.3 Prior to commencing installation of services, check the location and invert elevations of all service lines including sanitary sewer, and water mains and gas mains with local authorities.

1.17 Warranty

.1 Contractor to provide all labour and material to promptly correct defects or deficiencies in the work and the performance of the work, which appear prior to and during the one year Warranty period. The Warranty is to include complete labour and material Product warranties for all Products included in the work.

.2 The Warranty period for the corrected work is to be extended for an additional year following the correction of defects and deficiencies in the work carried out in the initial warranty period.

.3 The start of the Warranty period for completed mechanical work shall commence on the date of substantial completion unless stated otherwise.

.4 Certain items of equipment have extended warranties required in the specifications. Collect all agreements, guarantees, and warranty certificates and provide to the Owner.

1.18 Contract

.1 Project drawings and specifications are complimentary to this General Specification, in cases of conflict ambiguity or doubt apply to the Engineer for a ruling in writing, prior to tender closing. Once the Tender has closed the Engineer's ruling shall be final and binding, claims for extras will not be accepted.

.2 All jobs must be complete, performed and finished in a workmanlike manner. Work and materials of an incidental nature, necessary by implication to produce the finished job as specified, shall be supplied, even when not listed or described in detail.

.3 No deviations from the specifications or drawings will be allowed without written permission of the Engineer.

1.19 As-Built Drawings by Contractor

.1 The successful contractor shall be responsible for a complete set of as-built drawings.

.2 A set of prints shall be kept up-to-date as the work progresses. Show all changes and deviations from the original tender documents whether they be issued change orders, site instructions or contractor's changes.

.3 Record exactly the location of services where concealed or buried or where capped or plugged for future use. As-Built drawings shall show all duct sizes, piping sizes, component labeling, schedules, flow rates (air and water) etc.

.4 The Engineer shall make available the Tender Issue of the drawings. This contractor shall update these with all Change Orders, Site Instructions, and to reflect site conditions. An amount shall be held back, until these drawings are completed to the entire satisfaction of the Engineer.

.5 The Engineer reserves the right to request a number of verifications necessary to prove the exactness of the as-built drawings.

.6 Within two weeks of achieving Substantial Completion of the project, the contractor shall turn over a complete set of as-built drawings (marked up white prints, in red ink) to the Engineer. The

Engineer shall incorporate information received via the as-built drawings onto a set of Record Drawings for the client.

1.20 Definitions

.1 "Acceptable Material": means that item named and specified by catalogue number forms parts of specification and sets standard regarding performance, quality of material and workmanship, and when used in conjunction with a referenced standard, shall be deemed to supplement the standard. Equipment proposed shall be one of the named suppliers. Approval for other products/suppliers shall be obtained from the Engineer prior to tender closing. Such approval must be in writing.

.2 "Equal to", or "or equal": Means that other products meeting the same specification as the named product will be accepted as equal without prior approval as an alternate. The Engineer's decision will be final as to whether the product meets the specification in all respects, and if not, the named product shall be supplied. In general, the building systems have been engineered around those products named in the equipment schedules as shown on the drawings. In the event that a product, identified in this specification as an 'Equal', is selected for use by this contractor any additional costs resulting from the use of this equivalent product shall be borne by the responsible contractor. No extras will be considered.

1.21 Responsibility for Trial Usage

.1 Obtain written permission from Owner to start and test permanent equipment and systems prior to acceptance by Engineer.

.2 Engineer or Owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material and instruments required for testing.

1.22 Shop Drawings

.1 General:

.1 The Consultant shall review or take other appropriate action on the Contractor's submittals, such as shop drawings, product data, samples and other data, which the Contractor is required to submit, but only for the limited purposes of checking for conformance with the design concept and the information shown in the Construction Documents. This review shall not include review of the accuracy or

completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes, construction means or methods, coordination of the work with other trades or construction safety precautions, all of which are the sole responsibility of the Contractor.

The Consultant's review shall be conducted with reasonable promptness while allowing sufficient time in the Consultant's judgment to permit adequate review. Review of a specific item shall not indicate that the Consultant has reviewed the entire assembly of which the item is a component. The Consultant shall not be responsible for any deviations from the Construction Documents not brought to the attention of the Consultant in writing by the Contractor. The consultant shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

.2 Submit to the Consultant, for review, shop drawings, product data and samples specified. Until submission is reviewed, work involving relevant product may not proceed.

.2 Shop Drawings:

.1 Drawings by Contractor, Sub-contractor, supplier or distributor, shall be prints which illustrate appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate sections. Submit for review with all submission requirements identified in the specification.

.2 Identify details by reference to sheet and detail numbers shown on contract drawings.

.3 Maximum sheet size 44"x34".

.3 Ductwork, piping, and sprinkler drawings:

.1 Sprinkler fabrication drawings shall be prepared on AutoCAD 2008 or later edition. The Consultant will provide electronic background drawings to the successful contractor on request. Sprinkler drawings shall be submitted as outlined in the specification.

.2 The sheetmetal contractor shall prepare ductwork and equipment interference drawings on AutoCAD 2008 or later edition. These drawings shall show all equipment (above the ceiling or floor mounted), plumbing, piping, cable tray, pneumatic tube and sheetmetal layouts as required to fully

coordinate the ductwork installation with all other trades to avoid interference. Adjust duct aspect ratios as required to accommodate other services. These drawings shall be prepared and submitted, for review by the Consultant, prior to any sheetmetal fabrication. Six (6) sets of prints shall be submitted for review.

.4 Product Data:

.1 Certain specification sections specify that manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings.

.2 Above will only be accepted if they conform to the following:

.1 Delete information which is not applicable to the project.

.2 Supplement standard information to provide additional information applicable to project.

.3 Show dimensions and clearances required.

.4 Show performance characteristics and capacities.

.5 Show wiring diagrams and controls.

.6 For items with electrical connections, show voltage, phase and power (HP, watts, amps).

.5 Coordination of submissions:

.1 Review shop drawings, product data and samples prior to submission.

.2 Verify field measurements; field construction criteria; catalogue numbers; and similar data.

.3 Coordinate each submission with requirements of work and contract. Individual shop drawings will not be reviewed until all related drawings are available. The contractor shall submit all shop drawings specified in a section in one submission. Multiple shop drawing submissions for a specification section shall not be acceptable. In the event that shop drawings are submitted piece meal (multiple submissions) within a specification section, the shop drawings shall be retained by the Consultant until all shop drawings from that section have been received for review.

.4 Contractor's responsibility for errors and omissions in submission is not relieved by the Consultant’s review of submittals.

.5 Contractor's responsibility for deviations in submission from requirements of contract documents is not relieved by the

Consultant's review of the submission, unless the Consultant gives written acceptance of specified deviations.

.6 Notify the Consultant, in writing at time of submission, of deviations from requirements of contract documents.

.7 After the Consultant's review, distribute copies.

.6 Submission requirements:

.1 Schedule submissions at least 15 working days before dates reviewed submissions will be needed.

.2 Electronic shop drawing submissions are acceptable with the following conditions:

.1 The shop drawings are submitted in pdf format with a transmittal and include the contractor's review stamp.

.2 The page size cannot exceed 8.5"x11" and must be fully legible.

In the event that the electronic submission cannot conform to the requirements identified above, the Contractor shall submit six (6) sets of hard copies for review.

.3 On each submission sheet, ensure clear space 3" x 3" for review stamp (e.g. letter size data sheet on legal size paper).

.4 Accompany submissions with transmittal letter containing:

.1 Date; project title and number; Contractor's name and address; number of each shop drawing, product data and sample submitted.

.2 Other pertinent data.

.5 Submissions shall include:

.1 Date and revision dates; project title and number.

.2 Name of: Contractor; sub-contractor; supplier; manufacturer.

.3 Identification of product or material.

.4 Relation to adjacent structure of materials.

.5 Field dimensions, clearly identified as such.

.6 Specification section numbers

.7 Applicable standards, such as CSA or CGSB numbers.

.8 Contractor's stamp, initialled or signed, certifying review of submission, verification of field measurements and compliance with contract documents.

1.23 Maintenance Manuals

.1 One draft copy of the proposed maintenance manual shall be submitted for review within four (4) weeks of the review of shop drawings.

.2 The Engineer may withhold progress payments until such time as the draft copy is received.

.3 Once the draft copy has been reviewed by the Engineer, submit to Engineer three (3) copies of Operating and Maintenance Data incorporating the revisions as necessary, made up as follows:

- .1 Bind data in vinyl hard covered, three (3) ring, loose leaf binder for 215 x 280 mm size paper.
- .2 Enclose title sheet, labelled "Operating and Maintenance Data Manual", project name, date and list of contents.
- .3 Organize contents into applicable sections of work to parallel project specification breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.

.4 Include following information plus data specified.

- .1 Maintenance instruction for finished surface and materials.
- .2 Copy of hardware and paint schedules.
- .3 A clear copy of shop drawings for all equipment.
- .4 A schedule for all equipment summarizing the Reference Number, Make, Model, Serial Number, Capacity, Electrical Data, etc.
- .5 Description, operation and maintenance instructions for equipment and systems, including complete list of equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.
- .6 Names, addresses and phone number of sub-contractors and suppliers.
- .7 Guarantees, warranties and bonds showing:
  - .1 Name and address of projects.
  - .2 Guarantee commencement date (date of Final Certificate of Completion).
  - .3 Duration of guarantee.
  - .4 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.
  - .5 Signature and seal of Contractor.

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

.5 Neatly type lists and notes. Use clear drawings, diagrams or manufacturer's literature

1.24 Demolition

.1 Where indicated on the drawings and where walls are shown to be removed, disconnect, cap, and remove all services and equipment. All services and equipment which have become redundant under the contract shall be removed. All items removed during demolition shall be removed from the site, unless noted otherwise. All materials to be removed from site shall be disposed of in accordance with all Provincial codes and regulations. Engineer shall be notified if contractor is unsure of services to be removed or capped.

.2 The Contractor shall remove and reinstate to match existing, any items or services which interfere with demolition and new construction.

.3 The Contractor is responsible for immediate reconnection of any services which are to remain and which have been disconnected during the course of demolition or construction.

.4 Where existing materials are shown to be removed and reused, the Contractor is responsible for their removal, storage, cleaning to the satisfaction of the Engineer, and reinstallation.

.5 The Contractor shall be responsible for protecting all equipment and services to remain during the course of demolition. Should any damage occur, it shall be the Contractors responsibility to supply and install new services and equipment.

.6 Maintain adequate structural support for services and equipment to remain during the course of demolition.

.7 Remove, store safely, clean to the satisfaction of the Engineer, and reinstall grilles and diffusers where ceiling systems are disturbed.

1.25 Contractor Quality Assurance Program

.1 The Contractor is solely responsible for the control, charge and supervision of construction methods, techniques, sequences and procedures, and for safety precautions and programs required in connection with the work.

.2 The Contractor is responsible for the discovery and correction of deficiencies, errors and omissions in the execution and performance of the work and for the preparation of submissions, reports, relating to the work.

.3 The Contractor is responsible for providing the appropriate quality assurance program to ensure that the work is carried out and performs in accordance with the Contract Documents, industry standards and relevant codes and legislation. The Contractor Quality Assurance Program is to ensure the following:

.1 The use of qualified tradesmen, experts and professionals with the level of skill and experience required for the proper execution and performance of the work.

.2 The level of direction, supervision and inspection required for the proper execution and performance of the work.

.3 The level of co-ordination between trades, field conditions, material requirements and product requirements required for the proper execution and performance of the work.

.4 The level of management required for the quality assurance program to operate effectively so that deficiencies, errors and omissions in the work are identified by the Contractor on a continuous basis and that corrective action is carried out promptly.

.5 The level of management and communication required for the status of the work to be properly monitored and reported to the Owner and the Engineer.

.4 Project observation reports of the work by the Engineer and Owner are not to be considered part of the Contractor Quality Assurance Program.

.5 The review of Contractor prepared submissions (shop drawings, reports, etc.) by the Engineer and Owner are not to be considered part of the Contractor Quality Assurance Program, and do not alleviate the Contractors responsibility to meet all documented requirements.

1.26 Progress Payments

.1 Payment requests are to be submitted on a system by system, area by area, basis as per the agreed cost breakdown in conjunction with the Contractor Status Report.

.2 Date applications for payment for the last day of the monthly payment period and ensure amount claimed is for value proportionate to amount of Contract, of Work performed, and Products delivered to Place of Work at that date. Payment will not be authorized for materials that are not delivered to site at date of submission of claim.

.3 Payment for work that requires field testing such as pressure and leak tests; approval from authorities having jurisdiction; or approval from specified experts such as seismic control; will be limited to 90% of the value of the labour and material of such work until such time as the testing is completed, witnessed, and recorded; the authorities having jurisdiction have given their approval for the work; or the specified experts have provided their written verification of the installations.

.4 Payment for work that must prove performance through start-up, TAB, and commissioning activities will be limited to 98% of the value of the labour and material for each system until such time as the equipment manufacturer's start-up tests are complete and reports submitted and the equipment is in satisfactory operation.

.5 Payment against the Commissioning allowance will not commence until after the TAB is complete, and will be paid in proportion to the completion of the defined commissioning activities.

END OF SECTION

1.1 General

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

.2 These instructions apply to all mechanical trades employed on this project.

1.2 Equipment Requirements and Installation

.1 Permit equipment maintenance and disassembly by use of unions or flanges to minimize disturbance to connecting piping and duct systems and without interference from building structure or other equipment.

.2 Provide accessible means for lubricating equipment including permanent lubricated bearings.

.3 Mount base mounted equipment on chamfered edge housekeeping pads a minimum of 88 mm high and 50 mm larger than equipment dimensions all around. Concrete to be provided under Division 3, but this contractor shall layout and co-ordinate bases for all his equipment.

.4 Pipe drain lines to drains.

.5 Line up equipment, rectangular cleanouts and similar items with building walls wherever possible.

1.3 Protection of Openings

.1 Protect equipment and system openings from dirt, dust and other foreign materials.

1.4 Thermometers, Pressure Gauges

.1 General:

.1 Locate direct reading thermometers and gauges for reading from floor or platform.

.2 Provide remote reading thermometers and gauges where direct reading instruments cannot be satisfactorily installed.

.3 Locate engraved lamacoid nameplate as specified in Section 23 05 53 - Identification, identifying medium adjacent to thermometers and gauges.

.4 Thermometers and gauges shall operate at mid point on their scales.

.5 Install thermometers and pressure gauges as shown on the schematic and general arrangement drawings.

.2 Duct Thermometers:

.1 Shall be 125 mm (5") dial, bimetal thermometer with stainless steel case, dual F/C scales, range selected to be not more than twice working temperature.

.2 Supply back connected or bottom connected to suit application, with a minimum 6" stem length for pipework and 1/2 diameter length for ductwork systems (24" maximum).

.3 Where thermometers are located at higher than 2100 mm (7'0") above floor or platform height, or where otherwise required to permit easy reading, use adjustable angle type thermometers.

.3 Pipe Thermometers:

.1 Shall be industrial variable angle liquid filled type of 225 mm (9") length (CAN/CGSB 14.4) with stainless steel case.

.2 Provide stainless steel or brass thermal wells for all pipework applications with lagging type to be used for insulated piping.

.4 Pressure Gauges:

.1 All gauges to be in accordance with ANSI B40.1 Grade "1A", with minimum 100 mm (4") case, full size phosphor bronze bourdon tube, silver brazed tip and socket, 1/4 NPT lower connection, rotary type bushed movement, dual PSI and kPa scale, range selected between 1.25 and 2 times working pressure. Provide 1/4" bar stock needle valve.

.2 Gauges shall be liquid filled for all services except steam. For steam applications supply 6 mm pigtail siphons in addition to the needle valves.

.3 Accuracy to be not less than 1% gauges.

.4 Pressure Gauges to be registered with Provincial Boiler and Pressure Vessel Safety Branches with C.R.N. number where they are installed on pressure vessels or registered systems, as required by TSSA.

.5 Shop Drawings: Submit detailed schedules for all gauges and thermometers clearly indicating location, working pressure, full scale range, and model.

.6 Acceptable Material: Winters, Pitanco, H.O. Trerice.

1.5 Electric Motors, Equipment and Controls

.1 The electrical contractor shall be responsible to supply all motor starters and disconnect switches for all motors for the project, all line voltage wiring to starters and starters to the motors except on pre-wired packaged equipment. Some control wiring for mechanical equipment is specified in the Controls specifications. Refer to Electrical specifications for quality of materials and workmanship.

.2 All electrical equipment supplied by the Mechanical contractor (Variable frequency Drives, control panels,…) and installed in a sprinklered building or within mechanical rooms with hydronic systems shall be protected by suitable water resistant casing to minimize the risk of damage from water discharge. If the manufacturer's equipment is not protected by a suitable casing or enclosure, supply and install suitable non-combustible hoods or shields to protect the equipment.

.3 Motors:

.1 Provide motors for mechanical equipment as specified.

.2 If delivery of specified motor will delay delivery or installation of any equipment, install an acceptable motor for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

.3 All motor efficiencies shall be in accordance with the OBC 2012 supplementary standard SB-10 and ASHRAE 90.1-2013.

.4 Where variable speed drives are controlling the motor, all motors shall be coordinated with the selected variable frequency drive requirements and shall be marked for inverter duty as per CSA C22.2 No.100.

.5 All motors 25 HP and larger shall have thermistors installed.

1.6 V-belt Drives

.1 Fit reinforcing belts in sheave matched to drive. Multiple belts on unit to be matched set.

.2 Use cast iron or steel sheaves secured to shafts with removable keys.

.3 For motors 0.25 kW to 7.5 kW: standard adjustable pitch drive sheaves, having + or -10% range. Use mid-position of range for specified rpm.

.4 For motors over 7.5 kW: Sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide replacement sheaves of correct size and belts if required to suit balancing, at no additional cost.

.5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.6 Motor slide rail adjustment plates to allow for centre line adjustment.

.7 Tension belts to manufacturer's recommendations before start up and after first 100 hours of operation.

.8 Provide one spare set of V-belts for each piece of machinery.

1.7 Guards

.1 Provide guards for all exposed drives.

.2 Guards for drives shall have:
- .1 Expanded metal screen welded to 25 mm steel angle frame.
- .2 1.2 mm thick galvanized sheet metal tops and bottoms.
- .3 Removable sides for servicing.
- .4 38 mm diameter holes on both shaft centres for insertion of tachometer.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to permit movement of motors for adjusting belt tension.

.5 For flexible couplings, provide removable, "U" shaped, 2.7 mm thick galvanized frame and 1.2 mm thick expanded mesh face.

.6 Provide 19 mm galvanized mesh wire, expanded metal screen on inlet or outlet of exposed fan blades such that net free area of guard is not less than that of fan openings.

1.8 Vehicular Piping Protection

.1 All piping installed in areas susceptible to vehicular damage shall be protected with three sided 10mm thick welded steel boxes secured to building structure. As a minimum, protection shall be provided between 200mm to 1200mm above floor. Provide suitable opening to access cleanouts, valves, or other devices requiring access. Paint with primer and a minimum of two coats of safety yellow.

1.9 Pipe Hangers and Supports

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1-1989.

.2 Set inserts in position in advance of concrete work. Use grid system in equipment rooms.

.3 Support from top of structural members. Where structural bearings do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members. Obtain approval before using vertical expansion shields. Do not suspend from metal deck. Anchoring of piping and equipment shall be to manufacturer's recommendations.

.4 Adjustable clevis type hanger: on all sizes of pipes.

- .1 Acceptable Materials: Myatt, Grinnell.
- .2 Rigid hangers: on heating water, steam, condensate, domestic hot water, when ratio of pipe expansion to hanger rod length does not exceed 1:24.
  Minimum rod length: 300 mm.
- .3 Swing hangers: on heating water, steam, condensate, domestic hot water, when ratio of pipe expansion to hanger rod length does not exceed 1:6.
  Minimum rod length: 300 mm.
- .4 Use pipe rollers complete with bracing when ratios as above cannot be maintained.
- .5 For piping except as noted above, minimum rod length to be 150 mm.

.5 Provide spring hangers to offset expansion on horizontal runs which follow long vertical risers.

.6 Govern spacing between pipe rack supports using smallest pipe size.

.7 Use rod diameters and spacing for pipe supports as shown in table with the following exceptions.

.1 Support plumbing piping in accordance with more stringent requirements of authorities having jurisdiction. Canadian Plumbing Code, Provincial code.

.2 Support NPS 12 gas pipe every 1.8 metres. Support NPS 12 copper pipe every 1.5 metres.

.3 Support flexible joint roll grooved pipe in accordance with table below, but not less than one hanger for each joint.

.4 Support plastic piping in accordance with manufacturer's recommendations.

Pipe Size NPS	Rod Diameter	Maximum Steel	Spacing Copper
up to 20	10 mm	2.1 m	1.8 m
25	10 mm	2.1 m	1.8 m
30	10 mm	2.1 m	1.8 m
40	10 mm	2.7 m	2.4 m
50	10 mm	3.0 m	2.7 m
65	10 mm	3.6 m	3.0 m
75	10 mm	3.6 m	3.0 m
90	10 mm	3.9 m	3.3 m
100	16 mm	4.2 m	3.6 m
125	16 mm	4.8 m	
150	22 mm	5.1 m	
200	22 mm	5.7 m	
250	22 mm	6.6 m	
300	22 mm	6.9 m	

.8 Place support within 300 mm of each horizontal elbow.

.9 Hangers shall be 3 piece minimum standard, i.e. attachment, rod, pipe attachment.

.10 Mild steel wall hooks may be used to support non-expanding piping. Allow 25 mm minimum clearance for insulated pipe.

.11 Provide riser clamps as required and where shown.

.12 On un-insulated copper piping use copper or copper plated hangers or 6 mm lead crimped to hanger between copper and ferrous hanger.

.13 Provide saddles for insulated pipe and prefabricated insulation shields with high density insulation with vapour barriers for cold water piping.

.14 Offset hanger pipe and structural attachments in such a manner that rod is vertical when piping is hot.

.15 Adjust hanger rods to equalize load.

.16 Pipes to be supported on flat roof using interlocking, UV stabilized polypropylene support equal to Quick-Block by “A Better Idea Inc.”, Miro Industries, or equal. Provide support extension with unistrut as required to suit piping systems, with clamp or clevis hangers as required. All metal components shall be galvanized steel. Provide rollers on support system for straight pipe runs longer than 10 meters. Anchor to roof structure as required to suit seismic restraint design.

1.10 Pipe Expansion /Anchoring

.1 Provide for expansion and contraction of pipe risers and distribution mains for all heating, cooling, steam, steam condensate, and steam relief piping systems, in accordance with good Engineering principles. Provision shall be by way of offsets or U bends wherever practical and expansion bellows shall only be used where space does not permit pipe offsets to occur.

The contractor shall provide for all required anchoring as either shown on the drawings or as required.

To restrict pipe movement at those points and all piping to move in a controlled manner with other components of this system installed (i.e. expansion joints, pipe guides, etc.)

The contractor shall provide an engineered detail of the pipe anchor for each respective piping system. The engineered detail shall be sealed and signed by a Professional Engineer, licensed in the

Province of Ontario. The contractor shall be responsible for all force calculations that are required for this anchor design.

Submit shop drawing details of expansion and anchoring systems for the Engineer's review prior to construction. Include a full piping layout indicating locations of each piping system expansion joint, pipe guides, and pipe anchor.

1.11 Sleeves and Fire Stopping

Pipe Penetrations

.1 Firestopping system must be ULC/Warnock Hersey approved.

.2 Install sleeves where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.3 Sleeve material:

.1 Shall be Schedule 40 black steel. Where sleeves extend above finished floor, sleeves to have annular fins continuously welded on at mid-point. Before installation of exterior sleeves, paint exposed surfaces with a heavy application of zinc-rich paint to CAN/CGSB-1.181.

.2 Sleeves installed for future uses shall be fire stopped as a blank opening listed system in order to provide the same fire rating as the assembly.

.3 One step cast-in-place sleeve and fire stop assemblies are an acceptable alternative to steel sleeving systems. Cast-in-place sleeve shall be supplied with post pour threaded extension to extend the top of the sleeve above the finished slab. Acceptable material: Hilti CP680.

.4 Sleeve Installation:

.1 For concrete walls, masonry walls, and concrete floors slab on grade: Terminate sleeve flush with finished surface.

.2 All other floors: Terminate sleeve 50 mm above finished floor.

.5 Sealing:

.1 Floor Slabs: Seal with fire retardant, waterproof non-hardening material.

.2 Foundation Walls: Use Link-Seal modular seals.

.6 Firestopping:

.1 When penetration element pass through a fire rated separation floor or wall; maintain fire rating integrity.

.2 Provide free annular space according to the corresponding listed system to be used.

.3 Apply fire stop material according to the installation procedure corresponding to the selected listed systems used.

.4 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

.5 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

.6 Ensure no metal to metal contact where pipe passes through sleeve.

.7 Always submit specific firestop details of all penetration types as a shop drawing for review by Engineer prior to construction, showing approval number and installation details.

.8 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer; a manufacturer's engineering judgment 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 judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994).

.9 A manufacturer's direct representative (not distributor or agent) 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.

1.12 Acceptable Fire Stop Manufacturers

.1 Subject to compliance with through penetration firestop systems listed in U.L.C. Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory, provide products of the following manufacturers as identified below:

.1 Hilti (Canada) Limited, Mississauga, Ontario
1-800-353-4458

.2 Tremco Sealants & Coatings, Beachwood, Ohio
(216) 292-5000

.3 3M Fire Protection Products, St. Paul, Minnesota
(612) 736-0203

.4 Other manufacturers listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory.

1.13 Firestop Materials

.1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

.2 Cast-in place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic pipe (closed and open piping systems) penetrating concrete floors, the following products are acceptable:

.1 Hilti CP 680 Cast-In Place Firestop Device

.2 Equivalent products listed in the U.L.C. Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory).

.3 Sealant or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:

.1 Hilti FS-ONE Intumescent Firestop Sealant

.2 Hilti CP 604 Self Leveling Firestop Sealant

.3 Hilti CP 620 Fire Foam

.4 3M Fire Stop Sealant 2000

.5 3M Fire Barrier CP25 WB

.6 Tremco Tremstop Fyre-Sil Sealant

.7 Equivalent products listed in the U.L.C. Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.4 Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
- .1 Hilti CP 601s Elastomeric Firestop Sealant
- .2 Hilti CP 606 Flexible Firestop Sealant
- .3 Hilti FS-ONE Intumescent Firestop Sealant
- .4 Hilti CP 604 Self Leveling Firestop Sealant
- .5 Equivalent products listed in the U.L.C. Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.5 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable.
- .1 Hilti FS-ONE Intumescent Firestop Sealant
- .2 Hilti CP 620 Fire Foam
- .3 3M Fire Barrier CP25 WB
- .4 Tremco Tremstop WBM Intumescent Firestop Sealant
- .5 Equivalent products listed in the U.L.C. Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.6 Intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:
- .1 Hilti FS-ONE Intumescent Firestop Sealant
- .2 Hilti CP 618 Firestop Putty Stick
- .3 Hilti CP 620 Fire Foam
- .4 3M Fire Barrier CP25 WB
- .5 Tremco Tremstop WBM Intumescent Firestop Sealant
- .6 Equivalent products listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.7 Non curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:
- .1 Hilti CP 618 Firestop Putty Stick

.2 Equivalent products listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.8 Wall opening protective materials for use with U.L.C listed metallic and specified monmetallic outlet boxes, the following products are acceptable:
.1 Hilti CP 617 Firestop Putty Pad
.2 Equivalent products listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.9 Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems) tested to 50 Pa. differential, the following products are acceptable:
.1 Hilti CP 642 Firestop Collar
.2 Hilti CP 643 Firestop Collar
.3 Hilti CP 645 Wrap Strips
.4 3M Fire Barrier PPD Plastic Pipe Device
.5 Equivalent products listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.10 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
.1 Hilti FS 635 Trowelable Firestop Compound
.2 Hilti FS 657 FIREBLOCK
.3 Hilti CP 620 Fire Foam
.4 3M Firestop Foam 2001
.5 3M Fire Barrier CS-195 Composite Sheet
.6 Equivalent products listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.11 Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
.1 Hilti FS 657 FIREBLOCK
.2 Equivalent products listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

1.14 Firestop Field Quality Control

.1 Examine sealed penetration areas with both visual inspection combined with a small proportion of destructible test (destructible tests consist of removing the fire stop material on a small surface to ensure the proper thickness of fire stop material and proper thickness/compression of backing material plus verification of all limitations of listed system used to fire stop penetration) to ensure proper installation before concealing or enclosing areas.

.2 Keep areas of work accessible until inspection by authorities having jurisdiction.

.3 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

.4 Install a warning card that is clearly visible adjacent to all large and medium openings that may be re-penetrated. This card should contain the following information:

.1 Warning that the opening has been fire stop protected
.2 Indicate the fire stop system used (ULC or cUL)
.3 F rating FT rating
.4 Fire stop product(s) used
.5 Person to contact and phone number in case of modification or new penetration of fire stop system

1.15 Escutcheons and Plates

.1 Provide on pipes passing through finished walls, partitions, floors, and ceilings. Use chrome or nickel plated brass, split type, with set screws for ceiling or wall mounting. Inside diameter shall fit around finished pipe. Outside diameter shall cover opening or sleeve. Where sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension. Secure to pipe or finished surface, but not to insulation.

1.16 Tests

.1 Give 24 hours notice of date when tests will be made. Do not insulate or conceal work until tested and approved. Follow construction schedule and arrange for tests. Conduct tests in presence of Consultant and Owner. Bear costs including retesting

and making good. Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures.

.2 Test potable water system as per the OBC (ie: hydraulically @ 145 psi for at least 1 hour or for 2 hours without a drop in pressure at an air pressure that is at least 102 psi).

.3 Maintain test pressures without loss for 4 hours unless otherwise specified.

.4 Test drainage, waste and vent piping to code.

1.17 Painting

.1 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals, and all pipework.

.2 Touch-up all damaged equipment to match original manufacturer's paint quality and colour.

1.18 Access Doors

.1 Supply access doors for furred ceilings or spaces for servicing equipment and accessories. Access doors shall be flush mounted 600 x 600 mm for entry to service equipment unless otherwise noted. Access doors for hand entry to access valve shall be 200 x 200 mm unless noted otherwise. Doors shall open 180 degrees, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Steel shall be prime coated. Supply stainless steel access doors for tiled, marble, terrazzo or special surfaces. Access doors in fire rated walls and ceilings shall be ULC listed. Acceptable Materials: Zurn-LeHage-Buensod.

1.19 Dielectric Couplings

.1 Provide wherever pipes of dissimilar metals are joined. Provide insulating unions for pipe sizes NPS 2 and under and flanges for pipe sizes over NPS 2. Cast brass adapters may be used where approved by the Engineer. Provide felt or rubber gaskets to prevent dissimilar metals contact.

1.20 Instruction of Operating Staff

.1 Supply certified personnel to instruct operating staff on operation of mechanical equipment. Supply maintenance specialist personnel

to instruct operating staff on maintenance and adjustment of mechanical equipment and any changes or modification in equipment made under terms of guarantee.

.2 Provide instruction during regular work hours prior to acceptance and turn-over to operating staff for regular operation.

.3 Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn manual over to Owner.

1.21 Cutting and Patching

.1 The Mechanical Contractor shall x-ray floors and structural walls before any cutting to locate existing rebar and conduits and to obtain owner's approval for proposed cutting.

.2 The Mechanical Contractor shall confer with the General Contractor in regards to this work and shall give locations for all holes for pipes, ducts through floors, walls and roof etc., and provide sleeves required to execute the mechanical installation. All cutting and patching shall be by the General Contractor.

1.22 Flashing

.1 Do all flashing and counter flashing unless otherwise indicated where ducts and other mechanical parts are passing through weather and/or waterproofed walls, floors, roofs; all to the satisfaction of the Engineer and Architect.

1.23 Interference Drawings

.1 Prepare large scale 1:50 layout/interference drawings and not sketches for review by the Engineer. Additionally, provide layout drawings as required for equipment bases, sleeves, and openings. Interference drawings shall clearly show all equipment (above ceiling and floor mounted) & ductwork, fully coordinated with the sprinkler, plumbing trade, electrical trade, and general contractors' trades. Whenever work occurs within an existing facility, incorporate appropriate existing systems within the coordination drawings. Refer to section 20 00 00 item 1.24 "Shop Drawings" for submittal requirements.

.2 The mechanical and electrical drawings are diagrammatic and do not show details at intersection of services. Re-routing required for the clearance of all services that results in additional elbows and fitting for piping, ductwork, conduit, and cable tray within a 1500 mm radius from the diagrammatic position will not be cause for additional payment. Exact locations of runs of piping, ducts, cable trays, and conduits shall be established by the contractor in cooperation with sub-trades and other contractors prior to installation so that they will clear each other and other obstructions. In general, piping requiring uniform pitch on horizontal runs shall be given the right of way. All surface mounted components and instrumentation devices shall be carefully coordinated with the Prime Consultant and no final locations for such surface mounted items shall be chosen except with the Prime Consultant's written approval.

.3 For new building construction, coordinate all piping, ductwork, and equipment layout, dimensions and weights with structural steel supplier.

1.24 Coordination with the Controls Contractor

.1 The controls shall be supplied and installed by the controls contractor except where elements such as valves, control dampers, sensor pockets, sensors, air flow stations, and water flow meters, will be supplied by the controls contractor and installed by the different mechanical sub-trades (i.e., plumbing contractor and sheet metal contractor). Of the foregoing items, control dampers, sensors in air systems, and air flow stations shall be installed by the sheet metal contractor with the remaining items noted above being installed by the plumbing contractor. In the event that the plumbing contractor and sheet metal contractor are one in the same, the foregoing devices noted above shall be installed by that Contractor.

.2 The supply and installation of the following components, specified but not identified as to installation responsibility shall be by the sheet metal contractor.

.1 Access doors in ductwork to service fire dampers, manual dampers, motorized dampers, or mechanical equipment that is installed by the sheet metal contractor.

.2 Access doors other than those installed in ductwork such as in walls or ceilings to access equipment installed by the sheet metal contractor.

.3 Painting of equipment installed by the sheet metal contractor.

.4 Miscellaneous equipment where ductwork is connected.

In the event that the plumbing contractor and sheet metal contractor are one in the same, the foregoing items noted above shall be installed by that contractor.

.3 The supply and installation of the following components, specified but not identified as to installation responsibility, shall be by the plumbing contractor.

.1 Access doors, other than those installed in ductwork, such as in walls or ceilings to access equipment installed by the plumbing contractor.

.2 Painting of equipment installed by the plumbing contractor.

In the event that the plumbing contractor and sheet metal contractor are one in the same, the foregoing items noted above shall be installed by that contractor.

1.25 Balancing

.1 Balance and adjust all air handling systems including equipment, ductwork, diffusers, registers etc. to obtain air quantities shown on drawings, within +/- 5%. Adjust fan speeds as required to achieve balance, including fitting replacement sheaves and belts as required.

.2 Record the operating electrical characteristics of all equipment, and adjust overloads to correct values for proper protection.

.3 Report any excessive or unusual noise and/or vibration occurring during operating of systems. Examine and report probable causes.

.4 Compile complete data for all testing, balancing and adjusting work and submit complete reports thereon, using standard forms as illustrated in Section V, Procedures, Chapter 26 of the AABC National Standards, dated 1982.

.5 Provide instruments and manpower to verify results of up to 30% of all reported measurements.

1.26 Equipment Start-up

.1 Equipment start-up shall be supervised by a factory trained representative of the manufacturer.

.2 A detailed start-up report shall be forwarded to the Engineer to show the tests carried out, setpoints of controls and limits, and operation of safety devices.

1.27 Excavation and Backfilling

.1 Carry out all necessary excavation inside the limits of the building and to 1 metre outside of the foundation wall.

.2 Excavate bottom of trenches so that pipes are properly and adequately supported. Refer to the Geo-technical Report. No frozen soil will be permitted under the pipes.

.3 Bed piping in a minimum layer of 150 mm of compacted sand or stone dust and backfill around and over pipe to a depth of 300 mm above top of pipe with the same material and compacted in accordance with the Geo-technical Report.

1.28 Changes in the work

.1 Changes in the work may be requested from time to time by the issuance of a Contemplated Change Notice (CCN) and/or Proposed Change (PC). Refer to general conditions of the contract or front end specifications for requirements on how to quote changes in the work. Those requirements take precedence over the requirements following in this Section.

.2 Should the bid form, general conditions of the contract or front end specifications not address how to quote changes in the work, the requirements following in this Section shall apply.

.3 Provide detailed breakdowns of material and labour with unit prices and extensions required for review of Contemplated Change Notices (CCN's) or Proposed Changes (PC's).

.4 In addition to the net cost of the change, the Contractor shall be entitled to a 15% fee to cover overheads & profit on the work and a 10% fee to cover overheads and profit on sub-trades.

.5 Plumbing and piping labour shall be evaluated using “MCAA” labour units. Sheet metal field labour shall be evaluated using “SMACNA” labour units. Job Factors shall not be considered applicable unless construction work is being done in occupied areas of the building.

.6 The overhead percentage and use of MCAA and SMACNA labour units indicated above includes the following:

.1 Insurance
.2 Bonding
.3 Financing and interests
.4 Coordination with other trades
.5 Salaries of any staff above that of working foremen employed directly on the work
.6 Licenses and permits
.7 Onsite timekeeping and scheduling
.8 Rest periods
.9 Cleanup beyond MCAA recommended practice
.10 Material handling
.11 Personal hygiene
.12 Safety training
.13 Job site safety talks
.14 WHMIS information
.15 Health and safety committee
.16 Escalating site safety procedures
.17 Garbage bins
.18 Shipping and deliveries
.19 Project management
.20 Estimating
.21 Special cleaning
.22 Special handling/storage
.23 Equipment rentals for small tools
.24 Equipment start-up
.25 Any other non-productive time

.7 A single blended labour rate based on a crew of 1 working foreman and 4 journeymen shall be used for Normal working hours for the duration of the project and shall include the following:

.1 Base rate, Vacation Pay and Statuary Holidays as per the current collective agreement for unionized contractors.
.2 Union deductions for Benefits (Health and Welfare), Pension, Union Dues, Provincial Training for employee

and employer, Local Training, Industry Fund, and Stabilization Fund.

.3 Legislated Payroll Burdens for:
- .1 Canada Pension Plan
- .2 Employment Insurance
- .3 Workplace Safety & Insurance Boards
- .4 Employer Health Tax
- .5 HST on Insurance Premiums
- .6 Insurance PL & PD

.4 MCAO guideline adders for:
- .1 Small Tools
- .2 Site Facilities
- .3 Personal Protection Equipment
- .4 Parking as per collective agreement
- .5 Clean-up as per OCA recommended practice

.8 For Premium Night Shift (minimum three consecutive night shifts), use the Normal rate calculation with a 20% adder to Base Rate, Vacation Pay, Pension, and Health & Welfare Benefits.

.9 For Overtime, use the Normal rate calculation with a 100% adder to Base Rate, Vacation Pay, Pension, and Health & Welfare Benefits.

.10 Cost quotations shall be based on industry accepted costing methods. Plumbing and piping material shall be based on" All-Pricer" list pricing with a 30% discount applied. Sheet metal material shall be based on current market pricing. Submit supplier invoices for all materials not included in "All Pricer".

.11 The following job expenses shall be considered to be acceptable in certain pricing exercises:
- .1 Bonding Costs.
- .2 Warranty costs shall be based on 2% of the material & labour cost for the change.
- .3 Drafting costs shall be considered based on 2% of the labour cost for the change.
- .4 Hoisting shall be charged based on current craning costs.
- .5 Equipment rentals for large equipment.
- .6 Core drilling.
- .7 Travel in accordance with the applicable union agreement.
- .8 Sheet metal deliveries shall be charged per the Ontario Sheet Metal Association.

.12 The Mechanical Contractor shall submit a template proposed to be used for any CCN's/PC's as a formal shop drawing submission for review and recommended acceptance prior to any CCN's/PC's being issued.

1.29 Project Personnel

.1 The Project Manager and Site Foreman who are assigned to the project shall be consistent from project start to project completion. No substitution shall be permitted without the Engineer's and Owner's written acceptance/approval.

1.30 General Review Declaration

.1 Prior to time of occupancy permit application, the following work shall be complete:

- .1 Domestic hot and cold water to plumbing fixtures
- .2 Above and underground drainage plumbing.
- .3 Fire extinguishers.
- .4 Backflow preventors.
- .5 HVAC systems.
- .6 Fire dampers installed in accordance with ULC.
- .7 Air and water system balancing.
- .8 Seismic restraint systems

.2 Prior to time of occupancy permit application, submit the following items for review:

- .1 Municipal plumbing inspection report.
- .2 Backflow preventor test reports in accordance with CSA B64.
- .3 New HVAC systems startup reports.
- .4 Complete balancing report with no outstanding issues.
- .5 Letters from all respective Mechanical sub-trades indicating systems have been seismically restrained in accordance with the OBC. Letters shall be authored, signed, and sealed by a Professional Engineer licensed in the province of Ontario.

.3 Submissions shall be complete with transmittals or cover letters signed by an appropriate member of the Ontario College of Trades (OCOT), with their OCOT registration number indicated.

.4 The project must be substantially complete and ready for its intended use. Start up, balance and commission all systems. Ensure systems have been installed in accordance with the contract documents, manufacturer's recommendations, and industry standards as the case may be.

1.31 Voltage Regulation

.1 Electrical equipment including all chillers and motors for any equipment provided by this contractor shall operate normally under local power quality conditions typical to the area in which the project is located. As a minimum, equipment shall operate normally within the Extreme range of voltage conditions per CSA CAN3-C235-83 at the customer's main electrical service entrance, ie, between 306/530V and 367/635V.

.2 If the proposed equipment is unable to operate normally within the voltage range as described above, provide multi-tap electronic voltage regulating transformer system as necessary to suit the input voltage operating range requirements of the equipment. Voltage regulating system shall be complete with all electrical power and control components as required for a complete working system, and this contractor shall provide all field wiring and connections for power and controls to suit. Ensure equipment fits within the service space allocated on the drawings as no additional provisions will be made to accommodate.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Reference Standards

.1 Perform the work in accordance with Ontario Building Code and local authorities having jurisdiction.

1.3 Fixtures and Fittings

.1 In case of discrepancy between architectural and mechanical drawings as to number and location of fixtures, the architectural drawings shall govern.

.2 Fixtures, closet seats, and fittings, pipes and pipe fittings must bear CSA mark of approval, and be new and free of imperfections.

1.4 Site Services Connections

.1 Sanitary, storm and water connections, shall commence at a point one meter outside the foundation wall.

.2 Coordinate with the site services contractor to ensure correct elevations and locations.

PART 2 - PRODUCTS

2.1 Soil, Storm, Waste and Vent Pipe and Fittings

.1 Piping:

.1 Below Grade:
Sanitary drainage, Storm drainage, and Vent lines inside building: Cast Iron or PVC, unless otherwise noted. Drainage piping from urinals up to the connection to a sanitary main serving other plumbing fixtures shall be PVC. ABS piping is not permitted for any application.

.2 Above Grade:
Shall be DWV copper or cast iron, unless otherwise noted. ABS piping is not permitted for any application.

Drainage piping from urinals up to the connection to a sanitary main serving other plumbing fixtures shall be PVC with solvent weld joints. Piping shall be equal to IPEX PVC System 15 DWV piping certified to CAN/CSA B137.2. Piping shall meet the flame-spread rating requirement of twenty-five (25) or less. Combustible piping systems penetrating a fire separation must be sealed at the penetration by a fire stop system certified for the application.

When PVC piping is required to be installed in a return air plenum, the pipe material shall be rated for this application, meeting the flame spread rating of 25 and smoke development classification of 50. Material shall be equal to IPEX XFR.

.3 Pressurized drains from sump pumps or other pressurized systems: Type L copper, or Sch 40 PVC where permissible by Code.

.2 Fittings:

.1 Fittings for buried cast iron pipe: cast iron.

.2 Fittings for above ground cast iron: cast iron, to CSA B70-M1978, and with factory applied corrosion resistant coating inside and out approved by Engineer.

.3 Fittings for copper drainage tube: recessed solder joints, drainage pattern fittings of wrought copper or cast brass, with 50-50 solder (lead - tin alloy).

.4 Fittings for Ipex PVC-DWV piping shall be certified to CAN/CSA B137.3.

.3 Joints:

.1 Cast iron hub and spigot pipe joints: packed with oakum and tightly caulked with cast lead to CSA B67-1972.

.2 Cast iron MJ pipe joints: neoprene rubber gasket with stainless steel cover and rings, equal to Fernco.

.3 DWV copper pipe joints: solder joint.

.4 Threaded pipe joints: make with teflon tape or pulverized lead paste. Apply to male threads only.

.5 Copper to cast iron joints: male brass adaptors to tapped fitting or caulk ferrule to hub fitting, or MJ pipe joint.

.6 PVC piping: Joints to be PVC, all solvent welded.

.4 Fire Stopping: Submit shop drawings of fire stopping system proposal prior to construction. Refer to Section 20 00 10 for details.

.5 Tie Rods on Storm Piping:

.1 Cast iron storm piping of NPS 6 and larger using MJ style joints shall have thrust restraining tie rods fitted to all 90° and 45° elbows, wherever the elbows are installed more than 2½ metres below any roof drain connected to that section of drainage piping.

.2 Tie rods shall be installed in pairs and shall be minimum 12 mm diameter for up to NPS 8 piping, 15 mm diameter for NPS 10 to NPS 12, and 20 mm diameter for larger sizes.

2.2 Domestic Water Pipe, Valves and Fittings

.1 **Piping**:

.1 Above ground: NPS 3/4 and under use copper tube type M, NPS 1 through NPS 4 use copper tube type L, over NPS 4 use ductile iron Class 52 to AWWA C-151 with standard thickness cement lining to AWWA C-104.

.2 Buried Service: Type K soft annealed copper to NPS 2 with no buried joints. Over NPS 2 ductile iron Class 52 to AWWA C-151 with standard thickness cement lining.

.2 Fittings:

.1 Fittings for copper tube: wrought copper and bronze to ANSI B16.22-1980 or cast bronze to ANSI B16.18-1984.

.2 Fittings for ductile iron: mechanical joint ductile iron to ANSI A21.10-1982.

.3 T-drill branch connections for type 'L' copper tube with Silfos 5 joints are acceptable.

.3 Joints:

.1 Copper Tube: 95:5 tin antimony solder up to NPS 2-1/2, 5% silver solder type Silfoss 5 above NPS 2-1/2.

.2 Ductile Iron: rubber gasket to ANSI A21-11-1980, bolts to ASTM A307-83a heavy series.

2.3 Wall/Floor Penetrations

.1 All pipes penetrating below grades, wall or floor slabs shall use Link-Seal modular seals.

.2 Provide a Schedule 40 steel sleeve with welded puddle flange cast in the wall or floor, sized to suit the pipe penetration and install appropriate Link-Seal modular seal between the pipe and sleeve.

2.4 Valves - General

.1 All valves shall be industrial quality, manufactured to the specifications indicated. Wherever possible, valves shall be by one manufacturer.

.2 Shutoff valves up to NPS 2 for uninsulated systems only may be either ball valves or gate valves unless shown otherwise.

.3 Shut off valves over NPS 2 for uninsulated systems only, may be butterfly valves or gate valves, unless shown otherwise.

.4 Shut off valves on insulated systems must be gate valves for all sizes.

2.5 Gate Valves

.1 NPS 2 and under shall be soldered ends bronze body, union bonnet solid wedge disc, rising stem, Class 125, 860 kPa to MSS-SP-80. Acceptable Materials: Jenkins 813J, Crane 1334, Toyo 299, Nibco S-134, Kitz #44, Milwaukee 1169, Hattersley 608.

.2 Over NPS 2 shall be cast iron body, OS&Y rising stem, bronze trim, Class 125, 860 kPa FF flanges, to MSS-SP-70. Acceptable Materials: Jenkins 454J, Crane 465-1/2, Toyo 421JA, Nibco F-617-0, Kitz #72, Milwaukee F2885M, Hattersley T504.

2.6 Ball Valves

.1 For use up to NPS 2 shall be 2 piece rated 600 WOG of bronze body, soldered ends, TFE seat, plated bronze ball and shaft. Acceptable Materials: Watts B6001, Toyo 5049A, Nibco T-585-70, Crane F9222, Jenkins 202J, Kitz #59, Milwaukee BA150, Hattersley 1979, MAS-B-4, Apollo 70-200.

2.7 Globe Valves

.1 NPS 2 and under shall be soldered ends bronze body, renewable disc, Class 125, 860 MPa, with lockshield handles where indicated, to MSS-SP-80. Acceptable Materials: Jenkins 106BP, Crane 1310, Toyo 222, Nibco T-235-Y, Kitz #10, Milwaukee 1590T, Hatterley 14.

.2 Over NPS 2 shall be cast iron body, OS&Y bolted bonnet, bronze disc and seat ring, Class 125, 860 kPa, to MSS-SP-85. Acceptable Materials: Jenkins 2342J, Crane 251, Toyo 400A, Nibco F-718-B, Kitz #76, Milwaukee F2981M, Hattersley T731.

2.8 Check Valves

.1 NPS 2 and under shall be soldered ends bronze body Y pattern, Class 125, 860 kPa, screw in cap, swing disc to MSS-SP-80. Acceptable Materials: Crane 37, Jenkins 4092, Toyo 237, Kitz #23, Milwaukee 1509, 1509T, Hattersley 48.

.2 Over NPS 2 shall be of the wafer design 200 WOG with twin flappers, cast iron body for clamping between flanges. Flappers to be Type 304 stainless steel with stainless spring, and EPDM resilient seat to ASTM B62-82a. Acceptable Materials: Proquip, Duo-Check 2 (Mission), Gulf, Top Flow (Watts), Mueller.

2.9 Hydrants

.1 Shall be encased non freeze single outlet wall hydrants, 20 mm connection, complete with vacuum breaker, and polished nickel bronze box. Provide one extra key.

.2 Install 1.0 m above finished grade unless otherwise noted and with inside shut-off valve.

.3 Acceptable Material: Watts HY-725, or equal by Zurn, Ancon, or Smith.

2.10 Water Hammer Arrestors (Shock Absorbers)

.1 Provide arrestors to Plumbing and Drainage Institute Standard PDI-WH 201 on branch supplies to each fixture or group of fixtures. Size of arrestors to PDI-WH 201.

.2 Acceptable Material: Watts SG series, Zurn Z1500, Ancon S6 Series, Smith 5000 Series.

.3 Where approved by the Engineer a fabricated air chamber, 450 mm long of one size larger than the pipe to which it connects may be used as an acceptable alternate to the above.

2.11 Back Flow Preventer

.1 Provide backflow preventers on all water supply lines coffee machines or other similar appliances to protect water supply system to CSA B64. Backflow preventers shall be low pressure drop double check valve type equal to Watts LF7. Backflow preventers to be CSA approved, AWWA approved and suitable for potable water installations.

.2 Acceptable Material: Watts, Clayval, Hersey, Conbraco.

2.12 Hose Bibbs

.1 Bronze construction complete with integral back-flow preventer, hose threaded spout, replaceable composition disk chrome plated in finished areas. Acceptable Materials: Crane C-5046, Emco 3741, Waltec 27W833.

2.13 Vacuum Relief

.1 Install at each domestic hot water tank a 12 mm vacuum relief valve, equal to Watts No.36A.

2.14 Trap Seal Primers

.1 Provide trap primers in areas according to plumbing Code and where noted on drawings.

.2 Provide priming device piped to nearest suitable water closet or water supply pipe, so that device will introduce regulated amount of water into trap whenever fixture is used. Flush valve water closet water supply pipe, or other suitable varying pressure water supply pipe, shall be fitted with a trap seal primer connected to each drain (one per drain), equal to Watts LFTP 300. For flush tank water closets, the trap seal primer shall be equal to Watts series MS810. Trap seal primers shall be with integral vacuum breaker.

.3 Where suitable plumbing fixtures are not available to operate the trap seal priming device, provide a time clock and electric 2-way valve to prime traps twice a day. Time clock shall be a Tork D100 digital seven day time control, 120V input and output. Electric 2-way valve shall be Honeywell V4043A, normally closed, two-way, 20 mm valve with 120V power head. Provide 120V power supply from local branch panel as required, or low voltage wiring if applicable, to make system operational as per electrical

specification installation requirements. Install in a location as directed by the Engineer.

2.15 Air Vents

.1 Provide automatic float type air vents rated minimum 1033 kPa, at high points i.e. in penthouse and where indicated. Pipe to drain.

.2 Install on the top of a full line size Tee fitting.

.3 Acceptable Material: Maid-O-Mist No.7, Watts FV4 for up to NPS 3 pipe, Spirax Sarco No. 13W for NPS 4 and over.

2.16 Strainers

.1 860 kPa gauge pressure or system pressure whichever is greater with 20 mesh removable bronze screen, Y type.

.2 NPS 2 and under, screwed with brass cap. Acceptable Material: Sarco BT, Armstrong F4SC, Crane 988-1/2, Watts 777S, Toyo 380, Kitz #15, Combraco 59 series, Mueller.

.3 NPS 2-1/2 and over, cast iron, flanged with bolted or clamped cap, NPS 1 minimum size blow down valve to NPS 6, NPS 2 minimum size blow down valve on NPS 8 size and above. Acceptable Material: Sarco BF-150, Armstrong F4FL, Crane 989-1/2, Watts 77F, Toyo 381, Kitz #80, Combraco RPC 528B12, Mueller.

.4 Provide where shown on drawings.

2.17 Deep Seal Trap

.1 Cast iron body deep seal traps, threaded, hub, or spigot on inlet and/or outlet, with minimum seal equal to 127 mm. Provide where shown on drawing.

2.18 Cleanouts

.1 Provide at all traps, base of all soil and waste stacks, and rainwater leaders and at such points shown or required installed by codes. Unless serviceable from below floor bring cleanouts up to finished floor or wall. So far as possible provide access from walls rather than floors.

.2 Type: heavy cast iron male ferrule with brass screws and straight threaded bronze tapered plug. Sealing-caulked lead seat.

.3 Size: NPS 4 and under - line size. NPS 5 and over - 100 mm.

.4 Access covers or plates:

.1 Concealed or buried work. Acceptable Material: Zurn Z-1440 Series, Ancon CO-200 Series, Smith 4400.

.2 Wall Access: face or wall type, polished nickel bronze square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs. Acceptable Materials: Zurn Z-1460, Ancon CO-480S, Enpoco, Smith 4730.

.3 Floor access: square cast box with anchor lugs and:

.1 For concrete floors cast brass with hinged scoriated cover with locking screw VP. Acceptable Material: Zurn ZANB-1460-12, Wade, Ancon CO-300-S, Enpoco CO30SQ8, Smith 4940.

.2 For terrazzo finish: polished brass with recessed cover for filling with terrazzo, complete with locking screw VP. Acceptable Materials: Zurn ZN-1511, Ancon CO-300US, Enpoco CO30SQ8TR, Smith 4200.

.3 For tile and linoleum floors: polished brass with recessed cover for linoleum or tile infill, complete with locking screw VP. Acceptable Material: Zurn ZANB-1460-11, Ancon CO-300ST, Enpoco CO306S28, Smith 4930-T.

.4 Urinal cleanouts: shall be of the expandable plug type with round stainless steel cover. Acceptable Material: Ancon CO-440-RD, Zurn, Enpoco, Smith 4420.

2.19 Floor Drains

.1 Mechanical rooms and Service areas:
Epoxy coated cast iron with integral pan with clamping collar, and adjustable head with grate, and oval funnel where shown, 200 mm nominal heavy duty grate. Acceptable Material: Zurn ZN507 (ZN507F), Ancon FD300 (FD100EG), Enpoco FD30 (FD30H), Smith 2120 (Smith 3750).

.2 Washrooms and Shower Areas:
Epoxy coated cast iron 180 mm flanged body with weep holes and threaded 100 mm throat to receive an adjustable polished nickel bronze secured 125 mm diameter strainer. In shower areas provide membrane clamp. Acceptable Materials: Watts FD-300, Zurn ZN-210B, Ancon FD100A, Smith 2005.

.3 Washbay drain with hinged grate (CB-1): Shall be epoxy coated steel with side outlet, internal trap, membrane flashing flange with membrane clamping cast iron frame, sediment bucket, and hinged ductile iron 324x324 mm grate. Acceptable Materials: Watts FD-430, Zurn, Ancon, Smith.

2.20 Roof Drains

.1 Cast iron with vandal proof secured cast aluminum or cast iron dome, underdeck clamp, flashing clamp ring with integral gravel stop, adjustable extension and bearing pan, sump receiver flange, complete with single slot control flow weir equal to Watts Accutrol flowing 5 GPM per inch of head where indicated. Acceptable Material: Watts RD-100, Zurn Z-105-5CEA, Ancon RD-100BEDK, Enpoco RD10DEPW, Smith 1085.

2.21 Natural Gas System

.1 Provide piping to ASTM A53 Schedule 40 with approved shut-off valves, pressure regulators, reducing valves, isolation cocks, drip dirt pocket connections, hardware and supports.

.2 Connect to fuel handling systems in accordance with pertinent installation code. CAN/CGA B149.1-10 (gas, natural) and governing Provincial regulations under Provincial Energy Acts, using licensed mechanics holding current certificates of competency. Electrical work in accordance to the electrical specifications.

.3 See drawings for gas piping layout, gas loads and meter locations.

.4 Arrange with the Gas Company for the upgrade to the service and pay fees and apply for permit as required.

.5 Pressure downstream of regulator shall be 1736 Pa (7" w.g.).

.6 Shut-off Valves:

.1 Shut-off valves shall be supplied for all appliances and where shown on drawings, and must be approved CGA.

.2 Except where otherwise shown, gas valves shall be lubricated plug type with cast iron body, 100% pipe area, 150 psi SWP. Provide a single lever for each valve of 75 mm or larger. Acceptable Material:

DeZurik Fig.435, Homestead Fig.601, Rockwell Fig.141, Newman-Milliken 170M/200M.

.3 Shutoff valves for indoor appliances up to 50 mm shall be bronze ball valves rated to CGA 3.16, where approved by the local gas code/authority.
Acceptable Materials:
Crane 9302, Kitz 68, Toyo 5044A, Newman Hattersby.

.7 Testing:

.1 Test at a minimum of 680 kPa or as required by Gas Company.

.2 Provide a copy of the test chart for insertion into the Operating and Maintenance Manual.

.3 Painting: Paint all gas lines whether exposed or concealed. Colour shall be yellow except where exposed on exterior walls where the colour shall match the wall colour.

2.22 Plumbing Fixtures and Trim

.1 Plumbing fixtures shall be product of one manufacturer.

.2 Materials:

.1 Plumbing fixtures to CSA B45-1981.

.2 Plumbing fittings to CSA B125-1985.

.3 Exposed plumbing brass and metal work shall be heavy triple chromium plated.

.3 All infrared activated sink and lavatory faucets shall be supplied with a thermostatic mixing valve.

.4 All manually activated barrier free sink and lavatory faucets shall be supplied with a thermostatic mixing valve installed on the hot water supply.

2.23 Flush Valve Water Closets

.1 **Floor Mounted WC-1**: Vitreous china elongated syphon jet action bowl, height 15.24" (381mm) to rim, 1½" (38 mm) top spud, with flange bolts, bolt caps, floor flange and gasket. Suitable to handle 4.2 to 6 litre per flush. Elongated heavy duty solid plastic seat open front less cover with check hinges and chromated steel posts, washers and nuts.

Provide one flush valve per floor drain with trap primer connection on back of drop pipe. Manual flush valve shall be chrome plated quiet action diaphragm or piston type with vacuum breaker, angle stop, pressure loss check and non-hold open feature.

Acceptable Manufacturers
China: American Standard Madera Flowise Elongated #3451.001.020, Eljer, Kohler K-4350, Crane.
Trim: Kohler K-13516, Delta Commercial, Crane, Zurn, Toto, Moen, American Standard, or Sloan equivalent.

2.24 Flush Valve Barrier Free Water Closets .1

Floor Mounted WC-2. Vitreous china elongated syphon jet action bowl 16 ¾" (419mm) high, concealed trapway 1½" (38 mm) top spud, with flange bolts, bolt caps, floor flange and gaske. Suitable to handle 4.2 to 6 litre per flush. Elongated heavy duty solid plastic open front seat less cover, check hinges and chromated steel posts, washers and nuts. Coordinate installation height of flush valve with seat opening, grab bars and other washroom accessories. Provide permanent back rest equal to Franke CM-16104. Manual flush valve shall be chrome plated quiet action diaphragm or piston type with vacuum breaker, angle stop, pressure loss check and non-hold open feature. Manually operated flush valve handle shall be located on transfer side of water closet.

Acceptable Manufacturers:
China: American Standard Madera Flowise #3461.001.020 HET, Eljer, Kohler K-4368, or Crane equivalent.
Trim: Kohler K-13516, Delta Commercial, Crane, Zurn, Moen, American Standard, or Sloan equivalent.

2.25 Commercial Pressure-Assist Tank Type Water Closets .1

WC-3: Vitreous china for 6 litre flush, elongated syphon jet action bowl and lined tank complete with pressure assist operating system, concealed trapway with flange bolts, bolt caps, floor flange and gasket. Bowl height 15 ¼" (381mm) to rim. Chrome plated rigid supplies with angle stop, escutcheon and flexible riser.
Elongated heavy duty solid plastic open front seat less cover with check hinges and chromated steel posts, washers and nuts, for public use, and open front with cover for private use.

.2 Acceptable Manufacturers:
China: American Standard Cadet Pressure-Assisted Elongated #2462.016.020 low consumption toilet, Crane, Eljer, or Kohler equivalent
Trim: Integral with the specified china toilet above.

2.26 Flush Valve Urinals

.1 **UR-1:** Vitreous china washdown flush action for 0.5 litre per flush (0.125 Gallon per flush), integral flush spreader, open trap, removable stainless steel strainer, 3/4" (19 mm) top spud, and outlet, 2" (50 mm) connecting flange with gasket and bolts.

Manual flush valve shall be chrome plated quiet action diaphragm or piston type with vacuum breaker, angle stop, pressure loss check and non-hold open feature.
Wall access cleanout with round stainless steel face and v.p. stainless steel screw. Carrier with steel pipe legs, block base feet supports and bearing plates suitable for installation, equal to Watts.

.2 Acceptable Manufacturers:
China: Kohler K-4991-ET, American Standard Washbrook Flowise 6590, Crane
Trim: Zurn Z6003AV-ULF, Sloan Royal #186-0.125, Delta Commercial 81T231, Kohler 13520.

2.27 Countertop Lavatories

.1 **LAV-1:** Lavatory shall be vitreous china, self rimming-drop-in installation, side rear overflow faucet ledge, oval countertop design with 100 mm centre set, with NPS 1-1/4 chrome plated adjustable P-trap, offset style with open grid type strainer, chrome finish polished brass, faucet supplies with commercial duty ¼ turn ball valves (equal to Dahl "mini-ball" valve) angle stop, horizontal extension tubes, combination v.p. loose key handle, escutcheon and flexible copper riser. Provide thermostatic mixing valve on hot water supply to faucet.

Acceptable Materials:
Lavatory: American Standard Cadet Universal Access AF-9494.001, Crane, Eljer, or Kohler equivalent.

.2 Faucet shall be sensor activated, hard wired, chrome plated cast brass, 1.9 lpm (0.5 gpm), sensor range adjustment screw, variable time out setting, vandal resistant spray head with pressure compensating flow control, thermostatic mixing valve below counter. Provide 120V/24 V transformer as required. Set faucet discharge temperature to 43 deg C.

Acceptable Materials:
Trim: Sloan Optima ETF-600 series, Delta, Moen, American Standard, or Kohler equivalent.

2.28 Wall Hung Lavatories

.1 **LAV-2:** Vitreous china wall hung, integral contoured back splash lip, supply openings on 100 mm centres, rear overflow, concealed arms, NPS 1-1/4 chrome plated adjustable P-trap, offset style with open grid type strainer, chrome finish polished brass, faucet supplies with commercial duty ¼ turn ball valves (equal to Dahl "mini-ball" valve) angle stop, horizontal extension tubes, combination v.p. loose key handle, escutcheon and flexible copper riser. Supply steel and cast iron wall carrier suitable to fixture. For drywall partition installations, carrier shall be supplied with support legs extending down to the floor. Install in accordance to barrier free requirements.

.2 Acceptable Materials:
Lavatory: American Standard Murro #0954.000, Crane, Eljer, or Kohler equivalent.

.3 Faucet shall be sensor activated, hard wired, chrome plated cast brass, 1.9 lpm (0.5 gpm), sensor range adjustment screw, variable time out setting, vandal resistant spray head with pressure compensating flow control, and thermostatic mixing valve. Provide 120V/24 V transformer as required. Set faucet discharge temperature to 43 deg C. Install thermostatic mixing valve and faucet controller/motorized valve within ceiling space directly above faucet, not below sink. Provide extended control wiring between controller and faucet as required.

Acceptable Materials:
Trim: Sloan Optima ETF-600 series, Delta, Moen, American Standard, or Kohler equivalent.

2.29 Lavatory Insulation Kits

.1 Supply and install insulation kits on all barrier free sinks and lavatories. Supply and install insulation on the complete exposed drain, hot water, and cold water, piping under the lavatory.

.2 Insulation kits shall be an integral skin white antibacterial/fungal polyurethane foam product equal to Skal Gard by TCI Products, Prowrap by McGuire, or "Pro-Extreme" by Plumberex.

2.30 Stainless Steel Sinks

.1 **SK-1:** Shall be single compartment ledge back Type 302 stainless steel 20 gauge, self rimming, with clamps, undercoated, size o.d. 520 x 510 x 203 mm, complete with integral stainless steel basket strainer/stopper, tail piece and all brass chrome plated single lever washerless faucet with swing spout and aerator. Faucet supplies with commercial duty ¼ turn ball valves (equal to Dahl "mini-ball" valve) angle stop, horizontal extension tubes, combination v.p. loose key handle, escutcheon and flexible copper riser.

Acceptable Materials:
Sink: Franke ALBS 6808-1/1, Novanni Commercial, or Moen equivalent.

Trim: American Standard "Reliant" 4205.000.F15, Chicago Faucet, Moen, or Delta equivalent.

2.31 Fire Extinguishers

.1 FE-1: Shall be10 lb multipurpose dry chemical extinguisher equal to Badger model ADV-10, rated 4A:60-B:C, complete with heavy duty wall mounting bracket.

2.32 Hot Water Heaters

.1 Commercial Water Heaters (Electric):

.1 To CSA C22.2 No. 60950-1, CSA C191-04 and ASHRAE 90.1-2010. Glass lined tank with 3 years minimum warranty. Insulate with 50 mm minimum fibreglass insulation with outer casing of sheet steel with baked enamel finish. Provide adjustable thermostat control with 16 to 60 deg.C range. Glass lined construction, fitted with distributor tube, combination temperature and pressure relief valve, built to

withstand a gauge test pressure of 2 MPa, a gauge working pressure of 1000 kPa, valved drain. Unit shall be equipped with copper-resistor type flanged immersion elements, surface mounted thermostat, switching contactors, 120 volt control circuit with transformer and manual reset high temperature limit control. Heating: electric, flip-flop. Capacity: 1.5 kW, 120V, 1 phase, 10 gallon storage.

.2 Acceptable Material: Rheem CEGSP10, John Wood, A. O. Smith, or equal.

2.33 Domestic Hot Water Heater Safety Shut-off Valve

.1 Shall be electronically actuated resettable shut-off valve, to be installed on the cold water supply to the domestic hot water heaters. The valve shall be full flow and automatically close upon detection of a water leak. Valve construction shall be lead free.

.2 The System shall be supplied with an electronic sensing type water leak detector, to be installed within a pan below the hot water heater, with cable to connect to the system controller. The drain pan shall either be a pre-manufactured unit, or custom fabricated to suit tank selection. Pan shall have a side drain connection, to be extended to a floor drain.

.3 The system controller shall provide a visual and audible indication of actuation. The controller shall have the ability to be monitored by a building alarm or building automation system.

.4 The system shall be supplied with a power cut-off module to interrupt the power to the electric, gas, or oil fired domestic water heaters.

.5 The shut-off valve diameter shall match the diameter of the cold water supply pipe serving the domestic water heater. Wherever the domestic cold water supply pipe diameter exceeds the diameter of the largest available motorized shut-off valves, provide multiple shut-off valves piped in parallel to equal the cross sectional area of the domestic cold water supply pipe.

.6 The system shall be supplied with a battery back-up module to maintain the operation of the system during a power outage. In the event that a battery back-up option is unavailable from the

manufacturer, provide a separate UPS battery back-up power supply providing a minimum of 12 hours of operation.

.7 Acceptable materials: Watts LFWDS FloodSafe with WDS-BB battery backup, or equal

PART 3 - EXECUTION

3.1 Fixture Installation

.1 Connect fixtures complete with supplies and drains separately trapped, supported level and square. Each fixture must have shutoff valves. Hot water faucets shall be on left. Fixtures on outside walls to have supplies from floor; other fixtures to be served from wall.

.2 Provide a thermostatic mixing valve for all individual infrared faucets, metering faucets, or any other similar mixing type faucet intended to discharge tempered water. Thermostatic mixing valve shall be selected to suit the faucet flow requirement, c/w check valves on supplies. Install the thermostatic mixing valve below the sink/counter.

.3 Provide a thermostatic mixing valve on the hot water supply to each barrier free lavatory faucet, kitchen sink faucet, and any other barrier free plumbing fixture discharging hot water. Set the maximum hot water supply to the faucet to 43 deg C. Coordinate all barrier free fixtures with mechanical and architectural documents. Install the thermostatic mixing valve below the sink/counter.

.4 Provide chrome plated rigid supplies to fixtures with stops, reducers and escutcheon plates.

.5 All wall mounted water closets, urinals, lavatories, and any other wall mounted plumbing fixtures shall be supplied with a fixture carrier suitable for the selected plumbing fixture, wall construction, and available pipe chase. The plumbing fixture carrier shall be suspended independently of the wall structure, secured to the floor. Set fixtures level and square. Mount water closets so that a 230 kg mass at the end of the fixture will not loosen or distort mounting, damage the piping, or damage the wall finishes, and similarly a 90 kg mass will not impact other types of wall mounted fixtures.

.6 Fixtures mounted on glazed tile surfaces shall have ground faces to finished surface.

.7 Fixtures shall be serviced as follows:

Fixture	Waste	Vent	Cold Water	Hot Water
Lavatory	32 mm	32 mm	12 mm	12 mm
Sink	40 mm	32 mm	12 mm	12 mm
Water closet (tank)	75 mm	40 mm	12 mm	---
Water closet (flush)	75 mm	40 mm	25 mm	---
Slop or Mop Sink	75 mm	40 mm	12 mm	12 mm
Urinal (flush)	50 mm	40 mm	20 mm	---
Bath	40 mm	32 mm	12 mm	12 mm
Individual Shower	40 mm	32 mm	12 mm	12 mm
Drain	75 mm	40 mm trap primer		

.8 Mounting heights for wall hung fixtures and showers from finished floor:

.1 Standard: to comply with manufacturer's roughing in details unless otherwise indicated or specified.

.2 Physically handicapped: to comply with NBCC and OBC.

.3 Install drinking fountains in accordance with ARI 1020-84.

.9 The plumbing contractor shall retain the services of an appropriate trade to supply and install the low voltage wiring for automatic plumbing fixtures between the transformers and the plumbing fixtures, as well as provide the 120V connection between the junction boxes (boxes provided by the electrical contractor) and the transformers. Coordinate location of transformers with the electrical contractor. All electrical installation shall be performed as per the electrical code and electrical specification.

3.2 Piping Installation

.1 General:

.1 Install straight, parallel and close to walls and ceilings with specified pitch. Use standard fittings for direct changes.

.2 Install groups of piping parallel to each other; spaced to permit application of insulation, identification, and service access, on trapeze hangers.

.3 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

.4 Brass and copper pipe and tubing shall be free from surface damage. Replace damaged pipe or tubing.

.5 Ream ends of pipes and tubes before installation.
.6 Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.
.7 Use non-corrosive lubricant or teflon tape applied to male thread.
.8 Grooved pipe ends: cut square, seating surface clean and free from indent and score marks.
.9 Install swing or swivel joints to connect risers from one floor outlet to next.
.10 Install flanges or unions to permit removal of equipment without disturbing piping systems.
.11 Clean ends of pipes or tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.

.2 Equipment drainage:
.1 Install drain valves at low points in accessible location.
.2 Extend equipment drain piping to discharge into floor or hub drain.
.3 Install drain piping from drain pan of air handling units, full size of outlet connection with trap seal equal to fan total pressure, unless otherwise instructed by Engineer.

.3 Expansion and Contraction:
.1 Install expansion joints and compensators, flexible connections, pipe loops and off-sets as indicated.
.2 Support piping to prevent any stress or strain.
.3 Install guides for expansion joints, to manufacturer's instructions, otherwise, for minimum 3 m on each side of expansion joint for sizes 85 mm nominal, minimum 4.8 m on each side for larger pipe sizes.

.4 Sanitary and Storm Drainage:
.1 Run piping to main sewers with uniform grade. Trap and vent fixtures as required.
.2 Where inverts are not given, pipes shall have uniform grade of 1:100 for pipe sizes of NPS 4 or larger, 1:50 for smaller sizes.
.3 Plug or cap pipe and fittings to keep out debris during construction.
.4 Jointing of pipe: compatible with type of pipe used.
.5 Install thrust restraining tie rods on elbow fittings on storm piping as described in Part 2.

.5 Interior Buried Piping:

.1 Carry out all necessary excavation inside the limits of the building and to 1 metre outside of the foundation wall. Excavate bottom of trenches so that pipes are properly and adequately supported. Refer to the Geo-technical Report. No frozen soil will be permitted under the pipes.

.2 Bed piping in a minimum layer of 150 mm of compacted sand or stone dust and backfill around and over pipe to a depth of 300 mm above top of pipe with the same material and compacted in accordance with the Geo-technical Report.

.3 Do not lay pipe in water or when in opinion of Engineer conditions are unsuitable.

.6 Water Piping:

.1 Run water piping from service connection to fixtures, equipment, outlets.

.2 Connect pressure gauge graduated from 0 to a gauge pressure of 1100 kPa on water service main on building side of water meter. Install gauge cock between service main and gauge.

.3 Provide washroom groups and branch take-offs from mains with isolating gate valves. Install stop valve in each fixture supply.

.4 Where two or more branch recirculating hot water lines are connected to main recirculating line, provide lockshield globe valve and check valve in each branch line for balancing water flow and for prevention of back flow in one branch. Adjust balancing valves to provide recirculation through each circuit. Turn over lock-shield valve key to Engineer after balancing at interim take-over.

.5 Provide hose bibb or sediment faucet for complete system drainage.

.6 Flushing and cleaning procedure for piping systems:

.1 Flush and clean out after pressure tests.

.2 Fill with solution of water and non-foaming phosphate-free detergent.

.3 Flush and drain. Clean strainers.

.4 Refill water system with clean water.

.7 Disinfection: disinfect potable water system to requirements of authority having jurisdiction. Provide necessary chemicals and flushing required.

.7 Vent piping shall be sized and installed in accordance with the Ontario Building Code.

3.3 Cleanouts

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

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.4 Non-Freeze Wall Hydrants

.1 Install 600 mm above finished grade unless otherwise indicated.

3.5 Back Flow Preventers

.1 Install in accordance with CSA B64.10-M1981, where indicated and elsewhere as required by code.

.2 Pipe discharge to over nearest drain or to service sink.

3.6 Backwater Valves

.1 Install in main sewer lines where indicated and at weeping tile connection in pit provided at building cleanout. Install in access pit as indicated.

3.7 Testing

.1 Test piping in accordance with procedures outlined in Section 20 00 10, and as specified.

.2 Testing: ensure that insulated piping and equipment installed in concealed spaces is tested and inspected prior to permanent concealment. Give forty-eight (48) hour notice to Engineer in writing.

3.8 Commissioning .1 Equipment: make tests to demonstrate capabilities and general operating characteristics of equipment, as instructed by Engineer. Modify equipment as required to achieve design performance of equipment and systems.

3.9 Cleanup .1 Leave systems operating with work areas clean to satisfaction of Engineer.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Product Data

.1 Submit product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.1 Pipe/Tank Tracing Heating Cables

.1 Self-limiting heating cable equal to Raychem XL-Trace, 208V, 8 watts per lineal foot or equivalent by:
- .1 Britech
- .2 Ouellet

.2 Complete with one AMC-F5 line sensing thermostat per individual cable run.

.3 Provide all accessories for a complete working system.

PART 3 - EXECUTION

3.1 Installation

.1 Install pipe tracing heating cables prior to installation of pipe insulation by mechanical trades as indicated and in accordance with manufacturer's instructions. Distribute and fasten cable evenly on pipe using pipe strap or glass tape at maximum spacing 0.9 m. Ensure that heating cables do not touch or cross each other at any point. Run only cold leads in conduit. Bond shield to building ground. Co-ordinate cable installation with insulation application. Loop additional cable at fittings, valves and flanges.

.2 Make power and control connections. Source breaker to be GFI type.

3.2 Testing

.1 Perform tests in accordance with Section 26 05 00 - Electrical, General Provisions.

.2 Use 500V megger to test cables for continuity and insulation value.

.3 Replace any defective sections prior to final acceptance at no cost to the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Shop Drawings

.1 Provide separate shop drawings for each isolated system complete with performance and product data, showing all calculations for loads, deflections, etc.

.2 Provide detailed drawings of all seismic control measures for equipment and piping, giving Engineers calculations for all equipment restraints.

PART 2 - PRODUCTS

2.1 Elastomeric Pads

.1 Type P1 - neoprene waffle or ribbed: 9 mm minimum thick, 50 durometer, maximum loading 350 kPa.

.2 Type P2 - rubber waffle or ribbed: 9 mm minimum thick, 30 durometer natural rubber, maximum loading 415 kPa.

.3 Type P3 - neoprene-steel-neoprene: 9 mm minimum thick neoprene bonded to 1.71 mm steel plate, 50 durometer neoprene, waffle or ribbed, holes sleeved with isolation washers, maximum loading 350 kPa.

.4 Type P4 - rubber-steel-rubber: 9 mm minimum thick rubber bonded to 1.71 mm steel plate, 30 durometer natural rubber, waffle or ribbed, holes sleeved with isolation washers, maximum loading 415 kPa.

.5 Acceptable Materials: Korfund, Masdom VM, Mason, Vibro Acoustics, Vibron, Vibra-Sil.

2.2 Elastomeric Mounts

.1 Type M1 - colour coded, neoprene in shear, maximum durometer of 60, threaded insert and two bolt-down holes, ribbed top and bottom surfaces. Acceptable Materials: Korfund, Masdom VM, Mason, Vibro Acoustics, Vibron.

2.3 Isolator Springs

.1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with leveling devices.

.2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0

.3 Cadmium plate for all installations.

.4 Colour code springs.

2.4 Spring Mount

.1 Zinc or cadmium plated hardware, housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad. Provide neoprene lined mounting hole and neoprene washer for bolting down.

.3 Acceptable Materials: Korfund, Masdom VM, Mason, Vibro Acoustics, Vibron.

2.5 Hangers

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degree arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.4 Performance as indicated.

.5 Acceptable Materials: Korfund, Masdom VM, Vibro Acoustics, Vibron.

2.6 Seismic Control Measures

.1 General:

.1 All mechanical systems and equipment to be seismically restrained in the event of an earthquake in accordance with the Ontario Building Code.

.2 Earthquake restraints are to be provided in accordance with the Ontario Building Code, NFPA, SMACNA “HVAC Duct Construction Standards” and good engineering practice.

.3 All equipment shall be suitably anchored, whether rigidly connected to the structure, or on vibration isolators, and designed for earthquake loading for the Ottawa area.

.4 Drilled or power driven anchors and fasteners not permitted.

.5 No equipment, equipment supports or mounts to fail before failure of structure.

.6 Retain a structural engineer licensed in the Province of Ontario to perform a review of the proposed mechanical installation. Provide detailed shop drawings showing the required seismic supports, bracings and fastenings restraint system for all equipment and systems to be provided under the scope of the project. These documents shall be sealed and signed by the structural engineer and submitted as part of the shop drawing package prior to rough-in work commencing on-site. The mechanical contractor shall be solely responsible for the full scope of this work. Include all costs of structural design, materials, and site review in tender bid.

.7 In the event that seismic restraints are determined not be necessary by the contractor’s seismic design engineer, a signed and sealed letter confirming this conclusion shall be provided by the contractor’s seismic design engineer and submitted for review.

.8 Seismic control measures not to interfere with integrity of firestopping.

.2 Static Equipment:

.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.

.2 Suspended equipment shall be restrained using sway bracing and hanger rods. Equipment supported by vibration-isolation hangers should be detailed and installed with isolation hangers close to the structure and upward limit stops located directly below the hangers. Avoid bracing

equipment to separate portions of the structure that may act differently in response to an earthquake. For example, do not connect a transverse brace to a wall and a longitudinal brace to a floor or roof at the same brace location.

.3 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

.4 Piping System restraints shall be compatible with requirements for anchoring and guiding of piping systems.

PART 3 - EXECUTION

3.1 Installation

.1 Seismic control measures to meet requirements of the OBC.

.2 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers as follows:

.1 Up to NPS 4: first three (3) points of support. NPS 5 to NPS 8: first 4 points of support. NPS 10 and Over: first six (6) points of support.

.2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.3 Deflection shall be not less than that for the equipment to which the piping is connected.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

.7 Drilled or power driven anchors or fasteners not permitted for use with seismic control measures.

.8 All isolation hangers should be attached close to the slab or at maximum be twelve inches from the slab. Piping penetrations through the top floor slabs or walls in the penthouse mechanical rooms should be carefully sealed all around. Horizontal penetrations should be via a pre-fabricated metal sleeve with a compressible material between the pipe and the sleeve. Vertical penetrations should use an oversize hole in the slab with compressible material between the hole and the pipe and the pipe should be supported by a clamp resting on two steel load - distributing plating over neoprene pads.

3.2 Site Visit

.1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and make adjustments and corrections in accordance with written report.

.2 Provide Engineer with notice twenty-four (24) hours in advance of visit.

.3 The Engineer providing the certified design for seismic control of equipment/components/systems shall visit the site as required to provide a letter at the end of the construction indicating the installation is in accordance with the certified shop drawing submission and Ontario Building Code item 4.1.8.18 “Elements of Structures, Non-Structural Components and Equipment”. The letter shall be stamped and signed, with the Professional Engineer’s seal, licensed in the Province of Ontario.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 References

.1 CAN/CGSB-1.60-M89, Enamel, Interior, Gloss, Alkyd Type.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

PART 2 - PRODUCTS

2.1 Manufacturers Nameplates

.1 Provide metal nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters.

.2 Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

2.2 System Nameplates

.1 Colour: Hazardous - red letters, white background. Elsewhere - black letters, white background (except where required otherwise by applicable codes).

.2 Construction: 3 mm thick, laminated plastic matt finish, square corners, with letters accurately aligned and machine engraved into core.

.3 Sizes: Nameplates shall be appropriate size to accommodate 12 mm high lettering for equipment and 6mm high lettering for controllers and panels.

2.3 Existing System

.1 Where work is carried out in an existing building, identify new work in accordance with the standards in place in the building, unless instructed in writing to deviate from these standards.

2.4 Piping

.1 General: System shall be to CAN/CGSB-24.3. Identify the fluid medium by lettering, the classification of the fluid by the primary and secondary colours, and the direction of flow by arrows.

.2 Letter sizing shall be as follows:

Pipe/insulation OD (mm)	Letter Size (mm)
30	13
50	19
150	32
250	63
Over 250	88

.3 Primary colour bands shall be 500 mm long at valves and fittings, and 1000 mm long elsewhere. Secondary colour bands shall be 50 mm wide located 75 mm in from the end of primary colour band.

.4 Arrows shall be 150 mm long x 50 mm high where the pipe/insulation outside diameter is 75 mm and greater, and shall be 100 mm long x 35 mm high otherwise. Use double headed arrows where flow is reversible.

.5 Material: Paints shall be to CAN/CGSB-1.60. Legend markers, arrows and colour bands shall be pressure sensitive plastic coated cloth or vinyl material with protective overcoating and waterproof contact adhesive undercoating, suitable for 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C. Apply to dry clean prepared surfaces. Wrap tape around pipe or pipe covering with ends overlapping one pipe diameter. For pipes smaller than 20 mm, use waterproof and heat resistant pressure sensitive plastic marker tags.

.6 Arrows and lettering shall be black or white to contrast with the primary colour band, except for fire protection piping - see later.

.7 Pipe and valve identification:

Pipe Marker Legend	Valve Tag Legend	Primary Colour	Secondary Colour
City Water	CI.W	Green	None
Domestic cold water supply	D.C.W.	Green	None
Domestic hot water supply	D.H.W.S.	Green	None
Domestic hot water recirc.	D.H.W.R.	Green	None
Storm sewer	S.S.	Green	None
Sanitary sewer	SAN.S	Green	None
Vent (plumbing)	V.P.	Green	None

.8 Natural gas piping shall be painted entirely in yellow paint, unless specifically stated otherwise.

2.5 Ductwork

.1 50 mm high black stencilled letters indicating type of air system (Supply Air AHU-1, exhaust fan EF-1, etc.) and directional flow arrows 150 mm long x 50 mm high.

2.6 Valves and Controllers

.1 Brass tags with 12 mm stamped code lettering and numbers filled with black paint.

.2 Furnish Engineer with six identification flow diagrams of approved size for each system. Include valve tag schedule, designating number, service, function and location of each tagged item and normal operating position of valves.

2.7 Controls Identification

.1 Identify all systems, equipment, components, controls and sensors.

.2 The inscription shall identify function and, where applicable, the fail-safe position.

PART 3 - EXECUTION

3.1 General

.1 Carry out identification work in accordance with CGSB-24.3 except where specified otherwise.

.2 Provide ULC and/or CSA registration plates, as required by respective agency.

3.2 Location of Nameplates

.1 In conspicuous location to facilitate easy reading from operating floor and to properly identify equipment and/or system. Provide stand-offs for nameplates on hot surfaces and insulated surfaces.

.2 Do not insulate or paint over name plates.

3.3 Piping Identification

.1 Locate on long straight runs in open areas in boiler rooms and equipment rooms, so that at least one is clearly visible from any one viewpoint in operating areas or walking aisles and not at more than 17 metre intervals.

.2 Locate adjacent to all changes in direction; at least once in each small room through which piping passes; on both sides of visual obstruction or where run is difficult to follow; on both sides of any separation such as walls, floors and partitions; where piping is concealed in pipe chase, ceiling space, or other confined space, at entry and leaving points and adjacent to each access opening; at beginning and end points of each run and at each piece of equipment in run; at point immediately upstream of major manually operated or automatically controlled valves - where this is not possible, place identification as close to valve as possible, preferably on upstream side.

.3 Legend to be easily and accurately readable from usual operating areas and all readily accessible points. Plane of legend to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.

3.4 Ductwork Identification

.1 Stencil over the final finish only.

.2 Locate on long straight runs in open areas in boiler rooms, equipment rooms, galleries, and tunnel so that at least one is clearly visible from any one viewpoint in operating areas or walking aisles and not at more than 17 metre intervals.

.3 Locate adjacent to all changes in direction; at least once in each small room through which ductwork passes; on both sides of visual obstruction or where run is difficult to follow; and on both sides of any separation such as walls, floors and partitions.

.4 Where ductwork is concealed in duct chase, gallery or other confined space, locate at entry and leaving points and adjacent to each access opening.

.5 Locate at beginning and end points of each run and at each piece of equipment in run; at each access door; and at point immediately upstream of major manually operated or automatically controlled dampers. Where this is not possible, place identification as close to damper as possible, preferably on upstream side.

.6 Legend to be easily and accurately readable from usual operating areas and all readily accessible points. The plane of the legend to be approximately at right angle to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.

END OF SECTION

PART 1 -GENERAL

1.1 General

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Reference Standards

.1 Fire Resistance:

.1 Meet NFPA 90A and 90B. Maximum flame spread rating of twenty-five (25) and maximum smoke developed rating of fifty (50) in accordance with NFPA 255 and CAN4-S102.

.2 Materials tested in accordance with ASTM C411-82 shall not flame, smoulder, glow or smoke at temperature to which exposed in service.

.2 Pipe and duct insulation to be in accordance with ASHRAE/IES Standard 90.1 Latest Edition.

1.3 Samples Submittals

.1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.4 Definitions

.1 "Concealed" - insulated mechanical services and equipment in chases, furred spaces, pipe shafts or hung ceilings. Services in tunnels will not be considered to be concealed.

.2 "Exposed" - will mean "not concealed" as defined herein.

1.5 Acceptable Insulation Contractors

.1 The following is an approved list of acceptable contractors for thermal insulation work:

.1 Thermec
.2 G & L
.3 Alpine
.4 B.L. Thermal Insulation Inc.

PART 2 - PRODUCTS

2.1 Application

.1 Domestic cold water and non-potable water piping shall be insulated with 12 mm thick system P-2 or P-3.

.2 Domestic hot water supply and recirculating piping shall be insulated with system P-1 of thickness as follow:

.1 Up to 32 mm diameter pipe: 25 mm
.2 Over 32mm diameter pipe: 40 mm

.3 All horizontal sections of storm drainage and the first 1.5 m of the vertical stack either side of the horizontal leader, shall be insulated with 25 mm system P-2 or P-3. Insulate the drain body with flexible blanket and vapour barrier or
E-5.

.4 All external exposed storm drainage pipes, routed through soffits, or unheated spaces, shall be heat traced and insulated with 50 mm system P-2.

.5 For air conditioning systems, insulate all supply air ducting up to the diffusers with 25 mm system D-1 where concealed, and D-2 where exposed. The insulation is to be provided on all ductwork, including but not limited to above suspended ceilings, in return air plenums, exposed, and within shafts and service spaces. In non-heated spaces the thickness shall be 50 mm. The insulation shall be continuous over the full length of the ductwork, and cover all duct mounted equipment and devices, such as heating coils.

.6 For heating and ventilating systems, insulate only those portions of the supply and return ductwork running through unheated spaces with 50 mm system D-1 where concealed, and D-2 where exposed.

.7 Insulate exhaust ducts and plenums starting 1.5 m upstream of exhaust damper and carry the insulation to the exterior wall louvre. In the absence of a duct mounted damper, where applicable, carry the insulation from the louvre to the air handling unit damper. In the absence of any damper, the insulation shall extend a minimum of 1.5 m from the outdoor louvre. Insulation shall be 50 mm system D-1 where concealed and D-2 where exposed.

.8 Insulate all unconditioned outdoor air ducts and plenums with 50 mm system D-2 or D-3.

.9 For ducts with acoustic insulation, the thermal insulation thickness may be reduced by 25 mm for every 25 mm of acoustic insulation.

.10 All exposed insulated ducts shall be covered in a canvas jacket. All exposed insulated pipes shall be covered in a PVC jacket. Pipes on roof shall be covered in an embossed aluminum jacket. Jackets are not required on indoor piping when system P-3, D-3 and E-5 are used

2.2 System P-1

.1 Insulation shall be of fibreglass one-piece pipe insulation to CGSB 51-GP-9M with an 'all service' jacket. Butt joint strips of same material as jacket shall be furnished. Jacket seams and butt joint shall have 50 mm overlaps. When required insulation thickness exceeds that available in a single layer, manufacturer shall furnish insulation in multiple layer construction.

.2 Insulation shall be suitable for operating temperatures of 4°C to 454°C, water vapour permeance 0.02 perms maximum, thermal conductivity k of 0.26 maximum at 38°C mean temperature.

.3 Apply pipe insulation with joints and seams tightly butted together, using either the self sealing flaps or an approved tape and adhesive system. Bond laps by applying uniform pressure to assure complete and uniform contact.

.4 Insulate fittings for piping with fibreglass preformed fittings or mitred segments, wired in place, to the same thickness as adjacent insulation. Apply skim coat of insulating cement to provide a smooth surface. Finish with glass fabric embedded in mastic. Alternatively, PVC approved moulded fitting covers may be used.

2.3 System P-2

.1 Shall be as for System P-1 except in addition it shall include a continuous integral approved vapour barrier to CGSB 51-GP-52M.

.2 Fittings, valves, flanges, etc. shall be insulated with mitred segments or preformed fibreglass insulation, fittings shall be wired in place. The vapour barrier shall consist of .025 mm aluminum foil wrapped tightly over insulation, with all laps sealed with vapour seal mastic into which glass fabric is embedded. A final 3.2 mm wet coat of vapour seal mastic shall then be applied. The entire vapour barrier at each flange, valve and fitting shall extend a minimum of 51 mm on to adjacent pipe insulation.

2.4 System P-3

.1 Shall be a flexible elastomeric closed cell insulation to CAN/CGSB-51.40 with a flame/smoke rating not exceeding 25/50 when tested in accordance with CAN4-S102.

2.5 System D-1

.1 Shall be fibreglass blanket complete with vapour barrier to CGSB 51-GP-11M and CGSB 51-GP-52M.

.2 Adhere to duct surface with mechanical fasteners approved at the rate of one per 0.14 sq.m. Butt all edges of insulation and seal all joints with 50 mm foil tape. Seal all breaks with foil tape.

.3 On round ducts use 2.0 mm galvanized tie wires on 450 mm centres.

2.6 System D-2

.1 Shall be rigid mineral fibre board for ducting to CGSB 51-GP-10M with vapour barrier jacket and facing material to CGSB 51-GP-52M.

.2 For round ductwork shall be semi-rigid fiberglass blanket bonded to a flexible facing with vapour barrier jacket and facing material to CGSB 51-GP-52M, density 40 kg/cu.m, equal to Johns Manville Micro-Flex.

.3 Insulation shall be cut to fit between standing seams and stiffeners and shall be secured to ductwork by impaling over mechanical fasteners at the rate of one per 0.2 sq.m. All joints to be tightly butted. Tape all joints and cover all pin penetrations with 100 mm foil tape to provide a complete vapour barrier envelope.

.4 Protect all edges and around access door and main door openings with 0.4 mm aluminum 50 mm x 50 mm corner beads.

2.7 System D-3

.1 Shall be flexible elastomeric black insulation equal to Armaflex 2.

2.8 System E-5

.1 Shall be a flexible elastomeric closed cell sheet insulation to CAN/CGSB-51.40 with a flame/smoke rating not exceeding 25/50 when tested in accordance with CAN4-S102. When installed outdoors, cover insulation for UV protection as per manufacturer's recommendations.

2.9 System E-6

.1 Shall be batt type fibreglass blanket complete with foil encapsulating blanket. No exposed insulation fibres are acceptable.

.2 Secure insulation "blankets" to the back of all linear radiant heating panels using 2.0 mm galvanized tie wires on approximately 450 mm centres.

.3 Jacket to be compliant with CGSB 51-GP-52.M

.4 Insulation to be compliant with CGSB 51-GP-11M.

2.10 Fastenings

.1 Tape: self adhesive scrim reinforced foil, 100 mm wide rated under twenty-five (25) for flame spread and under fifty (50) for smoke development.

.2 Lap Seal Adhesive, quick setting adhesive for joints and lap sealing of vapour barriers. Flame spread ten (10) smoke development 0.

.3 Contact Adhesive: quick-setting adhesive for seams and joints of flexible unicellular insulation. Flame spread twenty-five (25), smoke development fifty (50).

.4 Lagging Adhesive: fire retardant coating approved by authorities having jurisdiction prior to application. Engineer and the authority having jurisdiction reserves right to remove sample of covering for testing.

2.11 Jackets

.1 Canvas shall be compact, firm, ULC labelled, 25/50 rated heavy plain weave cotton fabric, with flame spread less than twenty-five (25), smoke developed less than fifty (50), as supplied by S. Fattal Canvas Inc., or approved equal. Plaster dip shall be a mold inhibiting type.

.2 Aluminum where specified, apply 0.4 mm thick embossed alloy jacketing with longitudinal slip joints and 50 mm end lap with factory attached protective liner on interior surface. Secure with stainless steel butt straps with mechanical fasteners. Jackets on fittings 0.4 mm thick, die shaped components of alloy with factory attached protective liner on interior surfaces.

As an alternative for exterior piping and ductwork, 6 mm thick rubberized Bitumen foil faced adhesive membrane may be applied only in applications where the exterior temperature is suitable to satisfy manufacturer's installation instructions: Acceptable Material shall be Polyguard Alumaguard when applied at outdoor air temperatures above 10 deg F, or 3M VentureClad 1577CW when applied at outdoor air temperatures above -10 deg F.

.3 PVC shall be white or coloured meeting the twenty-five (25) flame spread, fifty (50) smoke developed ratings with premolded fitting covers. Acceptable material shall be Manville Zeston 2000 or Proto PVC. Install in accordance with manufacturers installations.

PART 3 - EXECUTION

3.1 Application

.1 Apply insulation after required tests have been completed and approved by Consultant. Insulation and surfaces shall be clean and dry when installed and during application of any finish in accordance with the manufacturer's recommendations.

.2 Work shall be performed by an insulation journeyperson.

.3 Apply insulation and coverings on hot piping and equipment while surface is between 50 - 60°C.

.4 Insulate roof drain body with 25 mm flexible insulation held in place with 100% coverage of insulating cement.

.5 Vapour barriers and insulation to be complete over full length of pipe, duct or surface, without penetration for hangers, standing duct seams, and without interruption at sleeves, pipe and pipe fittings.

.6 Install insulation with smooth and even surfaces.

.7 Apply insulation materials, accessories and finishes to manufacturer's recommendations.

.8 Apply 0.4 mm thick aluminum corners to all ductwork in mechanical rooms.

.9 Apply 0.4 mm thick aluminum edging around access doors, access panels, or any unprotected canvas edge.

.10 Use factory fabricated, easily disassembled insulation, for valves, fittings and process equipment requiring periodic maintenance of parts and sub-assemblies listed or indicated.

.11 Terminate insulation at each end of unions and flanges on hot lines, and at other points where indicated, with insulation cement, to CGSB 51-GP-6M, trowelled on bevel.

.12 Gouge out insulation for proper fit where there is interference between weld bead and insulation. Bevel away from studs and nut to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles, supports, hangers and clamp guides and seal with insulating cement.

.13 Insulation is not required for chrome plated piping, valves, unions, flanges and valve bonnets on domestic hot and cold water services including drinking fountains.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Reference Standards

.1 HVAC Duct Construction Standards - Metal and Flexible 1985.

.2 SMACNA HVAC Duct Leakage Test Manual 1985.

.3 ASHRAE Handbook, Fundamentals and Systems Volume.

.4 CAN4-S112-M82 1987: Fire Test of Fire Damper Assemblies.

.5 CAN/ULC S110-M86: Fire Tests for Air Ducts.

.6 UU81-1981: Factory Made Air Ducts and Connections.

.7 NFPA 90A-1985: Installation of Air Conditioning and Ventilating Systems.

.8 ASHRAE 36B-63: Method of testing for rating acoustic performance of air control and terminal devices and similar equipment.

.9 NFPA 251: Fire test of Building Construction Materials.

.10 ARI 430: ARI Standard for Central Station Air Handling Units.

.11 Fans

- .1 AMCA 99-1983, Standards Handbook
- .2 ANSI/AMCA 210-1985, Laboratory Methods of Testing Fans for Rating.
- .3 AMCA 300-1985, Reverberant Room Method for Sound testing of Fans.
- .4 AMCA 301-1976, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .5 ANSI/ASHRAE 51-1985, Laboratory Methods of Testing Fans for Rating.
- .6 CGSB 1-GP-181M-77, Coating, Zinc Rich, Organic, Ready Mixed.

1.3 Shop Drawings and Maintenance Materials

.1 Shop drawings shall include ductwork interference drawings clearly showing co-ordination with all other trades.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment and addresses of suppliers of same, together with list of specialized tools necessary for adjusting, repairing or replacing of same, for placement into operating manual.

1.4 Manufactured Items

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

1.5 Coordination

.1 Coordinate with all other trades to facilitate installation of lights, sprinkler heads, plumbing and sprinkler piping, etc.

PART 2 - PRODUCTS

2.1 H.V.A.C. Ductwork

.1 Ductwork shall be constructed to withstand 1-1/2 times the working static pressure without mechanical failure, using galvanized lock forming quality steel with Z90 designation zinc coating to ASTM A525M-86 or G90 designation to ASTM A525.

.2 Ductwork gauges, reinforcing and sealing techniques, shall be in accordance with latest edition of SMACNA, for the following classifications:

System	Pressure Class Pa.	("wg)	Seal Class
Washroom exhaust	-250	(-1")	C
Return air	-250	(-1")	--
Make-up air system	+250	(+1")	C
Fan Coil Units	+125	(+1/2")	--
Rooftop and indoor unit constant volume supply	+500	(+2")	C

The contractor shall submit a schedule for each system showing the proposed duct construction including size, gauge, reinforcing type, and support details.

.3 The seal classification outlined above is to comply with SMACNA, but generally as follows:

.1 Class A: Seal all transverse joints, longitudinal seams, and duct wall penetrations.

.2 Class B: Seal all transverse joints and longitudinal seams.

.3 Class C: Seal all transverse joints.

The sealant shall be of water based synthetic latex suitable for indoor and outdoor applications.
Acceptable Materials: Duradyne, Foster, McGill Air Seal.

.4 Tape shall be polyvinyl treated open weave fibreglass type, 50 mm wide.

.5 All fittings shall be constructed in accordance with SMACNA or ASHRAE standards. Radiused 1-1/2D elbows shall be used wherever possible. If necessary to avoid obstructions, smaller radii may be used with single thickness vanes. Square elbows over 400 mm size shall have double thickness vanes. Diffuser takeoffs shall be conical complete with butterfly dampers. VAV box takeoffs from duct main shall be conical, with rigid ductwork to the VAV box. Spin-ons shall not be used at any locations.

.6 For duct pressure classifications of 1000 Pa (+4") and higher, rectangular duct joints must be a proprietary system. Non proprietary systems are not acceptable.
Acceptable Materials: Ductmate, Nexus

.7 Leakage testing:
Refer to Part 3 of this section.

.8 Spiral Wound and Flat Oval ductwork to be as follows:

.1 Provide factory fabricated spiral wound duct and matching fittings in accordance with current SMACNA HVAC Duct Construction Standards - Metal & Flexible, except were indicated otherwise. Provide duct materials, gauges, reinforcing and sealing for operating pressures indicated.

.2 Transform duct sizes gradually, not exceeding 15° divergence and 30° convergence.

.3 Branch connections: 45° lateral takeoffs of 90° conical fittings.

.9 Button punch snaplock not to be used on medium or high pressure systems.

2.2 Duct Hangers and Supports

.1 Rectangular ductwork in exposed or concealed areas, insulated or non-insulated, shall be supported on black rolled steel angles with black steel threaded rods.

.2 Round ductwork up to 1270mm (50") diameter in exposed or concealed areas, insulated or non-insulated, shall be supported with galvanized steel straps with black steel threaded rods, equal to Ductmate round duct strap bracket. A galvanized steel suspension ring band with a threaded support rod is acceptable up to 300mm (12") diameter ductwork, equal to Ductmate round duct hanger. For ductwork larger than 1270mm (50") diameter, submit SMACNA support detail for review.

.3 Flat oval ductwork up to 1270mm (50") in width in exposed areas, insulated or non-insulated, shall be supported with galvanized steel straps with black steel threaded rods, equal to Ductmate round duct strap bracket. Larger ductwork shall be supported on black rolled steel angles with black steel threaded rods. For concealed areas, supports shall be as per exposed installations or alternatively supported on black rolled steel angles with black steel threaded rods.

.4 Steel angles shall be in accordance with the following table:

Duct Size mm	Angle Size mm	Rod Size mm	Spacing M
up to 750	25 x 25 x 3	6	3
751 to 1050	40 x 40 x 3	6	3
1051 to 1500	40 x 40 x 3	10	3
1501 to 2100	50 x 50 x 3	10	2.5
2101 to 2400	50 x 50 x 5	10	2.5
2401 and over	50 x 50 x 6	10	2.5

2.3 Flexible Ductwork

.1 Shall comply with the requirements of UL-181 "Standards for Safety, Air Ducts", Class 1 and NFPA 90A.

.2 Unless otherwise noted, a flexible duct shall not exceed a length of three (3) meters. Flexible ducting shall not be used in exposed locations.

.3 Duct shall be rated for 2500 Pa (10") pressure, and be of flexible spiral wound aluminum with triple locked seams and shall be factory insulated with 25 mm thick fibreglass insulation, and approved jacket, unless ductwork is not required to be insulated.

2.4 Internal Acoustic Duct Lining

.1 25 mm thick high density flexible fibrous glass duct liner fastened to interior sheet metal surfaces with 100% coverage of an approved fire resistant bonding adhesive and metal pins and washers, spaced on not more than 300 mm centres. Only long fibre products as manufactured by a flame attenuated process will be acceptable, with a black acrylic scrim lining on one face.

.2 Seal edges, pin penetrations and joints with approved fire resistant mastic.

.3 Protect leading edges with sheet metal edging.

.4 Flame spread rating on interior lining shall not exceed twenty-five (25).

.5 Materials:

.1 CGSB 51-GP-11M fibrous glass rigid board.

.2 Acceptable Materials:
Rectangular ductwork: CertainTeed ToughGuard, Johns Manville Permacote Linacoustic RC-HP, Manson equivalent.
Spiral and flat oval ductwork: Certainteed ToughGuard Ulra Round, Johns Manville Spiracoustic Plus, Manson equivalent.

.6 Duct sizes show only free area. Increase metal ducts to accommodate acoustic insulation.

2.5 Duct Access Doors

.1 Provide where indicated, and for access to all fire dampers, dampers, for cleanouts on specialty systems, and everywhere internal ductwork systems require inspection and maintenance. Access doors shall be fabricated of same material as ductwork. For insulated ducts, access doors shall be sandwich construction with 25 mm thick rigid fibreglass insulation.

.2 Access doors on rectangular ductwork shall be flat oval shape, double flange, ultra-low leakage with a minimum of two camlock fasteners. Minimum size shall be 450 x 250 mm, unless otherwise stated or required. Acceptable Material: Nailor 0800 type M1, or equal.

.3 Access doors on round ductwork shall be high pressure caulked and screwed to turret box, welded to saddle. Saddle shall be formed to duct radius. Door shall be held in place with a minimum of two camlock fasteners Size shall be suitable to provide maintenance access to internal component. Acceptable Material: Nailor 0895, or equal.

.4 Access doors on round duct branches to individual diffusers shall be low pressure design with curvature to match duct radius, with polyethylene gasket, hinge and locking brackets. Acceptable Material: Nailor 0890, or equal.

2.6 Flexible Connections

.1 Provide where indicated, at fans and at air handling units, neoprene coated fire resistant self extinguishing glass fabric, minimum density 814 g/sq.m. factory fabricated, not more than 150 mm long between metal parts and installed with just sufficient slack to prevent vibration transmission. Allow 100 mm movement to low pressure fans.
Flexible connections shall be air tight and suited for operations up to -40°to 120°C.

.2 Acceptable Materials: Durodyne Durolon, Vent Fabrics Inc. Ventglass, Elgen Manufacturers Neoprene

2.7 Turning Vanes

.1 Provide small arc air foil hollow vanes in duct elbow where centreline radius is less than 1-1/4 times turning dimension of duct.

2.8 Instrument Test Ports

.1 1.6 mm thick steel zinc plated, neoprene expansion plug complete with handle, chain and cam lock handles, 28 mm minimum inside diameter and neoprene mounting gasket. For insulated ducts use extension neck. Acceptable material: Durodyne, or equal.

2.9 Balancing Dampers

.1 Splitter dampers: where indicated with locking quadrant on exterior duct. Dampers to be single thickness one gauge heavier than duct.

.2 Single blade round butterfly dampers: to be 0.8 mm thick where indicated with locking quadrants.

.3 Multi-leaf opposed blade dampers: designed to SMACNA details with locking quadrant to be used in rectangular ducts.

2.10 Static Fire Dampers

.1 Fire dampers shall be listed and bear label of ULC, and shall meet requirements of NFPA 90A and authorities having jurisdiction. These dampers shall only be used in systems designed to be off during a fire alarm condition.

.2 To be factory fabricated for fire rating requirement to maintain integrity of membrane being pierced. Dampers shall be "out of airstream" type except where stated otherwise.

.3 Mild steel, fire link actuated top hinged door, multi-blade hinged weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow, sized to maintain full flow cross section. Link to be 165°F (74°C).

.4 Fire damper assemblies shall be galvanized steel. Installation shall be complete with frame and 40 x 40 x 3 mm angle iron on full perimeter of frame on both sides of barrier being pierced.

2.11 Gravity Back Draft Dampers

.1 Automatic gravity operated, multi-leaf, extruded aluminum construction with vinyl edge seals, counterweighted where indicated.

.2 Acceptable Material: Tamco series 7600, or equivalent.

2.12 Exhaust/Intake Dampers

.1 Dampers shall be constructed of 6" extruded aluminum insulated blades, 12 ga. insulated extruded aluminum frames, double sealed bearings, with side and blade seals, rated at less than 0.6% leakage at 10" s.p.

.2 Damper shall be supplied with end switch for confirmation of open damper position.

.3 Acceptable manufacturers: Tamco Series 9000, Ruskin CDTI-50, Alumavent 3900 Series.

2.13 Grilles, Registers and Diffusers - General

.1 Sizes indicated on the drawings are nominal. Provide correct standard product nearest to nominal for capacity throw, noise level, throat and outlet velocity.

.2 Contractor shall be responsible to confirm the exact diffuser module dimension for compatibility with the existing or new suspended ceiling grid system prior to submitting shop drawings. Perform necessary measurements on site for existing ceiling installations, and coordinate with Architectural trades and ceiling system shop drawings for new ceiling constructions.

.3 Construction:

- .1 Steel: prime coated stamped or cold rolled steel with exposed joints welded and ground flush and completely closed.
- .2 Aluminum: extruded with mechanical fasteners and completely closed corners.
- .3 Provide plaster frames as plaster stops where set into plaster or gypsum board.
- .4 Provide concealed fasteners and operators.

.5 Unless stated otherwise, colour shall be off-white.

.4 Linear diffusers shall include fully acoustically insulated plenums, even if not specifically listed in the grilles and diffuser schedules.

.5 Acceptable Materials: E. H. Price, Krueger, Nailor Industries, Metal-aire, Titus.

2.14 Roof Exhauster F-5

.1 Aluminum housing centrifugal fan unit, V-belt driven, complete with resilient mounted motor and fan, 12 mm x 2.0 mm aluminum mesh birdscreen, electrical disconnect switch within fan housing, continuous curb gaskets, cadmium plated securing bolts and screws, and self flashing galvanized steel roof curb, with 50 mm insulation, and built-in thermal overload protection. Capacity as shown on drawings.

.2 Acceptable Materials: Penn Domex, Greenheck GB Series, Carnes VEBC Series, Jenn Fan, Cook, Twin City, Canarm.

2.15 Ceiling Mount Exhaust Fans

.1 Fans shall have acoustically lined cabinet tested to AMCA Standard 300, with chatterproof backdraft dampers, centrifugal fan wheel, resilient mounted motor and wheel, 110 volt, 1 phase motor, solid state speed controller factory mounted on cabinet and wired to fan motor. Capacity as shown.

.2 Acceptable Materials: Penn Zephyr, Carnes VCDB Series, Greenheck SP or CSP Series, Jenn Fan, Cook, Broan.

2.16 De-stratification Fans F-6 & 7

.1 Shall be 56” diameter blade sweep, up/downdraft airflow rotation, 120V, 1ph., 0.9 AMPS impedance protected PSC type variable speed motor with permanently lubricated ball bearings. Blades shall be painted steel with curved ends. Colour shall be white or black, as directed by the Architect.

.2 Downrod length shall be a minimum of 16” (400mm), or longer as required to suit adjacent structural elements, light fixtures and other obstructions.

.3 Wall mounted fan speed controller shall provide infinite speed adjustment, with minimum speed adjustment screw, designed to fit in a standard electrical box. Speed controller shall be equipped with forward/reverse switch. Controller shall be capable of controlling a minimum of four (4) fans.

.4 Fan assembly shall be secured with chain to building structure.

.5 Acceptable Materials: Canarm model CP 56 F&R with FRMC5 controller, or equal.

2.17 Rooftop Air Conditioning Units

.1 Shall be single zone roof mounted package with DX cooling, gas heat exchanger, 50 mm 35% efficient filters, airside economizer controlled from dry bulb with intake and exhaust air hoods. The unit shall be CSA and ULC approved, and shall be rated to ARI 210 Standard for Unitary Air Conditioning Equipment. Cooling system efficiency, and fan efficiency for motors 5 HP and larger shall comply with ASHRAE 90.1-2013 edition. Compressors and heat exchangers shall be warranted for 5 years, parts only, non-prorated.

.2 Downflow units shall be complete with 600 mm high insulated roof curb suitable for seismic anchoring, or higher if noted otherwise on the drawings.

.3 Units shall have economizers with barometric dampers. Economizers shall be controlled from dry bulb.

.4 Compressors shall be hermetic with two (2) compressors with low ambient lockout on the second stage cooling. Condenser fans shall be permanently lubricated and have built in thermal overloads.

.5 Supply fans shall be either direct drive with a variable frequency drive, or belt driven with adjustable sheaves. DX units with a cooling capacity of 65,000 BTU or larger at AHRI conditions shall be supplied with a fan control system to automatically reduce the fan speed to no greater than 66% during periods of low cooling, drawing no more than 40% of the fan power at low speed.

.6 Heating shall be a minimum of two stages.

.7 Provide programmable electronic night setback thermostat, adjustable dead band control between cooling and heating of minimum 2.9 deg C (5 deg F) for automatic switchover control, fan on-auto switch, manual changeover control, anti-short cycle timer, and LCD display. Thermostat shall be supplied by rooftop unit supplier. Provide wiring as required between thermostat and unit. Exposed wiring to be installed in conduits.

.8 Unit shall be supplied with a factory installed and wired carbon dioxide (CO_2) sensor located in the return air path to control the outdoor air intake between the minimum and maximum airflow settings.

.9 Unit shall be supplied with a factory installed and wired main electrical weatherproof disconnect switch, as well as 120V/20A 5-20R weatherproof service receptacle for field wiring by electrical contractor.

.10 The rooftop units shall be supplied with a factory installed 24V relay to close a contact when cooling is activated. The relay is to be monitored by the electrical contractor to disable heating systems within the building.

.11 Acceptable Materials: Lennox, Trane, York, Carrier, Daikin, Aaon.

2.18 Louvres

.1 Louvres to be high performance AMCA rated, 100 mm deep, 2 mm thick extruded aluminum blade and frame construction, Type 6063-T5 alloy, entirely welded, 45 degree blades with drainable head frame, with 12 mm x 12 mm 1.6 mm aluminum birdscreen. Minimum free area shall be 50% for a 1200 x 1200 louvre, with a beginning point of water penetration at 960 fpm (4.88 m/s) with 0.104” w.g. (0.026 kPa) pressure drop. Finish in baked enamel in a colour to be selected at time of shop drawing review.

.2 Acceptable Materials: Airolite K609HP, or equivalent by Ruskin, Ventex/Alumavent, Nailor, Greenheck.

2.19 CO/NO_2 Hazardous Gas Detection System

.1 Provide complete gas detection system for the new service garage area.

.2 System shall provide continuous monitoring of carbon monoxide (CO) and nitrogen dioxide (NO_2) levels in parts per million (ppm). A signal from gas detection unit shall be used to start and control the exhaust fan and open the outdoor air intake damper.

.3 All sensors shall be factory calibrated before on-site installation. Provide all wiring as required between the controller and the sensors, to be installed within conduits.

.4 Manufacturer's technician shall be on site during system startup. System shall be suitable for operation at temperature of -10°C to +40°C and relative humidity to 100%. Locate sensor as shown on drawings.

.5 Unit Control Panel to include the following features:

- .1 LED indication for power, channel, low alarm, high alarm, and sensor fail. Built-in Test to monitor sensor inputs continuously.
- .2 Control panel to be field configurable for sensor type input, common or independent relay operation. Time delays for make or brake, and audible disable through dips switches inside panel.
- .3 Control panel enclosure to be a Nema 4 rating and accept either a solid state sensor input or 4 to 20 mA input.
- .4 Two DPDT 5A relays with 5, 10, or 15 min delays on make on 10, 15, or 25 min delays on break to proved output signal to exhaust fan. On start-up of exhaust fan there shall be a 5 min delay.
- .5 Calibration of setpoints to be digitally stored to EEPROM through dip switch selection.
- .6 Horn and strobe light to suit the sequence of operation. If externally mounted, provided interlocking wiring as required.

.6 Electrochemical sensor shall carry a one year manufacturer's warranty.

.7 Provide 120V/24V transformer as required for system operation. Wiring from control panel and sensors and to other control devices shall be 24V, to be installed in conduits.

.8 Sequence of Operation:

.1 Low level alarm condition to activate exhaust system (intake motorized damper, exhaust motorized damper, and exhaust fan) at 50 ppm CO and/or 3 ppm NO_2 with visual indication on unit. Exhaust system shall automatically shut down when low level condition is satisfied.

.2 High level alarm condition to activate visual and audible alarm at 100 ppm CO and/or 5 ppm NO_2 should condition remain for more than ten (10) minutes. High alarm shall automatically reset when high level condition is satisfied.

.3 Should system fail to operate properly, the exhaust system shall be automatically activated until repairs are made.

.9 Acceptable Materials: Quatrosense Environmental Ltd. Model M-Controller controller and solid state CO sensor and NO_2 sensor, Armstrong.

2.20 Exhaust and Intake Dampers

.1 Dampers shall be constructed of 6" extruded aluminum insulated blades, 12 ga. insulated extruded aluminum frames, double sealed bearings, with side and blade seals, rated at less than 0.6% leakage at 10" s.p.

.2 Damper shall be supplied with end switch for confirmation of open damper position.

.3 Acceptable manufacturers: Tamco Series 9000 or Ruskin CDTI-50.

2.21 By-Pass VAV Boxes

.1 Shall be low pressure terminal unit, with casing constructed of 22 gauge zinc coated steel, acoustically and thermally lined with minimum 13mm thick internal insulation meeting NFPA 90A. Units shall be suitable for cooling and heating/cooling systems. Unit shall be supplied with 900mm long sound attenuator on discharge of VAV box with minimum 13mm thick internal acoustic lining.

.2 Unit shall be supplied with round or oval inlet duct connection with balancing damper, internal diverter damper with actuator, balancing damper at bypass discharge opening, and minimum air volume stop on electric actuator for field adjustment. By-pass opening shall be either on side or top of casing, to be confirmed by contractor to satisfy site restrictions and installation requirements. Performance shall be tested in accordance with ANSI/ASHRAE 130-1996 and ARI 880-98.

.3 Controls shall be pressure dependent, analog electronic control with 120V/24V control transformer, electric damper actuator, toggle electrical disconnect switch, and wall mounted temperature sensor. Wiring between sensor and VAV box shall be 24V. Controllers shall be factory supplied and installed on VAV box. The unit shall be supplied with a heating/cooling switch-over controller to reverse the operation of the by-pass damper whenever the supply air temperature is above the room temperature setpoint.

.4 Acceptable Material: Nailor, E. H. Price, Krueger, Metal-aire, Titus.

2.22 Wall Exhaust Caps

.1 Washroom exhaust fan wall termination shall be mill finish aluminum, 0.02” thick, backdraft damper, insect screen, 8” (200mm) duct connection, equal to Famco RDWVA.

PART 3 - EXECUTION

3.1 Duct Installation

.1 Install steel duct in accordance with SMACNA standards.

.2 Do not break continuity of insulation vapour barriers by hangers or rods. Insulate strap hangers 100 mm beyond insulated duct.

.3 Install breakaway joints in ductwork on each side of fire separation.

.4 Anchor all risers in accordance with SMACNA Standard.

.5 Install fire dampers to NFPA 90A.

.6 Make fresh air intake ducts watertight up to end of transition. Fit drain connections on bottom with minimum 20 mm pipe to funnel drain.

.7 Apply sealant to outside of joint to manufacturer's recommendations. Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.

3.2 Fresh Air and Exhaust Openings

.1 Install to SMACNA details.

.2 Reinforce and brace air outlets and intakes for wind speed as per NBC for location.

.3 Provide air inlet openings with 1.6 mm thick 25 mm and air outlet openings with 12 mm mesh screwed aluminum birdscreens.

3.3 Duct Leakage Testing

.1 Supply ducts of pressure classification 750 Pa (+3") or higher for variable air volume systems, and all ductwork located outdoors, shall be tested for leakage at 1-1/4 times the ductwork design pressure class. Testing method and calculation shall follow SMACMA HVAC Duct Leakage Test Manual and ASHRAE 90.1 guidelines. Representative sections of ducts, representing a minimum of 25% of the total installed duct area, shall be pressure tested.

.2 All supply ducts of pressure classification 500 Pa (+2") from constant volume rooftop units and indoor air handling systems shall be tested for leakage at 1-1/4 times the ductwork design pressure class. Testing method and calculation shall follow SMACMA HVAC Duct Leakage Test Manual and ASHRAE 90.1 guidelines. Representative sections of ducts, representing a minimum of 25% of the total installed duct area, shall be pressure tested.

.3 Make trial leak test, as instructed to demonstrate workmanship.

.4 Install no additional ductwork until trial test has been passed.

3.4 Flexible Ductwork Installation

.1 Support flexible ducts at 1.0 metre centres.

.2 Maximum length of flexible duct connections: 900 mm for control boxes and 3 m for supply air diffusers.

.3 Make connections between flexible duct and terminal devices airtight with clamps and duct sealant.

3.5 Flexible Connection

Installation

.1 Install in following locations:
- .1 Inlets and outlets to supply air units and fans.
- .2 Inlets and outlets of exhaust and return air fans.
- .3 As indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:
- .1 Ducting on each side of flexible connection to be in alignment.
- .2 Ensure slack material in flexible connection.

3.6 Instrument Test Ports

.1 General: Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locations:
- .1 For traverse readings:
  - .1 At ducted inlets to roof and wall exhausters.
  - .2 At inlets and outlets of other fan systems.
  - .3 At main and sub-main ducts.
  - .4 And as indicated.
- .2 For temperature readings:
  - .1 At outside air intakes.
  - .2 In mixed air applications in locations as approved by Engineer.
  - .3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

3.7 Acoustic Duct Lining Installation

.1 Install lining in accordance with manufacturer's recommendations.

.2 Refer to drawings for ducts requiring acoustic duct lining shown cross hatched, or with internal dashed line.

3.8 Fire Damper Installation

.1 Install fire dampers to NFPA 90A-1985 and in accordance with conditions of ULC listings. Locate in fire walls and partitions where indicated or required by Code. All fire dampers installed within supply and return ductwork connecting to air handling systems, fans, or any other forced air system shall be dynamic type fire dampers.

.1 Prior to installation, the contractor shall submit the manufacturer’s ULC Listed installation instructions c/w the appropriate framing instructions as a shop drawing submission. Prior to installation, photos shall be submitted by the mechanical contractor indicating all framing for the fire dampers has been provided in accordance with the listed installation. Coordinate with the General Contractor with respect to the framing for the fire dampers.

.2 After completion, have installation approved prior to concealment.

.3 For fireproof ceiling assemblies, suspend unit from structure independently of ceiling system. Maintain integrity of rated ceiling assembly as per NFPA and ULC.

.4 Install access door adjacent to each fire damper.

3.9 Balancing Damper Installation

.1 Install balancing dampers at all branch ducts and as indicated on drawings.

3.10 Grilles, Registers and Diffusers

Installation

.1 Install in accordance with manufacturer's instructions.

.2 Fit frame with gasket to prevent leakage, and smudging.

.3 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible.

.4 Locations shown are approximate. Refer to reflected ceiling plans and coordinate with Division 16 for lights.

3.11 Exhaust Fans

Installation

.1 Install fans as specified. Complete with resilient mountings as applicable.

.2 Install flexible connector bands between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 75 mm flex between ductwork and fan during running.

.3 Install fan restraining snubbers. Flexible connections shall not be in tension during running.

.4 Provide sheaves and belts required for final air balance.

3.12 Filters

.1 At completion of the project, after equipment start-up, balancing and commissioning procedures are completed, replace all filters within all air handling equipment with new filters, including pre-filters and final filters. Supply client one full filter replacement package for each air handling equipment and store on site where instructed by client.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 These instructions apply to all electrical trades employed on this project.

1.2 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.3 Documents Required

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

- .1 Contract drawings
- .2 Specifications
- .3 Addenda
- .4 Reviewed shop drawings
- .5 Change orders
- .6 Other modifications to contract
- .7 Field test reports
- .8 Copy of approved work schedule
- .9 Manufacturer's installation and application instructions.

1.4 Construction Drawings and Specifications

.1 Following execution of the contract, an “Issued for Construction” revision of the drawings and specifications, which incorporates all addenda issued during the tender period, will be prepared by the Engineer and provided to the contractor for their review. The contractor shall review the “Issued for Construction” drawings and specifications to confirm that all addenda are included and confirm the contractor’s acceptance in writing back to the Engineer.

.2 The “Issued for Construction” drawings and specifications will be provided to the contractor for his initial review following execution of the contract. No claims for delays by the contractor will be considered relating to the issuance of Construction documents.

.3 Following acceptance of the "Issued for Construction" drawings and specifications by the contractor, the Engineer will supply the following items to the Prime Consultant for distribution to the contractor:

.1 Email electronic (pdf) files of the entire set of "Issued for Construction" drawings and specifications.

1.5 Work Schedule

.1 Provide within ten (10) working days after contract award, a schedule showing anticipated progress stages and final completion of work within time period required by contract documents.

.2 Interim reviews of work progress based on work schedule will be conducted as decided by Engineer and schedule updated by Contractor in conjunction with and to approval of Engineer.

1.6 Cost Breakdown

.1 Before submitting the first progress payment claim, submit detailed breakdown of contract price for review and approval of the Engineer and Owner aggregating to the total contract value. Submit breakdown not less than 14 days prior to making first progress claim, and arrange to have a review meeting with Engineer. Make revisions to breakdown as agreed with Engineer prior to submitting first claim.

.2 In this breakdown, present separate prices for the distribution equipment, fixtures, branch wiring, special equipment and other items as required by the Engineer. Indicate labour/material breakdown separately. No progress payment will be approved until this breakdown has been presented in an approved form.

.3 The breakdown shall be in sufficient detail to identify the labour, material, and start-up for each system, sub system and equipment on a floor by floor basis and area basis, to easily allow verification of progress of work. The information contained herein shall be consistent with the monthly Contractor Status Report information using the same categories expanded and in greater detail where required to identify the value of work executed, and to meet the criteria outlined herein. The breakdown shall include major equipment suppliers (those supplying equipment requiring a delivery timeline of more than 2 weeks after shop drawing review).

.4 Each line item shall include for the contractors over head and profit such that the aggregate amount totals to the contract value without applying multipliers.

.5 Multiple pieces of equipment that are supplied from one source, shall be broken down into logical categories consistent with the construction and required delivery schedule to meet this criteria.

.6 The breakdown shall identify separately the testing, adjusting and balancing work, the stipulated commissioning amount, and all cash allowances contained in the contract documents.

.7 The Engineer reserves the right to request copies of the quotations from suppliers or sub-contractors to verify the cost of materials or services shown in the detailed breakdown where in his opinion there is any doubt as to the adequacy of the amount shown.

.8 Not withstanding the above, the Engineer may, in his sole discretion, authorize payment against a progress draw prior to final approval of the cost breakdown where in the Engineer's opinion the contractor has made reasonable efforts to provide supplementary information and to revise the breakdown in accordance with the discussions with the Engineer. Such authorization for payment shall not be deemed to give approval of the cost breakdown for future payments and every effort shall be made by the contractor to provide the breakdown satisfactory to the Engineer before any subsequent payment requests

1.7 Contractor's Use of Site

.1 Do not unreasonably encumber site with materials or equipment.

.2 Move stored products or equipment which interfere with operations of Engineer or other Contractors.

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

1.8 Codes and Standards

.1 In this document, all references to Code numbers shall mean "Latest Edition".

.2 Do complete installation in accordance with CSA C22.1, except where specified otherwise, as amended and adopted in the Province of construction and in effect at the time of tender submission.

.3 Comply with CSA and Inspection Authority Electrical Bulletins in force at time of tender submission.

.4 Do overhead and underground systems in accordance with CSA C22.3No.1 except where specified otherwise.

.5 Abbreviations for electrical terms: to CSA Z85

.6 Where requirements of this specification exceed those of above mentioned standards, this specification shall govern.

.7 Comply with all municipal, provincial and federal laws, regulations, and by-laws including, but not limited to, those concerning the environment and the disposal of waste. The contractor shall inform itself of such requirements.

.8 Refer to Sections 00 and 01 for further information.

1.9 Location of Equipment and Fixtures

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

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

.3 Inform Engineer of impending installation and obtain his approval for actual location.

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

1.10 Cutting, Fitting and Patching

.1 Execute cutting (including excavation), fitting and patching required to make work fit properly.

.2 Where new work connects with existing and where existing work is altered, cut, patch and make good to match existing work.

.3 Obtain Engineer's approval before cutting, boring or sleeving load-bearing members.

.4 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.

.5 Fit work airtight to pipes, sleeves, ducts and conduits.

.6 Scanning of concrete floor slab is required before cutting to locate existing rebar and conduits and to obtain Owner’s approval for proposed cutting or core drilling. Repair all existing work damaged by cutting or core drilling at no extra cost to the contract.

1.11 Existing Services

.1 Where work involves breaking into or connecting to existing services, carry out work at times directed by governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.

.2 Before commencing work, establish location and extent of service lines in area of work and notify Engineer of findings.

.3 Submit schedule to and obtain approval from Engineer for any shut-down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.

.4 Where unknown services are encountered, immediately advise Engineer and confirm findings in writing.

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

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

1.12 Shut-downs of Services and Systems

.1 All shut-down to be in accordance with Sections 00 and 01.

.2 Contractors are to verify with Owner before making any connection to any existing systems. This will ensure that (1) the Owner is aware that work will be done on a system and (2) that the contractor is working on a system that is working when he starts his work.

1.13 Alterations, Additions or Repairs to Existing Building

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

.2 Where security has been reduced by work of Contract, provide temporary means to maintain security.

1.14 Additional Drawings

.1 Engineer may furnish additional drawings to assist proper execution of work. These drawings will be issued for clarification only. Such drawings shall have same meaning and intent as if they were included with plans referred to in contract documents.

1.15 Taxes

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

1.16 Permits, Fees

.1 Submit to Inspection Authority and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay associated fees and obtain all permits required for the performance of the work.

1.17 Explosive Actuated Devices

.1 Do not employ power guns using explosives, unless permitted expressly by the Structural Engineer; comply with fastening requirement of CSA Z-166 (Safety Code for Explosive Actuated Tools). Ensure concrete slabs not adversely affected.

1.18 Examination and Site Visit

.1 Acquire a full working knowledge of the building site and any existing conditions thereon which might affect any aspect of the job. Inspect the contract drawings for all trades since no extras will be entertained for work which could otherwise have been foreseen by prior inspection of the site and/or the contract drawings.

1.19 Warranty

.1 Contractor to provide all labour and material to promptly correct defects or deficiencies in the work and the performance of the work, which appear prior to and during the one year Warranty period. The Warranty is to include complete labour and material Product warranties for all Products included in the work.

.2 The Warranty period for the corrected work is to be extended for an additional year following the correction of defects and deficiencies in the work carried out in the initial warranty period.

.3 The start of the Warranty period for completed electrical work shall commence on the date of substantial completion unless stated otherwise.

.4 Certain items of equipment have extended warranties required in the specifications. Collect all agreements, guarantees, and warranty certificates and provide to the Owner.

.5 Final payment will not be released prior to receipt in writing of all warranties.

1.20 Contract

.1 Project drawings and specifications are complimentary to this General Specification. In cases of conflict, ambiguity or doubt, apply to the Engineer for a ruling in writing prior to tender closing. Once the Tender has closed, the Engineer's ruling shall be final and binding; claims for extras will not be accepted.

.2 All jobs must be complete, performed and finished in a workmanlike manner. Work and materials of an incidental nature, necessary by implication to produce the finished job as specified, shall be supplied, even when not listed or described in detail.

.3 No deviations from the specifications or drawings will be allowed without written permission of the Engineer.

1.21 As-Built Drawings by Contractor

.1 The successful contractor shall be responsible for a complete set of as-built drawings.

.2 A set of prints shall be kept up-to-date as the work progresses. Show all changes and deviations from the original tender documents whether they be issued change orders, site instructions or contractor's changes.

.3 Record exactly the location of services where concealed or buried or where capped or plugged for future use. As-built drawings shall show conduit sizes and runs, junction boxes, pull boxes, wiring with circuit numbers.

.4 The Engineer shall make available the Tender Issue of the drawings. This contractor shall update these with all Change Orders, Site Instructions, and to reflect site conditions.

.5 The Engineer reserves the right to request a number of verifications necessary to prove the exactness of the as-built drawings.

.6 Within two weeks of achieving Substantial Completion of the Project, the contractor shall turn over a complete set of as-built drawings (marked up white prints in red ink) to the Engineer. The Engineer shall incorporate information received via the as-built drawings onto a set of Record Drawings for the Client.

1.22 Definitions – Acceptable Materials/Equal to:

.1 "Acceptable Material": means that item named and specified by catalogue number forms parts of specification and sets standard regarding performance, quality of material and workmanship, and when used in conjunction with a referenced standard, shall be deemed to supplement the standard. Equipment proposed shall be one of the named suppliers. Approval for other products/suppliers shall be obtained from the Engineer prior to tender closing. Such approval must be in writing.

.2 "Equal to", or "or equal": Means that other products meeting the same specification as the named product will be accepted as equal without prior approval as an alternate. The Engineer's decision will be final as to whether the product meets the specification in all respects, and if not, the named product shall be supplied. In general, the building systems have been engineered around those products named in the equipment schedules as shown on the drawings. In the event that a product, identified in this specification as an 'Equal', is selected for use by this contractor any additional costs resulting from the use of this equivalent product shall be borne by the responsible contractor. No extras will be considered.

1.23 Responsibility for Trial Usage

.1 Obtain written permission from Owner to start and test permanent equipment and systems prior to acceptance by Engineer.

.2 Engineer or Owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material and instruments required for testing.

1.24 Shop Drawings Product Data and Samples

.1 General:

.1 The consultant shall review or take other appropriate action on the Contractor submittals, such as shop drawings, product data, samples and other data, which the Contractor is required to submit, but only for the limited purposes of checking for conformance with the design concept and the information shown in the Construction Documents. This review shall not include review of the accuracy or completeness of details, such as quantities, dimensions,

weights or gauges, fabrication processes, construction means or methods, coordination of the work with other trades or construction safety precautions, all of which are the sole responsibility of the Contractor.

The Consultant's review shall be conducted with reasonable promptness while allowing sufficient time in the Consultant's judgment to permit adequate review. Review of a specific item shall not indicate that the Consultant has reviewed the entire assembly of which the item is a component. The Consultant shall not be responsible for any deviations from the Construction Documents not brought to the attention of the Consultant in writing by the Contractor. The consultant shall not be required to review partial submissions or those for which submissions of correlated items have not been received.

.2 Submit to Engineer for review, shop drawings, product data and samples specified. Until submission is reviewed, work involving relevant product may not proceed.

.2 Shop Drawings:

.1 Drawings by Contractor, Sub-contractor, supplier or distributor, shall be prints which illustrate appropriate portion of work, showing fabrication, layout, setting or erection details as specified in appropriate sections.

.2 Identify details by reference to sheet and detail numbers shown on contract drawings.

.3 Maximum sheet size 860mm x 1120 mm.

.3 Product Data:

.1 Certain specification sections specify that manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings.

.2 Above will only be accepted if they conform to the following:

.1 Delete information which is not applicable to the project.

.2 Supplement standard information to provide additional information applicable to project.

.3 Show dimensions and clearances required.

.4 Show performance characteristics and capacities.

.5 Show wiring diagrams and controls.

.6 Show voltage, phase and power (HP, watts, amps).

.3 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.4 Where applicable, include wiring, single line and schematic diagrams.

.5 Include wiring drawings or diagrams showing interconnection with work of other Divisions or Sections.

.4 Coordination of submissions:

.1 Review shop drawings, product data and samples prior to submission.

.2 Verify field measurements; field construction criteria; catalogue numbers; and similar data.

.3 Coordinate each submission with requirements of work and contract. Individual shop drawings will not be reviewed until all related drawings are available. The contractor shall submit all shop drawings specified in a section in one submission. Multiple shop drawing submissions for a specification section shall not be acceptable. In the event that shop drawings are submitted piecemeal (multiple submissions) within a specification section, the shop drawings shall be retained by the Engineer until all shop drawings from that section have been received for review.

.4 Contractor's responsibility for errors and omissions in submission is not relieved by Engineer's review of submittals.

.5 Contractor's responsibility for deviations in submission from requirements of contract documents is not relieved by Engineer's review of submission, unless Engineer gives written acceptance of specified deviations.

.6 Notify Engineer, in writing at time of submission, of deviations from requirements of contract documents.

.7 After Engineer's review, distribute copies.

.5 Submission requirements:

.1 Schedule submissions at least 15 working days before dates reviewed submissions will be needed.

.2 Electronic shop drawing submissions are acceptable with the following conditions:

.1 The shop drawings shall be in pdf format with a transmittal and include the trade contractor’s review stamp.

.2 The page size shall not exceed 8.5”x11”, be black and white, and must be fully legible.
If colour or larger sheet size is required, the submission shall be in hard copy format rather than electronic; submit six (6) sets of hard copies for review.

.3 On each submission sheet, ensure clear space 75 mm x 75 mm for review stamp (e.g. letter size data sheet on legal size paper).

.4 Accompany submissions with transmittal letter, in duplicate, containing:
- .1 Date; project title and number; Contractor's name and address; number of each shop drawing, product data and sample submitted.
- .2 Other pertinent data.

.5 Submissions shall include:
- .1 Date and revision dates; project title and number.
- .2 Name of: Contractor; sub-contractor; supplier; manufacturer.
- .3 Identification of product or material.
- .4 Relation to adjacent structure of materials.
- .5 Field dimensions, clearly identified as such.
- .6 Specification section numbers
- .7 Applicable standards, such as CSA or ULC numbers.
- .8 Both the General Contractor and Electrical Contractor's stamp, initialled or signed, certifying review of submission, verification of field measurements and compliance with contract documents.

1.25 Maintenance Manuals

.1 One draft copy of the proposed maintenance manual shall be submitted for review within four (4) weeks of the review of shop drawings.

.2 The Engineer may withhold progress payments until such time as the draft copy is received.

.3 Once the draft copy has been reviewed by the Engineer, submit to Engineer three (3) copies of Operating and Maintenance Data incorporating the revisions as necessary, made up as follows:
- .1 Bind data in vinyl hard covered, 3 ring loose leaf binder for 215 x 280 mm size paper.

.2 Enclose title sheet, labelled "Operating and Maintenance Data Manual", project name, date and list of contents.

.3 Organize contents into applicable sections of work to parallel project specification breakdown. Mark each section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.

.4 Include following information plus data specified.

.1 Maintenance instruction for finished surface and materials.

.2 Copy of hardware and paint schedules.

.3 A clear copy of approved shop drawings for all equipment.

.4 A schedule for all equipment summarizing the Reference Number, Make, Model, Capacity, Electrical Data, etc.

.5 Description, operation and maintenance instructions for equipment and systems, including complete list of equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.

.6 Names, addresses and phone number of sub-contractors and suppliers.

.7 Guarantees, warranties and bonds showing:

.1 Name and address of projects.

.2 Guarantee commencement date (date of Final Certificate of Completion).

.3 Duration of guarantee.

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

.5 Signature and seal of Contractor.

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

.5 Neatly type lists and notes. Use clear drawings, diagrams or manufacturer's literature.

1.26 Demolition

.1 Full extent of demolition is not illustrated on drawings. Disconnect and remove all equipment located on existing ceilings and walls to be demolished. All services under equipment which have become redundant under the contract shall be removed. All items removed during demolition and which are not to be re-used shall be removed from site.

.2 Contractor to relocate any electrical items which interfere with the new construction and may not appear on drawings.

.3 Contractor is responsible for the reconnection of any services which are to remain and which have been disconnected during the course of demolition or construction.

.4 All equipment to be re-used is to be cleaned of paint, plastic, etc. to the satisfaction of the Engineer.

.5 Contractor is responsible for reconnecting any existing loads which do not appear on panel details and which are to be re-used.

.6 Where existing materials are to be re-used, the contractor for this Division is responsible for their removal, storage, cleaning and reinstallation.

.7 Turn over to the Owner any redundant existing material or equipment designated by the Owner or specified on drawings.

.8 Where some existing materials or equipment are to be retained in place or reconnected, it is the responsibility of the contractor of this Division to identify and protect the materials or equipment prior to the commencement of demolition.

.9 Maintain adequate structural support for equipment and material during demolition process.

.10 It is the responsibility of this Contractor to maintain electrical services and systems at all times to areas beyond the construction area.

.11 Reinstate immediately any existing services disrupted during demolition not intended to be removed as part of this contract.

.12 Retain continuity of service of the fire alarm system to all occupied areas of the building.

1.27 Contractor Quality Assurance Program

.1 The Contractor is solely responsible for the control, charge and supervision of construction methods, techniques, sequences and procedures, and for safety precautions and programs required in connection with the work.

.2 The Contractor is responsible for the discovery and correction of deficiencies, errors and omissions in the execution and performance of the work and for the preparation of submissions, reports, relating to the work.

.3 The Contractor is responsible for providing the appropriate quality assurance program to ensure that the work is carried out and performs in accordance with the Contract Documents, industry standards and relevant codes and legislation. The Contractor Quality Assurance Program is to ensure the following:

.1 The use of qualified tradesmen, experts and professionals with the level of skill and experience required for the proper execution and performance of the work.

.2 The level of direction, supervision and inspection required for the proper execution and performance of the work.

.3 The level of co-ordination between trades, field conditions, material requirements and product requirements required for the proper execution and performance of the work.

.4 The level of management required for the quality assurance program to operate effectively so that deficiencies, errors and omissions in the work are identified by the Contractor on a continuous basis and that corrective action is carried out promptly.

.5 The level of management and communication required for the status of the work to be properly monitored and reported to the Owner and the Engineer.

.4 Project observation reports of the work by the Engineer and Owner are not to be considered part of the Contractor Quality Assurance Program.

.5 The review of Contractor prepared submissions (shop drawings, reports, etc.) by the Engineer and Owner are not to be considered part of the Contractor Quality Assurance Program, and do not alleviate the Contractors responsibility to meet all documented requirements.

1.28 Progress Payments

.1 Payment requests are to be submitted on a system by system, area by area, basis as per the agreed cost breakdown.

.2 Date applications for payment for the last day of the monthly payment period and ensure amount claimed is for value proportionate to amount of Contract, of Work performed, and Products delivered to Place of Work at that date. Payment will not be authorized for materials that are not delivered to site at date of submission of claim.

.3 Payment for work that requires field testing, approval from authorities having jurisdiction, or approval from specified experts such as seismic control, will be limited to 90% of the value of the labour and material of such work until such time as the testing is completed, witnessed and recorded, the authorities having jurisdiction have given their approval for the work, or the specified experts have provided their written verification of the installations.

.4 Payment for work that must prove performance through start-up, balancing and commissioning activities will be limited to 98% of the value of the labour and material for each system until such time as the equipment manufacturer's start-up tests are complete and reports submitted and the equipment is in satisfactory operation.

.5 Payment against the Commissioning allowance will not commence until after the final balancing is complete, and will be paid in proportion to the completion of the defined commissioning activities.

1.29 Substantial Performance

.1 The Contractor's Application for Substantial Performance is to include documentation that supports the Contractor's certification that the work has been carried out and is performing in accordance with Contract Documents and is "ready for use for the purpose intended".

.2 The following documentation is required on a system-by-system basis in conjunction with the Contractor's Progress Payment Request:

.1 Component and System Test Reports.
.2 Distribution System Balancing and Capacity Test Reports.
.3 Local Authority Inspection Reports (Building Inspection, Electrical Safety Authority Occupancy Inspection, etc.).
.4 Fire Alarm System Verification Reports.
.5 Equipment Manufacturer Certification of Approval of Installation and Operation.

.6 Commissioning Verification Reports of proper (fully automatic) operation and performance, under all load conditions (part load, full load, seasonal).

.7 Commissioning Verification Reports of proper (fully automatic) operation and performance, under upset conditions (power failure, emergency power, device failure, control failure).

.8 Completion of Training activities to an extent which allows the Owner to undertake operation and maintenance of electrical systems.

.9 Turnover of completed Record Drawings to the Owner.

.10 Turnover of completed Maintenance Manuals to the Owner.

.11 Turnover of specified spare parts.

.12 Contractor's Warranty Certificate.

.13 Product Manufacturer's Warranty and Extended Warranty Certificates.

.14 Contractor's Report on work presently identified as being incomplete and the schedule to complete the work.

.15 Report on work presently identified as being deficient and the schedule to carry out corrective work.

.16 Report on Product Warranty start dates for work which is incomplete or Deficient.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Definitions

.1 "Provide" means supply, install and connect.

.2 "Approved" means approved in writing by Engineer.

.3 "Inspection Authority" means Electrical Safety Authority.

.4 "Supply Authority" means Hydro Ottawa.

.5 "Engineer" means designated representative of Owner for monitoring of work.

.6 "Manual" means Operations and Maintenance manual.

1.3 Operation and Maintenance Data

.1 Provide operation and maintenance data for incorporation into Manual specified in Sections 00 and 01.

.2 Include in operations and maintenance data:

- .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
- .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
- .3 Wiring and schematic diagrams and performance curves.
- .4 Names and addresses of local suppliers for items included in maintenance manuals.
- .5 As built panel schedules.

1.4 Maintenance Materials

.1 Provide maintenance materials as called for in these specifications.

1.5 Seismic Analysis and Provisions

.1 Install electrical systems with adequate structural support to withstand seismic forces in accordance with Section 4.1.8 of the Ontario Building Code.

.2 Apply the following Importance Categories: Post-disaster for buildings intended for such usage including hospitals, High for schools, and Normal for all other building types, as referenced in 4.1.8.5 of the Ontario Building Code.

.3 All equipment shall be suitably anchored, whether rigidly connected to the structure, or on vibration isolators, and designed for earthquake loading for the Ottawa area.

.4 Drilled or power driven anchors or fasteners not permitted for use with seismic control measures.

.5 No equipment, equipment supports or mounts to fail before failure of structure.

.6 Retain a structural engineer licensed in the Province of Ontario to perform a review of the proposed electrical installation. Provide detailed shop drawings showing the required seismic supports, bracings and fastenings restraint system for all equipment and systems to be provided under the scope of the project. These documents shall be sealed and signed by the structural engineer and submitted as part of the shop drawing package prior to rough-in work commencing on-site. The electrical contractor shall be solely responsible for the full scope of this work. Include all costs of structural design, materials, and site review in tender bid.

.7 In the event that seismic restraints are determined not to be necessary by the contractor's seismic design engineer, a signed and sealed letter confirming this conclusion shall be provided by the contractor's seismic design engineer and submitted for review.

.8 Seismic control measures not to interfere with integrity of firestopping.

.9 Static Equipment:

.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.

.2 Suspended equipment shall be restrained using sway bracing and hanger rods. Equipment supported by vibration-isolation hangers shall be detailed and installed with isolation hangers close to the structure and upward limit stops located directly below the hangers. Avoid bracing equipment to separate portions of the structure that may act differently in response to an earthquake. For example, do not connect a transverse brace to a wall and a longitudinal brace to a floor or roof at the same brace location.

.10 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

.11 The Engineer providing the certified design for seismic control of equipment/components/systems shall visit the site as required to provide a letter at the end of construction indicating the installation is in accordance with the certified shop drawing submission and Ontario Building Code item 4.1.8.18 “Elements of Structures, Non-Structural Components and Equipment”. The letter shall be stamped and signed, with the Professional Engineer’s seal, licensed in the Province of Ontario. Should the equipment and systems provided under the scope of this project not require seismic restraint systems as determined by the seismic system design engineer, the design engineer providing the review shall provide a letter, stamped and signed, indicating that the installation does not require seismic restraints.

.12 The electrical contractor shall be solely responsible for the full scope of this work. Include all costs of structural design, materials, and site review in tender bid.

1.6 Care, Operation, and Start-up

.1 Instruct Engineer and Operating Personnel in the operation, care and maintenance of equipment.

.2 Arrange and pay for services of manufacturer's factory service Engineer to supervise start-up of installation, check, adjust, balance and calibrate components, for special systems, e.g. fire alarm.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.7 Voltage Ratings

.1 Operating voltages: to CSA C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz. within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.8 Inspections

.1 Furnish a Certificate of Acceptance from Inspection Authority on completion of work.

1.9 Materials and Equipment

.1 Equipment and materials to be CSA certified, and manufactured to standard quoted.

.2 Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Inspection Department.

.3 Factory assemble control panels and component assemblies.

1.10 Electric Motors, Equipment and Controls

.1 Provide motor controls as indicated on electrical drawings.

.2 Refer to mechanical equipment schedules, or specifications, for further details on equipment supplied by mechanical trades. Obtain copy of each mechanical shop drawing, and co-ordinate electrical work to support all connections required. Bring discrepancies to attention of Engineer, and obtain ruling on resolution before installing services. No allowance will be made for corrections required due to failure to co-ordinate before installation.

.3 Control wiring and conduit is by electrical contractor where indicated on electrical drawings; otherwise control wiring up to and including 120 volts is by mechanical contractor. Connect as indicated, or to suit wiring diagram supplied with equipment to make a complete, operating system.

1.11 Finishes

.1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.

.2 Paint indoor switchgear and distribution enclosures "light grey" to EEMAC 2Y-1.

.2 Clean and touch up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean, prime and paint exposed hangers, racks, fastenings, to prevent rusting.

1.12 Acoustical Performance

.1 In general, provide equipment producing minimal sound levels in accordance with the best and latest practices established by the electrical industry.

.2 Do not install any device or equipment containing a magnetic flux path metallic core, such as gas discharge lamp ballasts, dimmers, solenoid, etc., which are found to produce a noise level exceeding that of comparable available equipment.

1.13 Equipment Identification

.1 Identify with lamicoid nameplates all electrical equipment shown on the drawings and/or mentioned in the specification such as switches, starters, panelboards, transformers, controls, and special receptacles, regardless of whether or not the electrical equipment was furnished under this section of the specification. Hand painted identification is not acceptable.

.2 Coordinate names of equipment and systems with other Divisions to ensure that names and numbers match.

.3 Wording on nameplates to be approved by the Engineer prior to fabrication.

.4 Identification to be English.

.5 Nameplates shall identify the equipment, the voltage characteristics, the power source for the equipment, and load being served (if applicable). Provide warning labels for equipment fed from two or more sources.

.6 Unless otherwise specified, nameplates shall be rigid lamicoid, minimum 1.5 mm (1/16") thick with black letters engraved on a white background. For emergency power circuits, use a red background.

.7 Mount nameplates using self-tapping 2.3 mm (3/32") diameter slot head screws, two per nameplate for nameplates under 75 mm (3") in height. A minimum of four (4) screws shall be used for larger nameplates. Other methods of attachment only with approval of Engineer.

.8 All nameplates shall have a minimum border of 3 mm (1/8"). Characters shall be 9 mm (3/8") in size unless otherwise specified. Nameplates for receptacles and light switches shall have 6 mm (1/4") characters.

.9 Provide neatly typed updated circuit directories in a plastic holder on the inside door of new panelboards, with copy in Manual.

.10 Carefully update panelboard circuit directories whenever adding, deleting, or modifying existing circuitry, with a copy in Manual.

.11 Identify all pull and junction boxes, with permanent handwritten marker identification of panel and circuits.

.12 Where referenced in other Sections, provide nameplates of following sizes:

NAMEPLATE SIZES

Size 1 10 x 50 mm	1 line	3 mm high letters
Size 2 12 x 70 mm	1 line	5 mm high letters
Size 3 12 x 70 mm	2 lines	3 mm high letters
Size 4 20 x 90 mm	1 line	8 mm high letters
Size 5 20 x 90 mm	2 lines	5 mm high letters

Size 6 25 x 100 mm	1 line	12 mm high letters
Size 7 25 x 100 mm	2 lines	6 mm high letters

1.14 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, using either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

1.15 Conduit and Cable Identification

.1 Colour code conduit system.

.2 Code with paint on covers of junction boxes and condulets.

.3 Colours to be
- .1 Fire Alarm: Red.
- .2 Emergency Power: Yellow.
- .3 Communication systems: Green.

1.16 Wiring Terminations

.1 Lugs, terminals, screws used for termination of wiring to be suitable for 75 degree C rated conductors, either copper or aluminum. Where existing equipment is rated for less than 75 degree C, transition to lower temperature rating 1.5 meters from termination point using larger sized wire and conduit to suit.

1.17 Manufacturers and CSA Labels

.1 Ensure that manufacturer's registration plates are properly affixed to all apparatus showing the size, name of equipment, serial number, and all information usually provided, including voltage, cycle, phase and the name and address of the manufacturer.

.2 Do not paint over registration plates or approval labels. Leave openings through insulation for viewing the plates. Contractors or sub-contractors nameplate not acceptable.

1.18 Warning Signs and Protection

.1 Provide warning signs, as specified or to meet requirements of Authorized Electrical Inspection Department and Engineer.

.2 Accept the responsibility to protect those working on the project from any physical danger due to exposed live equipment such as panel mains, outlet wiring, etc. Shield and mark all live parts with the appropriate voltage. Caution notices shall be worded in both English and French.

1.19 Single Line Electrical Diagrams

.1 Provide single line electrical diagrams in glazed frames as follows:
.1 Electrical distribution system: locate in main electrical room.

1.20 Location of Outlets

.1 Locate outlets as shown on drawings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change locations of outlets at no extra cost or credit, providing distance do not exceed 3 m, and information is given before installation.

.4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

.5 Outlets locations shown on drawings are approximate. Refer to architectural elevations, millwork, and equipment drawings for final locations and mounting height. No extra will be allowed for re-locations due to lack of co-ordination with all documents.

1.21 Mounting Heights

.1 Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not indicated, verify before proceeding with installation.

.3 Install electrical equipment at the following heights unless indicated otherwise.

- Local Switches	1100 mm
- Wall Receptacles:	
- General:	400 mm
- In mechanical and electrical rooms:	1100 mm
- Panelboards to top of trim:	1800 mm
- Telephone outlets (standard):	400 mm
- Telephone (wall mounted) and interphone outlets:	1100 mm
- Fire alarm stations:	1200 mm
- Fire Alarm Signals (wall mounted):	2300 mm and minimum 150 mm from top of device to ceiling.

1.22 Load Balance

.1 Measure phase current to panelboards with normal loads operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases, record changes, and revise panel schedules.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Submit, at completion of work, a report listing phase and neutral currents on new or revised panelboards, dry-core transformers, and motor starters, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.23 Conduit and Cable Installation

.1 Install sleeves prior to pouring of concrete: sized for free passage of conduit, and protruding 50mm.

.2 Install cables, conduits, and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.3 All exposed conduits and raceways to be installed parallel to building lines.

1.24 Firestopping

.1 Where cables or conduits pass through floors and fire rated walls, pack space between wiring and sleeve full with firestopping system to CAN 4-S115.

.2 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance. For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, then submit a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994).

.3 Cast-in place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic pipe (closed and open piping systems) penetrating concrete floors, the following products are acceptable:

.1 Hilti CP 680 Cast-In Place Firestop Device

.2 Equivalent products listed in the U.L.C. Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory).

.4 Sealant or caulking materials for use with non-combustible items including rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:

.1 Hilti FS-ONE Intumescent Firestop Sealant

.2 Hilti CP 604 Self Leveling Firestop Sealant

.3 Hilti CP 620 Fire Foam

.4 3M Fire Stop Sealant 2000

.5 3M Fire Barrier CP25 WB

.6 Tremco Tremstop Fyre-Sil Sealant

.7 Equivalent products listed in the U.L.C. Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.5 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including PVC jacketed, flexible cable or cable bundles, the following products are acceptable.

.1 Hilti FS-ONE Intumescent Firestop Sealant
.2 Hilti CP 620 Fire Foam
.3 3M Fire Barrier CP25 WB
.4 Tremco Tremstop WBM Intumescent Firestop Sealant
.5 Equivalent products listed in the U.L.C. Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.6 Intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:

.1 Hilti FS-ONE Intumescent Firestop Sealant
.2 Hilti CP 618 Firestop Putty Stick
.3 Hilti CP 620 Fire Foam
.4 3M Fire Barrier CP25 WB
.5 Tremco Tremstop WBM Intumescent Firestop Sealant
.6 Equivalent products listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.7 Non curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:

.1 Hilti CP 618 Firestop Putty Stick
.2 Equivalent products listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.8 Wall opening protective materials for use with U.L.C listed metallic and specified monmetallic outlet boxes, the following products are acceptable:

.1 Hilti CP 617 Firestop Putty Pad
.2 Equivalent products listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.9 Materials used for large size/complex penetrations made to accommodate cable trays, electrical busways in raceways, the following products are acceptable:
- .1 Hilti FS 635 Trowelable Firestop Compound
- .2 Hilti FS 657 FIREBLOCK
- .3 Hilti CP 620 Fire Foam
- .4 3M Firestop Foam 2001
- .5 3M Fire Barrier CS-195 Composite Sheet
- .6 Equivalent products listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

.10 Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, electrical busways in raceways, the following products are acceptable:
- .1 Hilti FS 657 FIREBLOCK
- .2 Equivalent products listed in the U.L.C Fire Resistance Directory - Volume III or UL Products Certified for Canada (cUL) Directory

1.25 Tests

.1 Conduct tests of the following:
- .1 Power distribution system including phasing, voltage, grounding and load balancing.
- .2 Lighting and its control.
- .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .4 All special systems, such as fire alarm.

.2 Furnish manufacturer's certificate or letter for each special system confirming that entire installation has been installed to manufacturer's instructions.

.3 Carry out tests in presence of Engineer. Provide 72 hours notice of tests. Wherever tests are called for in these specifications, test results shall be recorded neatly on a form identifying the date and test completed together with the results and a copy shall be included in each maintenance manuals. Where a Commissioning Agent has been retained, the tests shall also be performed in his presence.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Refer also to the detailed specification articles where additional testing requirements are outlined.

1.26 Insulation Resistance Testing

.1 Megger circuits, feeders and equipment up to 350V with a 500V instrument, and up to 600V with 1000V instrument.

.2 Check resistance to ground before energizing, and ensure value meets levels of Table 24 of the Code. Make good any circuits which do not meet this standard.

1.27 Coordination of Protective Devices

.1 Ensure circuit protective devices such as over current trips, relays, fuses, are installed to values and settings as indicated.

1.28 Motor Rotation

.1 For new motors, ensure that motor rotation matches the requirements of the driven equipment.

.2 For existing motors, check rotation before making wiring changes in order to ensure correct rotation upon completion of the job.

1.29 Cleaning

.1 Do final cleaning in accordance with Sections 00 and 01.

.2 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.

1.30 Access Doors

.1 Supply access doors for furred ceilings or spaces for servicing equipment and accessories or for inspection of life safety or operating devices for installation by the General Contractor.

.2 Access doors shall be flush mounted 600 x 600 mm for body entry, and 300 x 300 mm for hand entry, unless otherwise noted. Doors shall open 180 deg. have rounded safety corners, concealed hinges, screw-driver latches and anchor straps. Steel shall be prime coated.

.3 Supply stainless steel access doors for tiled, marble, terrazzo or special surfaces.

.4 Access doors in fire rated walls, ceilings and assemblies shall be ULC listed to suit the fire rating.

.5 Acceptable Materials:
- .1 Buensod
- .2 Le Hage
- .3 Zurn
- .4 Alternate materials as approved by addendum in accordance with Instructions to Tenderers.

1.31 Temporary and Trial Usage

.1 After approval by the Engineer, equipment shall be put into service for temporary or trial usage, at the discretion of the Engineer after it is mutually agreed that such use will not damage the equipment, create safety hazards nor void applicable guarantee.

1.32 Cooperation

.1 Before commencing work, examine the contract drawings and schedules of all other trades. Report at once to the Engineer any interference which might affect the scheduling of, or performance of, work under this Division.

.2 During construction, ensure that interference with the work of other trades is kept to a minimum and that the finished work of other trades is protected against damage from the electrical work.

.3 Coordinate any opening or sleeves required for the installation of circuits or equipment so as not to interrupt the progress of masonry and concrete work.

.4 Obtain approval from the Engineer, or from the Contractor responsible for structural members, before any openings are cut in structural supports, either concrete or steel.

1.33 Approval of Equivalent Products

.1 Manufacturers and/or catalogue references of equipment considered acceptable are shown herein and on the drawings. During the tender period, any manufacturers wishing alternative products to be considered shall submit to the Engineer a written application for approval of the equivalent product. Approval of an equivalent product shall be signified by the issuance of an appropriate addendum.

.2 No substitutes will be allowed for equipment previously approved by the Engineer for the job unless it can be shown that unforeseen delays in delivery of such equipment are causing a substantial delay in the construction schedule. The Engineer reserves the right to review such substitutions and investigate the reasons for delay with the manufacturer before approval is given.

1.34 Trade Qualifications

.1 All electrical trade workers shall have a Certificate of Qualification as Journeyman or Apprentice Registration for the province where the work is performed or an Inter-Provincial Certificate.

.2 The ratio of journeyman to apprentices shall not exceed the ratio in the Trades Qualification and Apprenticeship Act of Ontario.

.3 On award of contract, submit a list of trade journeymen and apprentices, together with their Certificate and Registration numbers.

.4 Certificates and Registrations must be provided on the Engineer's request.

.5 Maintain on-site an up-to-date record listing journeymen and apprentices working on-site.

.6 The Owner, in cooperation with the Engineer, reserves the right to immediately eject any trade personnel which has demonstrated to be improperly licensed, incompetent, accident prone, uncooperative, disregardful towards rules concerning safety, behavior, dress code, parking, or other actions which the Owner deems to be inappropriate and not representative of a professional worker.

.7 If applicable to this project, all electrical trades shall have personnel on staff who are fully trained in working in confined spaces. Additionally, the trade companies shall be responsible for ensuring proper training and provide equipment for working in confined spaces safely and in accordance with applicable legislation.

1.35 Project Personnel

.1 The project manager and site foreman assigned to this project shall be consistent from project start to project completion. No substitutions shall be permitted without written approval/acceptance from the Engineer and Owner.

1.36 Interference Drawings

.1 The electrical contractor shall provide cooperation and assistance with the interference drawings which are to be produced by the mechanical contractor. Provide locations of all equipment, cable tray, lighting, and conduit complete with shop drawings for the mechanical contractor to aid in the preparation of the interference drawings.

.2 The mechanical and electrical drawings are diagrammatic and do not show details at intersection of services. Re-routing required for the clearance of all services that results in additional elbows and fitting for piping, ductwork, conduit, and cable tray within a 1500 mm radius from the diagrammatic position will not be cause for additional payment. Exact locations of runs of piping, ducts, cable trays, and conduits shall be established by the contractor in cooperation with sub-trades and other contractors prior to installation so that they will clear each other and other obstructions. In general, piping requiring uniform pitch on horizontal runs shall be given the right of way. All surface mounted components and instrumentation devices shall be carefully coordinated with the Prime Consultant and no final locations for such surface mounted items shall be chosen except with the Prime Consultant's written approval.

1.37 Adhesives And Sealants

.1 All adhesives and sealants used must be low volatile organic compound type to conform to LEED® Indoor Environmental Quality Credit - Low Emitting Materials, as specified in Sections 00 and 01.

1.38 Changes in the Work

.1 Changes in the work may be requested from time to time by the issuance of a Contemplated Change Notice (CCN) and/or Proposed Change (PC). Refer to general conditions of the contract or front end specifications for requirements on how to quote changes in the work. Those requirements take precedence over the requirements following in this Section.

.2 Should the bid form, general conditions of the contract, or front end specifications not address how to quote changes in the work, the requirements following in this Section shall apply.

.3 Provide detailed breakdowns of material and labour with unit prices and extensions required for review of Contemplated Change Notices (CCN's) or Proposed Changes (PC's).

.4 In addition to the net cost of the change, the Contractor shall be entitled to a 15% fee to cover overheads & profit on the work and a 10% fee to cover overheads and profit on sub-trades.

.5 Required labour shall be evaluated based on published NECA Manual of Labour Units, current at time of tender closing, using the "normal" column. No other Job Factors shall be considered applicable.

.6 The overhead percentage and use of NECA labour units indicated above includes the following:

- .1 Insurance.
- .2 Bonding.
- .3 Financing and interest.
- .4 Coordination with other trades.
- .5 Salaries of any staff above that of working foremen employed directly on the work.
- .6 Licenses and permits.
- .7 Onsite timekeeping and scheduling.
- .8 Rest periods.
- .9 Electrical clean up beyond OCA recommended practice.
- .10 Material handling.
- .11 Personal hygiene.
- .12 Safety training.
- .13 Job site safety talks.
- .14 WHMIS information.
- .15 Health and Safety Committee.
- .16 Escalating site safety procedures.

.17 Garbage Bins.
.18 Shipping and deliveries.
.19 Project Management.
.20 Estimating.
.21 Special Cleaning.
.22 Special Handling / Storage.
.23 Equipment rentals for small tools.
.24 Equipment Start-up.
.25 Any other Non Productive Time items.

.7 A single blended labour rate based on a crew of 1 working foreman and 4 journeymen shall be used for Normal working hours for the duration of the project and shall include the following:
.1 Base rate, Vacation Pay and Statutory Holidays as per current collective agreement for unionized contractors.
.2 Union deductions for Benefits (Health & Welfare), Retail Sales Tax on Health & Welfare, Pension, and Union Funds.
.3 ECA Ottawa deductions.
.4 Legislated Payroll Burdens for:
.1 Canada Pension Plan.
.2 Employment Insurance.
.3 Workplace Safety & Insurance Board
.4 Employer Health Tax.
.5 ECAO guideline adders for:
.1 Expendable Small Tools (bits, blades, etc).
.2 Site Facilities (trailer, lunchroom, phone).
.3 Personal Protection Equipment (glasses, vests, fall protection, hearing).
.4 Parking as per Collective Agreement.
.5 Clean up as per OCA recommended practice.

.8 For Premium Night Shift (minimum three consecutive night shifts), use the Normal rate calculation with a 20% adder to Base Rate, Vacation Pay, Pension, and Health & Welfare Benefits.

.9 For Overtime, use the Normal rate calculation with a 100% adder to Base Rate, Vacation Pay, Pension, and Health & Welfare Benefits.

.10 Cost quotations shall be based on industry accepted costing methods. Wiring, conduit and similar commodity-type materials shall be based on current Trade Service Canadian Monitor Plus net pricing with a 30% discount applied. Submit supplier invoices for other types of material such as power distribution equipment, light fixtures, heating products, fire alarm components, etc.

.11 The following job expenses shall be considered to be acceptable in certain pricing exercises:

.1 Bonding costs.
.2 Warranty costs based on 2% of the material & labour cost for the change.
.3 Drafting costs based on 2% of the labour cost for the change.
.4 Hoisting.
.5 Equipment rentals for large equipment.
.6 Core drilling.
.7 Travel in accordance with the applicable union agreement.

.12 The Electrical Contractor shall submit a template proposed to be used for any CCN's/PC's as a formal shop drawing submission for review and recommended acceptance prior to any CCN's/PC's being issued.

1.39 General

Review Declaration .1 Prior to time of occupancy permit application, submit the following items for review:

.1 Electrical Safety Authority Certificate of Inspection, for Occupancy or Final, with no deficiencies noted.
.2 Emergency lighting letter from the Electrical Contractor indicating the lighting is connected to emergency power as per drawings and specifications.
.3 Letter indicating systems have been seismically restrained in accordance with the OBC. Letter shall be authored, signed, and sealed by a Professional Engineer licensed in the province of Ontario.

.2 Submissions shall be complete with transmittals or cover letters signed by an appropriate member of the Ontario College Of Trades (OCOT), with their OCOT registration number indicated.

.3 The project must be substantially complete and ready for its intended use. Energize, test and commission all systems. Ensure systems have been installed in accordance with the contract documents, manufacturer's recommendations, and industry standards as the case may be.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Related Work

.1 Wire and Cable: Section 26 05 21

.2 Outlet Boxes: Section 26 05 32

PART 2 - PRODUCTS

2.1 Materials

.1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors: with fixture type current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Clamps or connectors for armoured cable, flexible conduit, as required.

PART 3 - EXECUTION

3.1 Installation

.1 Remove insulation carefully from ends of conductors and:

- .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
- .2 Install fixture type connectors and tighten. Replace insulating cap.
- .3 Install box connectors as required.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 In general the wiring is not indicated on the drawings for the different systems. The necessary wiring shall however be provided between all outlets and the panels and/or relays to which they are referred to on drawings. In some cases, the panel identification is not given for each circuit but is shown for a particular area.

1.2 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

PART 2 - PRODUCTS

2.1 Building Wires

.1 Conductors: stranded for 10 AWG and larger.

.2 Copper conductors, size as indicated, with 600V insulation.
- .1 RW 90 XLPE for branch wiring unless otherwise noted.
- .2 AF or approved equal for wiring in or through lighting fixtures.

.3 Same as .2 above except RWU 90 for all outdoor circuits, and in conduits below lowest floor slab.

.4 Minimum conductor size shall be #12 AWG for power, #16 AWG for controls and fire alarm.

.5 Wire and conduit sizes shown are based on RW90 XLPE using 75 degree C ampacity ratings and are minimum sizes. Contractor responsible for wire and conduit sizes for other approved wires.

.6 Colour code wiring for 3 phase non-isolated systems as follows:

.1	Phase conductors:	red, black, blue
.2	Neutral conductors:	white
.3	Bonding to ground:	green
.4	Isolated bonding conductor:	green with yellow stripe

2.2 TECK Cable

.1 Cable: to CAN/CSA-C22.2 No. 131, multi-conductor type.

.2 Conductors:
- .1 Grounding conductor: copper
- .2 Circuit conductors: copper, size as indicated.

.3 Insulation:
- .1 Chemically cross-lined thermosetting polyethylene rated type RW 90, 600V.

.4 Inner jacket, Polyvinyl Chloride (PVC) material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic PVC material with improved LFS/LGE jacket for fire protection and low acid gas evolution, meeting requirements of Vertical Tray Fire Test to CSA C22.2No.0.3 with maximum flame travel of 1.2 m.

.7 Fastenings:
- .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for two or more cables at 1500 mm centres.
- .3 6 mm dia. threaded rods to support suspended channels.
- .4 For single conductor cables, provide fastenings without ferrous loop around cables, to satisfaction of Engineer.

.8 Connectors: Approved for TECK cable.

2.3 Armoured Cables

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90.

.3 Armour: interlocking type fabricated from aluminum strip.

.4 Connectors: to suit.

2.4 Control Cables

.1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket. Plenum rated cable (FT-6) required in ceiling space where not in conduit.

.2 600V Type: solid annealed copper conductors, minimum size 16 AWG where installed in raceways. In multi conductor assemblies, minimum 18 AWG is permissible.

.3 Fire alarm and signal cables: shall be type FAS90.

.4 For fire alarm conductors, multi conductor cables are permissible for main risers, provided labeled permanently terminal strips are used for all joints.

PART 3 - EXECUTION

3.1 Installation of Building Wires

.1 Install wiring in conduit systems in accordance with Section 26 05 34 except where otherwise noted.

.2 Install all service entrance and panel feeder circuits without break or splice.

.3 Install branch wiring without break or splice in new construction. In renovations, keep splices to absolute minimum.

.4 Size wires for 3% maximum voltage drop to farthest outlet based on a fully loaded circuit.

.5 Provide dedicated full size neutral wire for each single phase circuit.

3.2 Installation of TECK Cable 0 - 1000V

.1 Install cables only where indicated on plans or for flexible connections to motors. Do not use in air plenums.

.2 Group cables wherever possible on channels.

.3 Terminate cables in accordance with Section 26 05 20.

3.3 Installation of Armoured Cables

.1 Group cables wherever possible.

.2 Install cable for vertical branch wiring within walls or for interconnection of ceiling fixtures, maximum length 3 meters.

.3 Install cable for horizontal branch wiring within walls to interconnect adjacent devices, maximum length 1 meter.

.4 Terminate cable in accordance with Section 26 05 20.

3.4 Installation of Control Cables

.1 Install control cables, as indicated, in conduit.

.2 Provide 10% spares (minimum 2) in all multi-conductor cables, and where more than 5 wires in one conduit.

.3 Make connections of control wiring to suit wiring diagram supplied with equipment, to make complete, operating system.

.4 In each conduit, make each wire a unique colour, or provide permanently numbered wires with unique numbers on each wire to assist in wiring and trouble shooting.

.5 Provide junction boxes and numbered terminal strips wherever connections are required in any conduit system carrying 5 or more wires. Provide clear record showing terminal numbers and wires connected to each by number and function at time of completion, and indicate location and designation of box. Put one (1) copy in box, and one (1) copy in each maintenance manual.

.6 Ground control cable shield at one end only unless equipment data sheets recommend otherwise.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

PART 2 - PRODUCTS

2.1 Materials

.1 Grounding equipment: to CSA C22.2No.41.

.2 Copper grounding and bonding conductors to: ASA G7.1.

2.2 Equipment

.1 Clamps for grounding of conductors, size as required to electrically conductive underground water pipe.

.2 Insulated grounding and bonding conductors to Section 26 05 21, green insulation, or green taped at all accessible locations.

.3 Non-corroding accessories necessary for grounding system, including but not limited to:

.1 Grounding and bonding bushings.
.2 Bolted type conductor connections.
.3 Thermit welded type conductor connectors.
.4 Bonding jumpers, straps.
.5 Pressure wire connectors.

PART 3 - EXECUTION

3.1 Installation General

.1 Install complete permanent, continuous, system and circuit, equipment grounding systems including new conductors, connectors, accessories, as indicated, and to conform to requirements of Inspection Authority.

.2 Run a separate green insulated bonding conductor in all EMT conduits, including those feeding toggle switches and receptacles. Provide a minimum of one bonding conductor per group of three ungrounded phase conductors. Conduit not to be used as a bonding system.

.3 Install connectors to manufacturer's instructions.

.4 For 120/208V branch circuits, the bonding conductor shall be the same size and ampacity as the ungrounded conductors.

.5 Protect exposed grounding and bonding conductors from mechanical injury.

.6 Make buried connections, using copper welding by thermit process.

.7 Use mechanical connectors for grounding and bonding connections to equipment provided with lugs, and to conductive water main using approved grounding device.

.8 Soldered joints not permitted.

.9 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.10 Install separate bonding conductor to outdoor lighting standards.

.11 Make grounding and bonding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connection.

3.2 Equipment Grounding and Bonding

.1 Install grounding and bonding connections to equipment as shown and as required by Code.

3.3 Tests

.1 Perform tests in accordance with Section 26 05 00 and submit results to Engineer before energizing electrical system.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.

.3 Disconnect ground fault indicator during tests.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

PART 2 - PRODUCTS

2.1 Support Channels

.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended as indicated.

.2 Smaller sections subject to Engineer's approval.

.3 All fastenings and supports to be hot dipped galvanized.

PART 3 - EXECUTION

3.1 Installation

.1 Secure equipment to tile and plaster surfaces with quality nylon anchors, with independent grip protrusions.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.

.7 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm dia. threaded rods and spring clips.

.2 Support 4 or more cables or conduits on channels supported by 6 mm dia. threaded rod hangers where direct fastening to building construction is impractical.

.3 Trim excess threaded rod such that maximum 25mm protrudes beyond nut.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.13 Provide minimum 2400 mm support channel on each suspended fixture in open areas, with rigid stem supports from structure to channel, and fixture secured to channel.

.14 All cut ends exposing base material to be completely sealed with field applied coating to give equivalent protection to hot dipped galvanized prior to installation. Following complete installation, all damage to protective layer to be carefully and completely touched up with same field applied coating.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

PART 2 - PRODUCTS

2.1 Splitters

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least two spare terminals on each set of lugs in splitters less than 400A.

2.2 Junction and Pull Boxes

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

2.3 Cabinets

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

.2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm painted plywood backboard for surface/flush mounting as indicated.

2.4 Fire Rating

.1 Boxes and cabinets installed in fire rated walls, ceilings and assemblies shall be ULC listed or suitably fire stopped to suit the fire rating.

PART 3 - EXECUTION

3.1 Splitter Installation

.1 Install splitters as indicated and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 Junction, Pull Boxes and Cabinets Installation

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor. Install with top of trim to line up with any adjacent panels.

.3 Install terminal blocks as indicated in Type T cabinets, and for all fire alarm connections where multi conductor cables are used.

.4 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed Code requirements between pull boxes.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

PART 2 - PRODUCTS

2.1 Outlet and Conduit Boxes General

.1 Size boxes in accordance with Ontario Electrical Safety Code Section 12 for number and size of conductors installed. Use of extension boxes is prohibited, except where used to extend for surface conduit distribution or by special permission from the Engineer.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347V outlet boxes for 347V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 Sheet Steel Outlet Boxes

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side.

.2 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 Masonry Boxes

.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 Concrete Boxes

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 Conduit Boxes

.1 Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for outdoor surface wiring of switches and receptacles.

.2 Electro-galvanized utility type for indoor surface wiring.

2.6 Fittings - General

.1 Bushing and connectors with smooth throats.

.2 Knock-out fillers to prevent entry of foreign materials.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.7 Fire Rating

.1 Boxes installed in fire rated walls, ceilings and assemblies shall be ULC listed or suitably fire stopped to suit the fire rating.

PART 3 - EXECUTION

3.1 Installation

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.5 Extension rings or boxes are not allowed unless necessary to connect to an existing encased or embedded enclosure or box.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Location of Conduit

.1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

.2 All conduits under floor slab shall be zoned in groups and run in as straight a line as possible.

PART 2 - PRODUCTS

2.1 Conduits

.1 Rigid galvanized steel threaded conduit: size as indicated.

.2 Electrical metallic tubing (EMT), with steel couplings sized as indicated.

.3 Rigid PVC conduit: to CSA C22.2 No.211.2, size as indicated.

.4 Flexible metal conduit and liquid-tight flexible metal conduit: size as required.

2.2 Conduit Fastenings

.1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for four or more conduits at spacing required by code.

.4 6 mm diameter threaded rods to support suspended channels.

2.3 Conduit Fittings

.1 Fittings for raceways: to CSA C22.2 No.18.2 and No.18.3.

.2 Fittings to be suitably sized for conduit used. Fittings used with EMT to be steel, not cast.

.3 Factory "ells" where 90 deg. bends are required for 25 mm and larger conduits, or field bends with approved hydraulic bender.

2.4 Expansion Fittings for Rigid Conduit

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 or 200 mm linear expansion as required.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions as indicated.

PART 3 - EXECUTION

3.1 General

.1 Conduit sizes shall be as required by Code. Unless otherwise noted on drawings, minimum conduit size shall be 21 mm.

3.2 Installation

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.3 Except where otherwise noted, conduits shall be as follows:

- .1 For the indoor distribution and wiring:
  - .1 Under slabs on ground and in poured concrete: rigid galvanized steel or rigid PVC, complete with ground wire.
- .2 Exterior, underground branch circuit wiring:
  - .1 Rigid PVC, complete with ground wire for power circuits.
- .3 Conduit connections to vibrating equipment:
  - .1 Use liquid tight flexible metal conduit complete with ground wire to make final connection to a vibrating piece of equipment.

.4 Conduit connections to dry type transformers:
  .1 Use flexible metal conduit complete with ground wire to make primary and secondary connections to dry type transformers.
.5 For all other systems:
  .1 Use EMT with separate ground wire.

.4 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.5 Mechanically bend steel conduit over 21 mm diameter.

.6 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.7 Install polypropylene fish cord in empty conduits.

.8 Where conduits become blocked, remove and replace blocked section.

.9 Dry conduits out before installing wire.

3.3 Surface Conduits

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with a minimum of 25 mm at crossovers.

3.4 Concealed Conduits

.1 Do not install horizontal runs in masonry walls.

.2 Do not install conduits in terrazzo or concrete toppings.

3.5 Conduits in Poured Concrete

.1 Submit proposed layout of conduit to structural engineer and obtain approval prior to rough-in. Co-ordinate with structural trades.

.2 Maximum in-slab conduit size not to exceed 2" diameter.

.3 Coordinate distribution and installation of in-slab conduit with structural rebar layout, locate to suit. Contain conduit runs to middle third of span (minimizing runs over column locations). Keep crossing/overlapping of conduits to a minimum and contain the overlapping to the middle thirds of spans.

.4 Following rough-in, obtain structural engineer's approval of actual conduit layout on-site prior to concrete pour

.5 Protect conduits from damage where they stub out of concrete.

.6 Install sleeves where conduits pass through slab or wall.

.7 Where conduits pass through waterproof membrane provide oversized sleeve before membrane is installed. Use cold mastic between sleeve and conduit.

.8 Encase conduits completely in concrete.

3.6 Conduits Under Poured Slabs on Grade

.1 Run conduits 27 mm and larger below slab. Provide 50 mm of sand over conduit.

3.7 Conduits Underground

.1 Slope conduits and provide drainage at low points except where noted otherwise.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

PART 2 - PRODUCTS

2.1 Photoelectric Lighting Control

.1 Wall mounting, as indicated.

.2 Compatible with lighting control equipment specified under Section 26 09 43.

.3 Voltage variation +/- 10%

.4 Temperature range: -40ºC to 70ºC.

.5 Rated for 5000 operations.

.6 Fail safe circuit completed when relay de-energized.

.7 Switching time delay of 30 seconds.

.8 Wall mounting bracket where required.

.9 Colour coded leads: size 10 AWG 5.26 sq.mm.

.10 Adjustable light sensitivity.

PART 3 - EXECUTION

3.1 Installation

.1 Install photoelectric controls and connect to lighting control system as indicated and as per manufacturer's recommendations.

.2 Confirm operation of each control.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

.2 Transformers shall comply with the efficiency requirements of Ontario Regulation 419/16.

1.2 Product Data

.1 Submit product data in accordance with Section 26 05 00.

.2 Provide test results stating decibel rating.

PART 2 - PRODUCTS

2.1 Transformers, Standard Dry-Type

.1 Use transformers of one manufacturer throughout project.

.2 Design:

- .1 Type: ANN.
- .2 Single or 3 phase, size primary and secondary voltage as indicated.
- .3 150 deg.C temperature rise insulation system.
- .4 Basic Impulse level (BIL): standard.
- .5 Hipot: standard
- .6 Average sound level: standard
- .7 Impedance at 170 deg.C: standard
- .8 Enclosure: CSA 2 with sprinkler hoods for horizontal and vertical spray protection. Label to clearly indicate winding type. Removable metal front panel, complete with integral vibration absorbing pads.
- .9 Mounting: wall up to 50 kVA, floor over 50 kVA.
- .10 Finish: in accordance with Section 26 05 00.
- .11 Taps on primary to be full capacity, to 2-1/2% above and to 2-1/2% below normal.
- .12 Aluminum windings.

.3 Acceptable materials:
- .1 Schneider / Square D to match existing.
- .2 Alternate materials as approved by addendum in accordance with General Instructions.

PART 3 - EXECUTION

3.1 Mounting

.1 Install as per manufacturer's recommendations on support structure indicated on plans.

.2 Mount dry type transformers as indicated.

.3 Ensure adequate clearance around transformer for ventilation and to meet Code requirements.

.4 Install transformers in level upright position.

.5 Remove shipping supports only after transformer is installed and just before putting into service.

.6 Loosen isolation pad bolts until no compression is visible.

3.2 Connections

.1 Make primary and secondary connections shown on wiring diagram.

.2 Energize transformers immediately after installation is completed, where practicable.

.3 Provide ground wire from main service ground to neutral point of secondary windings, sized to Code. Run in primary feeder conduit, and bond to transformer case to satisfaction of Inspection Authority.

.4 Provide flexible conduit connections for last 1 m in each conduit.

3.3 Equipment Identification

.1 Size 7 label in accordance with Section 26 05 00.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Shop Drawings

.1 Submit product data in accordance with Section 26 05 00.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.3 Plant Assembly

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

PART 2 - PRODUCTS

2.1 Panelboards

.1 Panelboards: to CSA C22.2No.29.

.2 Panelboards to be product of one manufacturer.

.3 Bus and breakers rated for following symmetrical interrupting capacity unless otherwise indicated.
- 120/208V Panelboards - 10 KA
- 600/347V Panelboards - 14 KA Alternatively, fault current protection may be provided by use of integrated system series rating.

.4 Above values of interrupting capacities may be reduced if short circuit study is performed prior to shop drawing submission. Submit short circuit study results to Engineer for review with shop drawings.

.5 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.6 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.7 Two keys for each panelboard and key panelboards alike.

.8 Aluminum bus with tin plated joints, to extend full height of enclosure such that each space is ready to accommodate future breaker whether indicated elsewhere in the contract documents or not.

.9 All panelboards to be equipped with full size neutrals.

.10 Mains suitable for bolt-on breakers.

.11 CSA Type 1 Enclosure, finish trim and door baked grey enamel unless otherwise noted.

2.2 Breakers

.1 Breakers to Section 26 28 16.02.

.2 Breakers with thermal magnetic tripping in panel boards except as indicated otherwise

.3 Lock-on devices for fire alarm, emergency lighting circuits, exit signage and night light circuits.

2.3 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete a dated circuit directory with typewritten legend showing location and load of each circuit.

2.4 Acceptable Materials

.1 Square D to match existing.

.2 Alternate materials as approved by addendum in accordance with General Instructions.

PART 3 - EXECUTION

3.1 Installation

.1 Co-ordinate with mechanical contractor to confirm final circuit breaker requirements of mechanical equipment prior to ordering distribution equipment. Bring any discrepancies to attention of Engineer.

.2 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.

.3 In combustible construction, provide 1 layer of 16 mm (5/8") gypsum board behind each surface mounted panel, full size of panel.

.4 Mount panelboards to height given in Section 26 05 00 or as indicated.

.5 Connect loads to circuits as indicated.

.6 Connect neutral conductors to common neutral bus with respective neutral identified.

.7 Refer to Section 26 05 34 for installation of spare conduits.

3.2 Panelboard Layouts

.1 Follow panelboard details and schedules for layout of circuits and breaker sizes wherever possible.

.2 Record all changes to panelboard details and schedules and submit as part of "As-built" drawing set for review at completion of the project. Insert copies in each manual.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

PART 2 - PRODUCTS

2.1 Switches

.1 120V and 347V switches shall be rated 20A, and single pole, double pole, three-way, four-way type as indicated.

.2 Manually-operated general purpose ac switches as indicated and with following features:

- .1 Terminal hole approved for No.10 AWG.
- .2 Silver alloy contacts.
- .3 Urea or melamine moulding for parts subject to carbon tracking.
- .4 Suitable for back and side wiring.
- .5 White toggle.

.3 Toggle operated fully rated for LED, tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

.5 Acceptable Materials: Hubbell No.1221 (120V), No. 18221 (347V) or equivalents by:

- .1 Arrow Hart No.CSB120 (120V)
- .2 Bryant No. CSB120 (120V), No.6901 (347V)
- .3 Leviton No.CSB1-20 (120V)
- .4 Pass & Seymore No. CSB20AC (120V), No. PS372010 (347V)
- .5 Alternate materials as approved by addendum in accordance with General Instructions.

2.2 Receptacles

.1 Duplex receptacles, CSA type 5-15 R, 125V, 15A, U ground, specification grade with following features:

- .1 White urea moulded housing.
- .2 Suitable for No.10 AWG for back and side wiring.
- .3 Break-off links for use as split receptacles.
- .4 Eight back wired entrances, four side wiring screws.
- .5 Double wipe contacts and rivetted grounding contacts.

.2 Single receptacles CSA type 5-15R, 125V, 15A, U ground with following features:
- .1 Ivory urea moulded housing.
- .2 Suitable for No.10 AWG for back and side wiring.
- .3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

.5 Acceptable Materials:
- .1 Arrow Hart No.5252,
- .2 Bryant No.5262,
- .3 Leviton No. 5096 or 5262,
- .4 Hubbell No. 5262.
- .5 Pass & Seymore No. BR15.
- .6 Alternate materials as approved by addendum in accordance with General Instructions.

2.3 Occupany Sensors

.1 Provide dual technology wall switch sensors with manual 'off' override. White finish. Coordinate with other trades so that wall switch sensors are not located below thermostats or temperature sensors. Dual technology wall switch sensor shall be equal to Wattstopper DW-100-24 series complete with power and auxiliary relay packs unless otherwise indicated.

.2 Provide dual technology ceiling mounted sensors – type OS1 generally recessed in acoustic / drywall ceilings and type OS2 typically surfaced mounted / suspended to avoid exposed ceiling interference. Coordinate with other trades so that ceiling mounted sensors do not interfere with diffusers or sprinkler heads. Install ceiling sensors a minimum four feet away from air supply ducts and diffusers. Ceiling mounted sensor shall be equal to Wattstopper DT-300 series complete with power and auxiliary relay packs unless otherwise indicated.

.3 Occupancy sensors to have 0 to 30 minute adjustable time delay, set to 20 minutes default.

.4 Acceptable Materials:
- .1 Legrand/Wattstopper
- .2 Leviton

.3 Sensor Switch
.4 Alternate materials as approved by addendum in accordance with General Instructions.

2.4 Cover Plates

.1 Cover plates for wiring devices.

.2 Cover plates from one manufacturer throughout project.

.3 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in a flush-mounted outlet box.

.4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD boxes, or utility boxes.

.5 Weatherproof at exterior locations or indicated by “WP” on plans. Weatherproof receptacles shall be complete with spring-loaded cast aluminum cover plates and gaskets for devices.

.6 Cover plates for housekeeping receptacles shall be engraved with “Housekeeping Only” lettering.

PART 3 - EXECUTION

3.1 Installation

.1 Switches and Occupancy Sensors:
.1 Install single throw switches with handle in "UP" position when switch closed.
.2 Install devices in gang type outlet box when more than one switch is required in one location.
.3 Mount devices at height specified in Section 26 05 00 or as indicated.
.4 Adjust occupancy sensor coverage pattern on site to suit local conditions for best coverage.

.2 Receptacles:
.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location in finished areas.
.2 Mount receptacles at height specified in Section 26 05 00 or as indicated.
.3 Install GFCI receptacles with maximum of three protected downstream receptacles for all receptacles marked "GF".

.3 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 meant for flush outlet boxes on surface-mounted boxes.

.4 Provide plastic coverplate for dimmers, colour to match device.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

PART 2 - PRODUCTS

2.1 Fuses - General

.1 Fuses: product of one manufacturer.

.2 All fuses to have minimum 200,000 amps interrupting capacity.

2.2 Fuse Types

.1 Fuses shall be CSA certified HRCI-J/Class J time delay with dimensions and current limiting performance in accordance with CSA C22.2 No.106.

.2 Fuses over 200A to be current limiting type.

2.3 Materials

.1 Acceptable Materials:

- .1 Bussman Type LPJ
- .2 Gould/Ferraz Shawmut/Mersen Type AJT
- .3 Noram Duralim
- .4 Alternate material as approved by addendum in accordance with General Instructions.

PART 3 - EXECUTION

3.1 Installation

.1 Co-ordinate with mechanical contractor to confirm final fuse requirements of mechanical equipment prior to ordering distribution equipment. Bring any discrepancies to attention of Engineer.

.2 Install fuses in mounting devices immediately before energizing circuit.

.3 Ensure correct fuses fitted to physically matched mounting devices.

.4 Ensure correct fuses fitted to assigned electrical circuit.

.5 At completion of work, turn over three (3) spare fuses of each type and size used, in original shipping cartons.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Product Data

.1 Submit product data, including time-current characteristic curves, for breakers with ampacity of 400A and over.

PART 2 - PRODUCTS

2.1 Breakers General

.1 Bolt-on moulded case circuit breaker, quick-make quick-break type, for manual and automatic operation.

.2 Common-trip breakers with single handle for multiple applications.

.3 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.

.4 Circuit breakers with interchangeable trips on main service entrance breaker, and as indicated.

.5 New breakers in existing panels to be of same manufacturer as panel.

2.2 Thermal Magnetic Breakers

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping under overload conditions and instantaneous magnetic tripping for short circuit protection.

2.3 Acceptable Materials

.1 Square D to match existing.

.2 Alternate materials as approved by addendum in accordance with General Instructions.

PART 3 - EXECUTION

3.1 Installation

.1 Co-ordinate with mechanical contractor to confirm final circuit breaker requirements of mechanical equipment prior to ordering distribution equipment. Bring any discrepancies to attention of Engineer.

.2 Install circuit breakers as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Product Data

.1 Submit product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.1 Equipment

.1 Enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No.4.

.2 Fuse holder assemblies to CSA C22.2 No.39.

.3 Fusible and non-fusible disconnect switch in CSA Type 2 Enclosure as indicated.

.4 Provision for padlocking in On-Off switch position by locks.

.5 Mechanically interlocked door to prevent opening when handle in ON position.

.6 Fuses as indicated in accordance with Section 26 28 13.01.

.7 Fuse holders in each switch suitable without adaptors, for type of fuse as indicated.

.8 Quick-make, quick-break action.

.9 ON-OFF switch position indication on switch enclosure cover.

2.2 Equipment Identification

.1 Indicate name of load controlled on size 4 nameplate to Section 26 05 00.

2.3 Acceptable Materials

.1 Siemens

.2 Square D / Schneider

.3 Cutler Hammer / Westinghouse

.4 General Electric

.5 Alternate materials as approved by addendum in accordance with General Instructions.

PART 3 - EXECUTION

3.1 Installation

.1 Co-ordinate with mechanical contractor to confirm final fuse requirements of mechanical equipment prior to ordering distribution equipment. Bring any discrepancies to attention of Engineer.

.2 Install disconnect switches complete with fuses as indicated.

.3 Main disconnect switches are shown. Provide additional disconnect switches as required to satisfy Inspection Authority and to satisfy Code requirements.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Product Data

.1 Submit product data per Section 26 05 00 for Contactors over 100A.

PART 2 - PRODUCTS

2.1 Contactors

.1 Contactors: to CSA C22.2No.14 and EEMAC No.1CS.

.2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.

.3 Breaker or fused switch combination contactor as indicated.

.4 Complete with 1 normally open and 1 normally closed auxiliary contacts for Owner's use unless indicated otherwise.

.5 Mount in CSA Type 2 enclosure unless otherwise indicated.

.6 Include following options in cover unless otherwise noted.
- .1 Red indicating lamp when contactor "ON".
- .2 Hand-off-auto selector switch with terminals for external connections.

.7 Control transformer and secondary fuse in contactor enclosure for 120V control.

2.2 Equipment Identification

.1 Size 4 nameplate in accordance with Section 26 05 00 indicating name of load controlled.

2.3 Acceptable Materials

.1 Allen-Bradley Canada Ltd.

.2 Canadian General Electric Co.

.3 Cutler-Hammer Ltd.

.4 Square D Company

.5 Siemens

.6 Westinghouse Canada Ltd.

.7 ASCO

.8 Alternate materials as approved by addendum in accordance with General Instructions.

PART 3 - EXECUTION

3.1 Installation

.1 Install contactors and connect auxiliary control devices as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 26 05 00.

.2 Indicate:
- .1 Mounting method and dimensions.
- .2 Starter size and type.
- .3 Layout of identified internal and front panel components.
- .4 Enclosure types.
- .5 Wiring diagram for each type of starter.
- .6 Interconnection diagrams.

1.3 Operation and Maintenance Data

.1 Provide data for incorporation into maintenance manual specified in Section 26 05 00.

.2 Include operation and maintenance data for each type and style of starter.

PART 2 - PRODUCTS

2.1 Materials

.1 Starters: to CSA C22.2 No.14, EEMAC E14-1. Half size starters not acceptable.

.2 CSA Type 2 enclosures.

2.2 Manual Motor Starters

.1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
- .1 Switching mechanism, quick make and break.
- .2 Overload heater in each phase leg, manual reset, with trip indicating handle.

.2 Accessories:
- .1 Toggle switch: standard labelled as indicated.
- .2 Indicating light: standard type and colour as indicated.
- .3 Locking tab to permit padlocking in 'ON' or 'OFF' position.

2.3 Full Voltage Magnetic Starters

.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
- .1 Contactor solenoid operated, rapid action type.
- .2 Motor overload protective device in each phase, manually reset from outside enclosure.
- .3 Power and control terminals.
- .4 Wiring and schematic diagram inside starter enclosure in visible location.
- .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starter to include disconnect switch with operating lever on outside of enclosure to control disconnect and provision for:
- .1 Locking in 'OFF' position with up to 3 padlocks.
- .2 Locking in 'ON' position.
- .3 Independent locking of enclosure door.
- .4 Provisions for preventing switching to 'ON' position while enclosure door open.

.3 Accessories:
- .1 Pushbuttons and selector switches: "Test-Off-Auto" with spring return from Test, unless otherwise noted.
- .2 Indicating lights: push-to-test type and colour 1 green 'ON' unless otherwise noted.
- .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 Control Transformer

.1 Single phase, dry type, control transformer with primary voltage to suit motor voltage and 120V secondary, complete with secondary fuse, installed in starter.

.2 Size control transformer for control circuit load plus 20% spare capacity. Co-ordinate with mechanical contractor to determine circuit requirements.

2.5 Finishes

.1 Apply finishes to enclosure in accordance with Section 26 05 00.

2.6 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, size 5 engraved as indicated.

2.7 Acceptable Materials

.1 Allen Bradley

.2 Canadian General Electric

.3 Cutler Hammer

.4 Siemens

.5 Square D

.6 Moeller

.7 Alternate material as approved by addendum in accordance with General Instructions.

PART 3 - EXECUTION

3.1 Installation

.1 Co-ordinate with mechanical contractor to confirm final starter requirements of mechanical equipment prior to ordering starter or distribution equipment. Bring any discrepancies to attention of Engineer.

.2 Install starters, connect power and control as indicated.

.3 Ensure correct fuses and overload devices elements installed.

3.2 Tests

.1 Perform tests in accordance with Section 26 05 00 and manufacturer's instructions.

.2 Operate switches, contactors, to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

.5 Before starting the motors:
- .1 Make sure that the section supplying the motor is present.
- .2 Check the rotation with the concerned section.

3.3 Report

.1 Upon completion of the wiring of all motors, present to the Engineer, a typewritten report of voltage and phase currents at the motor terminals together with the motor HP rating, nameplate full load amps, overload setting and identification of the motor.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Product Data

.1 Submit product data in accordance with Section 26 05 00.

.2 Mark each data sheet with the appropriate fixture type designation for this project.

1.3 Maintenance Materials

.1 Supply and install replacement ballast, driver or lamp for any that fail or exceed their original noise level rating within 12 months of take-over.

PART 2 - PRODUCTS

2.1 Materials

.1 Socket screw-shell lampholders: to CSA C22.2 No.43.

.2 Light Emitting Diode (LED) fixtures: to CSA C22.2 No. 250.13.

.3 Fixtures and lamps shall be Energy Star approved and on the Design Lights Consortium List.

2.2 Luminaire Details

.1 Provide luminaires as indicated in table on drawings or attached to this section.

.2 Provide supporting devices, plaster frames, junction boxes and outlet boxes where required.

.3 Stamped steel luminaire bodies not to be less than 1.0 mm thick cold rolled steel. Reflective steel plates of minimum 0.8 mm thick metal.

.4 Provide lenses or diffusers of glass or acrylic material as indicated. Acrylic prismatic lenses shall have the following characteristics:

- .1 Minimum 0.125" thick K12 pattern.
- .2 UV inhibitors.
- .3 Must not visibly sag when installed in 0.3 to 0.6 meter luminaries.

.4 Must not exceed yellowing factor of 3 (when tested by IES-SPI-NEMA method).

.5 Include finishes to Section 26 05 00 and as indicated.

.6 Provide gaskets, stops and barriers to form light traps to prevent light leaks.

.7 Interior fixtures manufactured by Acuity Brands, Axis, Cooper, Cree, Focal Point, Finelite, General Electric, HE Williams, Hubbell, Peerless, Philips, and Visioneering, and having the same appearance and design features as the ones specified are accepted as equivalent unless otherwise noted in fixture schedule, subject to shop drawing review.

.8 Exterior fixtures manufactured by Acuity Brands, Cooper, General Electric, Hubbell, Ligman, and Philips, and having the same appearance and design features as the ones specified are accepted as equivalent unless otherwise noted in fixture schedule, subject to shop drawing review. Where requested, submit lighting calculations for Engineer's review at least 5 days prior to tender closing.

.9 Refer to lighting fixture schedule for fixtures that may be noted as "no substitutions" or similar wording; these shall be matched exactly.

2.3 Lamps

.1 Provide all required lamps as indicated in fixture list.

.2 LED lamps shall provide the minimum delivered lumens indicated on light fixture schedule and shall maintain 70% of initial lumens after 50,000 hours of operation. Colour rendering index minimum 80 or higher as noted in fixture schedule on drawings, colour temperature per schedule.

.3 Acceptable Materials:

.1 General Electric
.2 Osram/Sylvania
.3 Philips
.4 Cree
.5 Nichia
.6 Samsung
.7 Alternate materials as approved by addendum in accordance with General Instructions.

2.4 LED Drivers

.1 Each LED fixture to be complete with integral, modular, replaceable drivers.
- .1 Minimum efficiency: 85%
- .2 Maximum THD: 20%
- .3 Discrete driver, heat sink, circuit board and housing components.

.2 Acceptable driver manufacturers:
- .1 Universal
- .2 General Electric
- .3 Sylvania/Osram
- .4 Ultrasave
- .5 Philips
- .6 EldoLED (Acuity)
- .7 Cree
- .8 Nichia
- .9 Samsung
- .10 Xicato

PART 3 - EXECUTION

3.1 Installation

.1 Locate luminaires as indicated.

.2 For suspended ceiling installations, provide independent slack chain suspension on each fixture, to keep fixture approximately level if ceiling support is removed, to satisfaction of Inspection Authority. Provide for relocated fixtures where no such support presently exists.

.3 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.4 Align luminaires mounted individually parallel or perpendicular to building grid lines.

.5 For chain suspended fixtures, close all S-hooks after installation.

3.2 Wiring

.1 Connect all open area luminaires to lighting circuits as indicated, via centralized junction boxes in radial fashion. Loops are not permitted except by written permission of the Engineer.

.2 In T-bar ceilings, use type AC wiring between fixtures on same circuit to allow easy removal of fixtures from ceiling.

3.3 Lamps

.1 Adjust lamp light centre position to produce specified beam distribution for luminaire type.

3.4 Tests

.1 Perform tests in accordance with Section 26 05 00.

.2 Clean and check luminaires and replace defective lamps, ballasts and accessories just prior to turnover to Owner.

3.5 Spares

.1 Turn over to Owner at completion of work, 1% of each lamp type installed, minimum quantity 2.

.2 Lamps to be new, clean, and in original packaging.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Product Data

.1 Submit product data per Section 26 05 00.

.2 Data to indicate system components, mounting method, source of power and special attachments.

1.3 Guarantee

.1 Provide written copy of terms of battery guarantee in maintenance manual, and note date of acceptance for start of guarantee period.

PART 2 - PRODUCTS

2.1 Equipment

.1 Unit equipment for emergency lighting: to CSA C22.2 No.141.

.2 Supply voltage: 347V AC, unless noted.

.3 Output voltage: 12 DC.

.4 Operating time: 30 minutes with connected load shown on drawings or minimum 200 watts, whichever is greater.

.5 Battery: sealed, maintenance free.

.6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected, modular construction.

.7 Solid state transfer.

.8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.9 Signal lights: solid state, life expectancy 100,000 h minimum, for 'AC Power ON' and 'High Charge'.

.10 Lamp heads: integral on unit and remote adjustable mounting, swivel type, die cast metal housing, white finish, dual head with 5 watt, minimum 285 lumen LED lamps.

.11 Cabinet, typical: suitable for direct or shelf mounting to wall unless otherwise noted and complete with knockouts for conduit.

.12 Auxiliary equipment:
- .1 Test switch
- .2 Battery disconnect device
- .3 AC input and DC output terminal blocks inside cabinet.
- .4 Bracket
- .5 Cord and plug connection for ac where required.

2.2 Wiring of Remote Heads

.1 Conduit: type EMT, to Section 26 05 34.

.2 Conductors: RW90 type to Section 26 05 21, sized to limit voltage drop to 5%.

PART 3 - EXECUTION

3.1 Installation

.1 Install unit equipment for emergency lighting in accordance with CSA C22.1, Section 46.

.2 Install unit equipment and remote mounted fixtures as indicated.

.3 Cut and re-cap cord to remove surplus.

.4 Clean all heads, and direct as indicated by Engineer at time of acceptance.

.5 Test each unit and verify operation of all remote heads.

.6 Disconnect AC power to one unit selected by Engineer, and record operating time before shutdown, at time of acceptance.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Product Data

.1 Submit product data per Section 26 05 00.

PART 2 - PRODUCTS

2.1 Exit Lights General

.1 Exit lights: to CSA C22.2 No. 141 and NR Can C860 registered.

.2 Housing: cold rolled steel minimum 1.0 mm thick, white finish.

.3 Face and back plates: die formed cold rolled steel.

.4 Lamps: LED, non-protruding type with maximum power rating of 2.5 watts per face.

.5 Designed for 50,000 h life of continuous operation without relamping.

.6 Pictogram: green Running Man type with directional arrow indicators as shown on plans.

.7 Fixture to have separate LED circuit for automatic switch over to DC emergency power circuit.

.8 Face plate to remain captive for relamping.

2.2 Design

.1 Universal type for wall, end to wall, or ceiling mounted as required.

.2 Double face unless noted.

.3 Arrow: as shown on drawings.

PART 3 - EXECUTION

3.1 Installation

.1 Install exit lights as indicated and ensure arrow directions are correct.

.2 Connect fixtures to exit light circuits as indicated.

.3 Connect emergency lamp sockets to emergency circuits as indicated.

.4 Ensure that exit light circuit breaker is locked in on position.

END OF SECTION

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

.2 Conform with requirements of ANSI TIA/EIA-569.

1.2 System Description

.1 Empty raceway system consists of outlet boxes, cover plates, conduits, sleeves and caps, and fish wires.

PART 2 - PRODUCTS

2.1 Material

.1 Conduits: EMT type, to Section 26 05 34.

.2 Outlet boxes and fittings: to Section 26 05 32.

.3 Fish wire: polypropylene type.

.4 Direct buried ducts: to Section 33 65 76, and to Utility standards.

PART 3 - EXECUTION

3.1 Installation

.1 Install empty raceway system, including fish wire, outlet boxes, cover plates, conduit, sleeves and caps, miscellaneous and positioning material to constitute a conduit system as shown on drawing.

.2 Install conduits in accordance with ANSI TIA/EIA-569; provide pull box for every two 90 degree bends, do not change direction of conduit run at pull box, all bends to be sweeping type minimum six times conduit diameter.

.3 Provide smooth plastic or phenolic bushings on both ends of each conduit.

.4 Where conduits are gathered, as at telephone back-board, clearly and permanently label each conduit with location of area served, using column grid line references, not name of tenant or group.

END OF SECTION

PART 1 - GENERAL

1.1 Related Work

.1 Demolition: Section 02 41 00

.2 Excavating, Trenching and Backfilling for Site Work: See Civil drawings

.3 Asphalt Pavements and Granular Bases: See Civil drawings

.4 Foundation Drainage Section 33 46 20

1.2 General

.1 The requirements of Division 01 form part of this Section.

1.3 Soils Report

.1 Examine soils report. See Section 00 31 00.

.2 Report is #62788.04 dated 27 August 2018 prepared by GEMTEC.

.3 Neither the Consultant, nor the Owner offer a warranty to the Contractor that this information is representative of the conditions prevailing on site.

.4 Comply with all recommendations and instructions of the soils reports as well as the additional requirements of this specification.

1.4 References

.1 American Society for Testing and Materials International (ASTM).
.1 ASTM D698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-1bf/ft³) (600 kN-m/m³).

1.5 Definitions

.1 Unclassified excavation: excavation of deposits of whatever character encountered in Work.

1.6 Regulations

.1 Shore and brace excavations, protect slopes and banks and perform all work in accordance with Provincial and

Municipal regulations whichever is more stringent.

1.7 Engineering Services for Temporary Structures

.1 Engage services of qualified professional Engineer, registered in Ontario to design and inspect cofferdams, shoring, bracing and underpinning required for Work.

.2 Design and supporting data used to bear stamp and signature of the qualified professional Engineer.

.3 Keep design and supporting data on site.

.4 Submit proof of insurance coverage for Engineer's professional liability.

.5 Where Engineer is employee of Contractor, submit proof that Work by Engineer is included in Contractor's insurance coverage.

.6 The qualified professional Engineer shall provide periodic field review during construction and shall submit reports. Contractor shall submit copies of all reports to Consultant.

1.8 Tests and Inspections

.1 Testing of materials and compaction of backfill will be carried out by testing laboratory designated by Owner.

.2 Not later than one week before backfilling, provide to designated testing agency, 23kg samples of each type of backfill materials proposed for use. Submit in accordance with Section 01 30 00.

.3 Do not begin backfilling or filling operations until material has been approved for use by Consultant.

.4 Notify testing company to inspect all bearing surfaces prior to placement of concrete and granular foundation.

.5 Not later than 24 hours before backfilling or filling with approved material, notify Testing Agency so that compaction inspection can be carried out by designated testing agency.

.6 Inspection and testing will be paid for from allowances described in Section 01 21 00 except as described in Section 01 45 00.

1.9
Buried Services

.1 Before commencing work establish the location and state of use of all buried services on and adjacent to the work area.
.1 Size depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
.2 Record location of maintained, re-routed, abandoned, and new underground lines.

1.10
Protection

.1 Protect walls and floors of excavations from freezing, desiccation and moisture.

.2 Protect ground under existing and new footings and slabs-on-grade from freezing.

.3 Keep excavations clean and free of loose soil.

.4 Protect natural and man-made features required to remain undisturbed. Guard against damage to natural and man-made features required to remain undisturbed. Protect from damage existing trees which are to remain.

.5 Assume full responsibility for any damage to existing natural and man-made features and buried services on or off site resulting from this work including third party claims for disruption of services.

.6 Conduct with Consultant condition survey of existing trees, plants, lawns, fencing, services, paving, survey bench marks and monuments, which may be affected by work.

1.11
Extra or Less Work

.1 Base average soil profile on straight line interpolation of bore hole and test pit data in soils report. In estimating work assume variation in soil profiles from the average straight line interpolation and include for additional volume or removal to be expected as a result.

.2 Measurements to determine additional and reduced excavation to be based on cross sections of areas involved made by Contractor and agreed to by Consultant, both

immediately before and immediately after excavation.

.3 Correct unauthorized over excavation as directed by Consultant at no cost to the Owner.

PART 2 - PRODUCTS

2.1
Materials

.1 Granular "A": Clean, hard, durable, crushed gravel or stone, free from shale, clay, cementation, friable materials, organic matter and other deleterious substances, to OPSS Form 1010 - for Granular "A" when tested in accordance with OPSS 1001; virgin material only under building.

.2 Granular "B", Type II: Clean, hard, durable, gravel or stone, free from shale, clay, cementation, friable materials, organic matter and other deleterious substances, to OPSS Form 1010 - for Granular "B", crushed, when tested in accordance with OPSS 1001; virgin material only under building, 50mm minus material under building.

.3 Granular "B", Type I: Clean, hard, durable sand, gravel or crushed stone, free from shale, clay, friable materials, organic matter and other deleterious substances to OPSS Form 1010 - for Granular "B" when tested in accordance with OPSS 1001; virgin material only under building, 50mm minus material only under building.

.4 Engineered Fill: Granular B, Type II or Granular A laid-in max. 300mm lifts and compacted to min. 100%.

.5 Sand Bedding: Clean, hard, durable sand, free from shale, clay, friable materials, organic matter and other deleterious substances, to OPSS Form 1004 - December 1983 for "Sand Bedding for Electrical Cable" consisting of modified Granular B, Type 1 with 100% passing a 4.75mm sieve.

.6 Native and Imported Fill: Selected material from excavation or other sources, approved by Consultant for use intended, unfrozen and free from rocks larger than 75mm, cinders, ashes, sods, brick, refuse or other deleterious materials.

PART 3 - EXECUTION

3.1
Site Preparation

.1 Remove obstructions, ice and snow from surfaces to be

excavated.

.2 Sawcut pavements or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

.3 Remove pavements and granulars from area of new building, pavements and landscaping.

3.2
Cofferdams, Shoring, Bracing and Underpinning

.1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Provincial Regulations.

.2 During backfill operation:
.1 Remove sheeting and shoring from excavations.
.2 Do not remove bracing until backfilling has reached respective levels of such bracing.
.3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500mm above toe of sheeting.

.3 Upon completion of substructure construction:
.1 Remove cofferdams, shoring and bracing.
.2 Remove excess materials from site.

3.3
Dewatering

.1 Lower groundwater table to below the maximum excavation depth prior to excavating below water table.

.2 Submit for Consultant's review, details of proposed dewatering methods.

.3 Keep excavations free of water while work in progress.

.4 Protect open excavations against flooding and damage due to surface run-off.

.5 Dispose of water in a manner not detrimental to public and private property, or to any portion of work completed or under construction.

.6 Use best management practices including flocculation

tanks, settling basins, or other treatment facilities as required to remove sediments, suspended solids, pollutants, or other
materials before discharging to storm sewers, water courses or drainage areas. Monitor regularly to ensure effectiveness of methods and compliance with Provincial/Federal Legislation pertaining to water quality and habitat.

3.4
Excavation

.1 Excavate to lines, grades, elevations and dimensions indicated.

.2 Excavate all material encountered:
.1 For all excavation shown or required by the contract documents, and
.2 To the proper lines, grades, elevations and dimensions indicated on the drawings, and
.3 To install specified thickness of paving, slabs, bases and sub-bases, and
.4 To remove loose, wet, frozen, organic and disturbed soil from area of buildings and pavements, and
.5 To remove fill under new building and the zone of influence of the building's foundations and
.6 To give bearings satisfactory to the Consultant.

.3 Excavate so that bearing capacity of adjacent foundations is not interfered with.

.4 Excavate so that footings are supported at not steeper than 1.5H:IV, by undisturbed, intact soil or Engineered Fill. Slopes of bottom of excavations under Engineered Fill shall not be steeper than 1.5H:IV.

.5 Do not excavate more than 30m of trench in advance of installation operations and do not leave more than 15m of trench open at end of day's operation. Keep excavated and stockpiled materials a safe distance away from edges of excavations. Restrict vehicle operations directly adjacent to open trenches.

.6 Do not disturb soil within branch spread of trees or shrubs that are to remain.
.1 If excavating through roots, excavate by hand and cleanly cut roots with sharp axe, saw or pruning shears at sides of trench.
.2 Keep roots damp with burlap curtain secured to trench wall and keep continuously damp while trench is open.

.3 Prune crown to compensate for root loss while maintaining general form and character of the trees.
.4 Fertilize in spring at rate of 0.25 Kg/m² of Nitrogen.

.7 Excavate so that earth bottoms of excavations are undisturbed soil, flat, free from loose, soft or organic matter.

.8 Do not obstruct flow of surface drainage or natural watercourses.

.9 Notify Consultant when surface at bottom of excavation appears unsuitable and proceed as directed by Consultant.

.10 Obtain Consultant's approval of completed excavation. Ensure bearing surfaces are inspected by a competent geotechnical engineer prior to placing concrete, Engineered Fill, and backfill.

.11 Remove unsuitable material to extent and depth directed by Consultant.

.12 Except as otherwise directed, correct unauthorized over excavation as follows:
.1 Fill under bearing surfaces and footings with Engineered Fill as directed by Consultant.
.2 Fill under slabs with additional granular sub-base material, compacted as specified.
.3 Fill excess trench excavation with additional bedding and compaction as specified.

.13 Hand trim, make firm and remove loose material and debris from excavations.

.14 Protect excavated surfaces from below freezing temperatures immediately upon exposure. Protect ground under footings and slabs from freezing.

.15 Dispose of surplus and unsuitable excavated material off site.

.16 Excavate for mechanical and electrical work. Co-ordinate layout and supervision with trade concerned. Grade bottom of trenches accurately to suit service elevations. Trench to width and depth required for bedding and backfilling. Co-ordinate with Divisions 22 to 28 and refer to mechanicaland electrical drawings for details of trenches and backfill required.

3.5
Backfill Types and Compaction

.1 Use types of fill as indicated or specified below. Compaction densities are percentages of maximum dry density to ASTM D698-00ae1, Method C. Unless otherwise specified, compact to following minimum densities:
.1 Engineered Fill: 100%
.2 Granular “A”: 98%
.3 Granular “B” Type II: 98%
.4 Granular “B” Type I: 95%
.5 Sand Bedding: 95%
.6 Native and Imported backfill under pavements: 98%.
.7 Native and Imported backfill under landscaped areas: 92%.

.2 Place granular backfill material in uniform layers of max. 300mm loose thickness except as otherwise noted then compact. Compact each layer before placing succeeding layer. Place other fill in max. 400mm loose layers, then compact.

.3 Underground services:
.1 Install bedding and protective cover as indicated and in accordance with Engineers’, drawings, specifications, and governing regulations.
.2 Conduit, cable and cable duct bedding and immediate protective cover: Except as otherwise indicated; cover bottom of trench with 150mm of sand bedding. After cables and ducts are in place, side fill ducts with sand bedding up to top of ducts. Tamp around ducts with hand tampers and cover with 150mm of same material.
.3 Fill above protective cover.
.1 In areas within buildings fill remainder of trench with Granular materials to match adjacent slab-on-grade backfill.

.4 Notify Consultant 2 days prior to backfilling of trenches for services.

3.6
Backfilling

.1 Do not commence backfilling until fill material and spaces to be filled have been inspected and approved by Consultant. Remove formwork, shoring and bracing and

satisfactorily backfill voids prior to Consultant's inspection.

.2 Remove all snow and ice, frozen soil, frozen backfill, standing water, construction debris and organic soil from spaces to be filled.

.3 Do not use backfill material which is frozen or contains ice, snow, debris or other contamination.

.4 Do not place backfill over frozen sub-grade, or over ice, snow, debris or other contamination.

.5 Commence placing granular backfill promptly after stripping excavations and densifying are completed and sub-grade approved by Consultant.

.6 Remove snow from granular backfill and remove frozen granular materials and snow, ice or freezing rain contaminated granular materials which has formed or collected, before laying down additional granular materials.

.7 Use backfill methods and protection which will ensure backfill is not and will not become frozen.

.8 Backfilling around installations.

.1 Place bedding and surround material as specified elsewhere.

.2 Do not backfill around or over cast-in-place concrete within 3 days after placing.

.3 Place layers simultaneously on both sides of installed work to equalize loading. Difference not to exceed 0.4 m.

.4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures.

.1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Consultant.

.2 If approved by Consultant, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Consultant.

.5 Place material by hand under, around and over installations until 600mm of cover is provided. Dumping material directly on installations will not be permitted.

.6 Do not use motorized equipment to compact fill in immediate vicinity of walls, services, and other installations.

.9 Backfill to exterior perimeter of foundations and to retaining walls to be material free from rocks larger than 150mm, sand, Granular B, or other granular, non-frost susceptible sand material acceptable to Soil's Consultant, except;
.1 Where such excavations occur under concrete pavement, asphalt pavements, unit pavements; backfill with Granular "B" up to underside of sub-base.
.2 Except under pavements, backfill against retaining walls to be nominally compacted to min. 95%.

.10 Backfill from excavated subsoil up to underside of granular foundations for concrete slabs-on-grade to be Granular B, Type I or II.

.11 Bases and Bedding:
.1 Granular base for concrete slabs-on-grade to be min. 300mm layer of 19mm clear crushed stone except as otherwise indicated.

3.7
Rough Grading

.1 Rough grade to levels, profiles and contours allowing for surface treatment as indicated.

.2 Slope rough grade away from building 1:50 minimum.

.3 Prior to placing fill over existing ground, scarify surface to depth of 150mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

.4 Where required, raise subgrade to rough grade level with approved site excavated materials

3.8
Restoration

.1 Upon completion of work, remove waste materials and debris, trim slopes, and correct defects noted by Consultant.

.2 Clean and reinstate areas affected by work to condition and location which existed prior to excavation or to new requirements required, as directed by Consultant.

3.9
Surplus Materials

.1 Dispose of surplus and unsuitable material off site.

3.10
Winter Protection

.1 Provide temporary insulation and enclosure to prevent ground below footings and ground below granular sub-base at slab-on-grade from freezing.

END OF SECTION

TOPSOIL AND FINISH GRADING

1. General

.1 The requirements of Division 01 form part of this section.

.2 Schedule placing of topsoil and finish grading to permit sodding or seeding under optimum conditions.

2. Materials

.1 Topsoil:

.1 Friable loam, suitable for intended use, 30-60% sand, min. 4% organic for clay, 2% for sandy loam. H, P, K of 20-40, 10-20, and 80-120 micrograms/gm respectively. Ph. 6.0-7.5. Stone, debris and toxin free. Soil amendments to OMAF recommendations.

.2 Acceptable Materials: Imported or recovered materail meeting above specification.

.2 Peatmoss: partly decomposed, elastic, homogenous, brown Sphagnum Moss free from wood and delitrious material; min. 5mm particle size.

.3 Sand: washed coarse silica sand. Medium to coarse textured.

.4 Limestone: 85% Calcium Carbonate, well graded.

.5 Fertilizer: complete, commercial, with 35% soluable N.

3. Stripping Topsoil

.1 Do not handle topsoil while in wet or frozen condition.

.2 Cut existing grass to 60mm height. Remove clippings.

.3 Strip topsoil from areas to be landscaped, of new construction and pavements, and to be used for construction. Do not mix topsoil with subsoil.

.4 Stockpile height not to exceed 2m. Dispose of unused topsoil off site.

4. Finish Grading

.1 Verify that rough grade is correct before proceeding. Grade to eliminate uneven areas and low spots, ensuring positive drainage.

.2 Remove debris, roots, branches, stones over 50mm, contaminants.

.3 Coarse cultivate to 75mm depth and similarly cross-cultivate.

.4 Spread topsoil in max 150m layers over unfrozen subgrade, free of standing water.

.5 Spread to min. 125mm compacted depth under sod keeping 15mm below finished grade.

.6 Spread and mix in soil amendments and fertilize uniformly and thoroughly. Apply fertilizer at least one week after limestone.

.7 Grade to eliminate rough spots and low areas and ensure positive drainage.

.8 Consolidate topsoil to required bulk density. Leave surface smooth, uniform and firm against deep footprinting.

- END -

PART 1 - GENERAL

1.1 General

.1 The requirements of Division 01 form part of this section.

1.2 Related Work

.1 Electrical — Division 26

1.3 References

.1 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .2 ASTM A90/A90M-13, Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- .3 ASTM A121-13, Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
- .4 A653/A653M-08, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .5 ASTM F1664-08(2013), Standard Specification for Poly(Vinyl Chloride) (PVC) - Coated Steel Tension Wire Used with Chain-Link Fence.
- .6 ASTM A123/A123M-09, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
- .7 ASTM F2200 - Standard Specification for Automated Vehicular gate Construction.

.2 Canadian General Standards Board (CGSB).
- .1 CAN/CGSB-138.1-96, Fabric for Chain Link Fence.
- .2 CAN/CGSB-138.2-96, Steel Framework for Chain Link Fence.
- .3 CAN/CGSB-138.3-96, Installation of Chain Link Fence.
- .4 CAN/CGSB-138.4-96, Gates for Chain Link Fence.
- .5 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.3 Canadian Standards Association (CSA International).
- .1 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
- .2 CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CAN/CSA-A3000-08, Cementitious Materials Compendium. Includes:
.1 CAN/CSA-A23.5-08, Supplementary Cementing Materials.

.4 CAN/CSA-C22.2 No.247 Operators and Systems of Doors, Gates, Draperies and Louvres.

1.4
Submittals

.1 Provide shop drawings of major components and general configuration including:
.1 Typical section, typical post configuration and foundation, configuration at each change of direction.
.2 Gate configuration including electric operator, control locations, plan indicating operator & accessory layouts.
.3 Manufacturer's data for:
.1 Fencing material
.2 Operators including controls.

1.5
Delivery, Storage
and Handling

.1 Deliver, store, and handle materials in accordance with manufacturer's written instruction.

.2 Store and protect from damage.

.3 Replace defective or damaged material,

.4 Store gate and gate operator components to manufacturer's recommendations. Store to avoid damage from moisture, abrasion, and other construction activities. Store off the ground.

1.6
Coordination and
Sequencing

.1 Coordinate gate installation with line fencing and paving. Installation can be independent of asphalt paving, however, operator foundation & electrical conduits must be in place.

1.7
Warranty

.1 Provide manufacturer's standard three (3) year warranty against defective materials and workmanship.

PART 2 - PRODUCTS

2.1
Materials

.1 Concrete:

.1 Materials: Portland cement to CAN/CSA-A3000-A5-03,Type 10. Water, fine aggregates, normal weight coarse aggregates to CAN/CSA-A23.1-04. Additives: fly ash to CAN/CSA-A23.5-08.

.2 Concrete mix designed to produce 25MPa minimum compressive strength at 28 days and containing 20mm maximum size, 5mm minimum size coarse aggregate, with water/cement ratio to CAN/CSA-A23.1-04 for Class C2 exposure and 60mm slump at time and point of deposit. Air entrainment: 5 to 8%.

.2 Chain link fence fabric: to CAN/CGSB-138.1-96.

.1. 6ga steel core 50 x 50mm mesh. galvanized, smooth coat, not hot-dipped galvanized.

.2 Height of wire: as indicated.

.3 Posts, beams and rails: to CAN/CGSB-138.2-96 galvanized steel pipe.

.1 Corner, end and straining posts: 88mm O.D. extra strong.

.2 Gate posts: 114mm O.D. double extra strong.

.3 Line posts: 60mm O.D. extra strong.

.4 Top rails: 42mm O.D.

.4 Tie wire fasteners: to CAN/CGSB-138.1-96, Table 2, single strand, galvanized steel wire conforming to requirements of fence fabric, 5mm diameter.

.5 Bottom Tension Wire: single strand, galvanized steel wire conforming to requirements of fence fabric, 5mm diameter. Weave into fence fabric at 300mm intervals.

.6 Tension bar: To ASTM A653/A653M, 5 x 20mm minimum, galvanized steel.

.7 Tension bar bands: To ASTM A653/A653M, 3 x 20mm minimum, galvanized steel.

.8 Vertical Pivot Gates:

.1 Frame: top and bottom rails, 63.5mm; sides to match fence posts. Brace as per manufacturer's recommendations and:

.1 Diagonal welded pipe gate trusses.

.2 Cable Wind Bracing: 4.75mm aircraft coated cable anchored to operator and min. ⅔ length of gate.

.3 Fully assembled in shop with no joints splices or bottled sections. Close all tube ends.

.4 All exposed joints to be butt tight, flush, and hairline, seal with continuous welds.

.2 Fabricate frame and infill fabric to match fence material and finish. Top with barb wire to match fence.

.3 Provide components required for receiving yoke anchorage of gate ends. Fabricate of same material and finish as gate.

.4 Gate Operator:

.1 Provide gate operator system including; gate operator, field supplied batteries, external entrapment B1 non-contact sensing devices and external entrapment B2 type contact sensing devices.

.2 Gate Speed: Fully open to fully closed, to fully open not less than 10-12 seconds.

.3 Frequency of use: Continuous duty.

.4 Battery powered back up DC drive system: Operator to run on 24 volt DC current integral power supply with stand-by battery system with built-in battery maintainer and “over-charge” protection.

.1 Provide two (2) 12V batteries, complying with manufacturer’s requirements (Group 24, 12Volt, Scaled Marine Starting).

.2 Power supply to operator: 120 vac(20 Amp).

.5 Gate Operator Enclosure: Fabricate enclosure from steel tubing and sheet metal. Continuously seal weld all frame seams with welds ground smooth.

.1 Frame: 50mm, 3mm thick, steel tubing.

.2 Skins: 1.3mm thick galvanneal steel.

.3 Mounting Pads: 75mm wide x 905mm thick 304 stainless steel.

.4 Finish: Grey powder coating.

.6 Mechanical Gate Operator Drive: 24VDC high torque gear motor and DBL reduction DBL “V” belt design. Hydraulic components not acceptable.

.7 Control Circuitry: Solid state control board in electrical enclosure. Sealed gate position sensor to be weather and moisture proof. Boards to be tested to - 40°C.

.8 Gate operator system to be listed to UL 325 Class III.

.1 Operator shall have a Type A Entrapment Sensing Device with inherent gate position and speed sensing system as part of the operator system. Type A device shall be constructed such that it may not be removed or bypassed.

.2 Operator shall have provision for connection of control system and be supplied with External Entrapment Sensing Device.

.9 External Entrapment Sensing Device:

.1 Photo Beams Type B1 - non contact sensor, transmitter/ receiver type.

.10 Operator Options:

.1 Provide surge and spike protection.

.2 Provide external Emergency Stop Button, mounted near operator min. 1800mm away from moving parts of gate.

.11 Control Systems:

.1 Control Station, located as shown, two position (open & close), with key switch to lock out open and close button.

.2 Radio Control: Digital system consisting of universal receiver for each gate.

.3 Operation: Gate to open and stay opened on "open" command. Gate to close and stay closed on "close" command.

.4 Vehicle Loop Detector: Free exit loop as shown.

.12 Accessories:

.1 Thermostatically controlled heat cable to maintain favourable operational temperature.

.13 System design based on AutoGate Inc., Model VPG240 Vertical Pivot Gate, configuration Chain Link 300. Equivalent products acceptable.

.9 Fittings and hardware: to CAN/CGSB-138.2-96 hot dipped, galvanized, steel or malleable or ductile cast iron.

.10 Provide vertical tops to provide waterproof fit to carry top rails and barbed wire strands. Provide clips or recesses to hold 3 strands of barbed wire 125mm apart.

.11 Zinc rich coating: to CAN/CGSB-1.181-99.

.12 Barbed wire: to CAN/CGSB-138.2, 2.5mm diameter, 4 point barbs, 125mm spacing.

2.2
Finishes

.1 Galvanizing:

.1 For pipe: 550g/m^2 minimum to ASTM A90-81(1991).

.2 For other fittings: to CAN/CSA G164-M92 at the rate of 610g/m^2 min.

.3 For chain link fabric: to CAN/CGSB-138.1-96, Grade2.

.4 For barbed wire: to CAN/CGSB-138.2-96.

PART 3 - EXECUTION

3.1
Utility Lines

.1 Before commencing work, establish locations and extent of underground utility lines in area of excavation.

.2 Known underground and surface utility lines are indicated on drawings. No guarantee is given of completeness or accuracy.

.3 Make good and pay for damage to existing utility lines resulting from work.

3.2
Grading

.1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Provide clearance between bottom of fence and ground surface neither less than 30mm nor more than 50mm.

3.3
Erection of Fence

.1 Erect fence along lines indicated and in accordance with CAN/CGSB-138.3-M96 except as otherwise noted.

.2 Augur post holes to min. size and min. depth as follows: where auguring not possible, excavate, provide sonotube forms, backfill to rough grade with OPS Granular B, Type 2, compacted to 95%.
- .1 Fences up to 1500mm high:
  - .1 Corner, end, and straining, post holes 1400 [1200] mm depth and 350mm dia.
  - .2 Other posts 1200 [1000] mm depth and 300mm dia.
- .2 Fences over 1500mm and up to 3000mm high:
  - .1 Corner, end, and straining, post holes 1600 [1400] mm depth and 400mm dia.
  - .2 Other posts 1400 [1200] mm depth and 350mm dia.

.3 Space line posts 3m apart, measured parallel to ground surface.

.4 Space staining posts at equal intervals not exceeding 150m if distance is greater than 150m between end or corner posts on straight continuous lengths of fence over reasonably smooth grade.

.5 Install additional straining posts at sharp changes in grade and where directed.

.6 Install corner post where change in alignment exceeds 10 degrees.

.7 Install end posts at end of fence and at buildings. Install gate posts on both sides of gate openings.

.8 Place concrete in post holes then embed posts into concrete to min. depth as follows:

.1 Gate, corner, high posts, and straining posts,1400mm

.2 Other posts 1200mm

.3 Finish concrete 150 mm below ground level and slope to drain away from posts.

.9 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.

.10 Do not install fence fabric until concrete has cured a minimum of 7 days.

.11 Install brace between end gate, posts and line post, placed in centre of panel and parallel to ground surface. Install braces on both sides of corner and straining posts in similar manner.

.12 Install post caps on posts.

.13 Install top rail between and through post caps, and fasten securely to terminal posts. Secure waterproof caps.

.14 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turn buckles and tension bars.

.15 Lay out fence fabric. Install fabric on outside face of compound framework. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300mm intervals.

.16 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 300mm intervals. Give tie wires minimum two

twists.

.17 Confirm by pull tests that a 13kg perpendicular pull at mid-point of each mesh panel will displace mesh max. 50mm from vertical plane.

.18 Face collar nuts to compound interior and torque tight.

3.4
Installation of Gates:

.1 Install gates in locations as indicated.

.2 Level ground between gate posts and set gate bottom 40mm above ground surface.

.3 Coordinate location of electrical conduit prior to installation.

.4 Foundations:
.1 Construct pads and yokes as indicated. Coordinate with reviewed shop drawings. Pads and yokes to be placed on undisturbed soil or to recommendations of geotechnical engineer. Install all fasteners and accessories in coordination with concrete installation.

.5 Install operators as per manufacturers written instructions.

.6 Install external entrapment protection devices as appropriate and as indicated on reviewed shop drawings. Installer to review specific site conditions to identify all potential entrapment zones and notify the consultant if system not adequate to provide required protection.

.7 Gate installation:
.1 Connect gate to operator as per manufacturer's written instructions.
.2 Install gate plumb and level and when fully closed:
.1 Max. misalignment from true position: 6.0mm.
.2 Max. misalignment from adjacent members: 3.0mm.

.8 Adjustment:
.1 Adjust and lubricate operating components for smooth, accurate operation free of binding and racking.

.9 Start-Up and Demonstration:
.1 Provide at least 2 hours of manufacturer's representative time for start-up and initial operation. Ensure proper operation of each operator and gate. Ensure all safety provisions are in place. Make final check of each gate's operation with

consultant and Owner's representative present. Schedule as per Contractor's schedule.

.2 Instruct Owner's personnel in proper use, operation, and maintenance of gate and operator. Review emergency procedures, including if gate fails to open or close. Review and demonstrate manual closing and opening of gate in event of power loss.

.3 Instruct Owner's representatives in proper use, operation and maintenance of all accessories and entrapment protection devices and provisions.

.4 Confirm that control systems and operating devices are functioning properly.

3.5 Touch-Up

.1 Repair damaged galvanized surfaces. Clean damaged surfaces with wire brush removing loose and cracked coatings. Pretreat damaged surfaces according to zinc-rich paint manufacturer's instructions. Apply two coats of colour matched approved zinc-rich paint to damaged areas.

3.6 Cleaning

.1 Clean and trim areas disturbed by operations. Dispose of surplus excavated material and replace damaged sod as directed.

END OF SECTION

PART 1 - GENERAL

1.1 Scope

.1 This section specifies the requirements for the supply and installation of ornamental metal fencing and accessories, including excavation for post bases, concrete foundation for posts and all related hardware, accessories, and finishing.

1.2 Submittals

.1 Submit Shop Drawings showing layout, dimensions, spacing of components and anchorage and installation details for review and approval.

1.3 Quality Assurance

.1 Installation shall be by a contractor and crew with at least three years of experience in construction of fences on projects of similar nature or dollar cost.

1.4 Delivery, Material Handling and Storage

.1 Contractor shall check all materials delivered to the site to ensure they are in good condition.

.2 The Contractor shall store and handle all materials in accordance with manufacturer's recommendations and in a manner to prevent deterioration or damage due to moisture, temperature changes, contaminants, breaking, chipping or other causes.

PART 2 - PRODUCTS

2.1 Products

.1 Manufactured fence: Ornamental metal fencing consisting of modular fencing panels, supported by metal posts complete with vertical and horizontal rails and pickets.

.1 Posts, Pickets and Rails: Cold formed steel tubing with interior and exterior galvalume, powder coated.

- .1 Posts: 76 x 76 mm. x 2mm thick.
- .2 Post Cap: pyramid shape.
- .3 Rails: 38 x 64mm. x 1.6mm thick.
- .4 Pickets: 19 x 38mm x 1.6mm thick.
- .5 Welds: Stainless steel.

.2 Provide all fittings and accessories as required to provide a complete and finished product.
.3 Colour: Grey.
.4 Acceptable Product: Iron Eagle II Series, Canadian Eagle or similar.

.2 Concrete:
.1 Min. 28 day compressive strength of 20 MPa.
.2 300mm x 1200mm footing place 50mm below finish grade.

PART 3 - EXECUTION

3.1 Examination

.1 Verify areas to receive fencing are completed to final grades and elevations.

.2 Ensure property lines and legal boundaries are clearly established.

3.2 Installation

.1 Excavate for fence post foundations as shown.

.2 Place post in vertical position and set accurately in line.

.3 Place concrete around post in a continuous pour and trowel finish around post to direct water away from post.

.4 Install fence in accordance with manufacturer's instructions. Ensure fence is straight and true.

.5 Align fence panels between posts. Firmly attach rail brackets to posts with approved bolt and lock nut.

.6 Install post caps and other accessories to complete fence.

3.3 Clean-Up

.1 Remove from site excess materials, soil and debris caused by
Work of this Section.

.2 Repair and re-instate any damage due to Work of this Section.

END OF SECTION

SODDING

1. The requirements of Division 01 form part of this section.
2. No. 1 Turf Grass Nursery Sod: Min. 40% Kentucky Bluegrass and min. 50% Chewing or Creeping Red Fescue. Max 2 broadleaf or 10 other weeds per 40m².
3. Cultivate and fine grade top 25mm of topsoil.
4. Lay during growing season and not in dry or freezing periods. Lay within 36h of lifting (24h if >20°C). Immediately water in well.
5. Maintain until growth of all areas clearly established and approved.
6. On slopes steeper than 3:1, use 200mm staples to secure biodegradable 40mm sq. mesh, just under top of topsoil.
7. Evenly fertilize 1 month after sodding at 0.5kg N / 100m².

- END -

PART 1 - GENERAL

1.1 General Requirements

.1 Conform with requirements of front end Sections 00 and 01 as they apply to the work of this discipline.

1.2 Related Work

.1 Excavation and Backfilling per Section 31.

PART 2 - PRODUCTS

2.1 Materials

.1 Plastic underground power cable ducting: to CSA B196.1.

.2 PVC underground telecommunication cable ducting: to CSA B196.3.

.3 Plastic polyethylene pipe not acceptable.

2.2 PVC Ducts

.1 Rigid PVC ducts for direct burial, size as indicated with minimum wall thickness at any point of 2.8 mm, Type II duct.

.2 Rigid PVC couplings, reducers, bell end fittings, plugs, caps, adaptors as required to make complete installation.

.3 Rigid PVC 90 and 45 bends as required.

.4 Rigid PVC 5 angle couplings as required.

.5 Expansion joints as required.

.6 Rigid PVC split ducts as indicated.

2.3 Solvent Weld Couplings

.1 Solvent weld compound for PVC duct joints.

2.4 Cable Pulling Equipment

.1 6 mm stranded nylon pull rope tensile strength 5 kN.

PART 3 - EXECUTION

3.1 Installation

.1 Install ducts as indicated and to manufacturer's instructions.

.2 Clean inside of ducts before laying.

.3 Ensure full, even support every 1.5 m throughout duct length.

.4 Slope ducts as indicated with 1 to 400 minimum slope, and install drain pit at low point, or drain to building perimeter drain.

.5 During construction, cap ends of ducts to prevent entrance of foreign materials.

.6 Pull through each duct a wooden mandrel not less than 300 mm long and of a diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.

.7 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end. Seal ends of duct immediately after installation of pull rope.

END OF SECTION