

1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- 1.1.1 Work of this Contract comprises Site work and renovation of The Regional Municipality of Peel Helipad, located at 13653 MCLAUGHLIN ROAD CALEDON, ON L7C 2B2; and further identified as The Regional Municipality of Peel Helipad.

1.2 CONTRACT METHOD

- 1.2.1 Construct Work under stipulated price and unit price contract.

1.3 DESCRIPTION OF WORK

1.3.1 Air Side Civil Works:

- .1 The airside civil work generally includes the removal of existing asphalt and some existing Portland Cement Concrete (PCC) complete with offsite disposal of the material. Excavation of existing topsoil, native material and existing granular is to be completed to meet design elevations and the material is to be disposed offsite. Following removal and excavation work, subdrain is to be installed along the perimeter of the airside pavements along with the installation of a new drainage swale to the southeast of the hangar. The existing septic system tile bed may require relocating prior to commencing any new installations. Granular subbase and granular base are to be supplied, placed, graded and compacted to meet design specifications and elevations. A trench drain is to be supplied and installed complete with reinforced concrete surround, grating, and its Polyvinyl Chlorid (PVC) outlet pipe. A pre-cast oil-grit separator is to be installed inline with the trench drain outlet complete with pipe connections and PVC outlet pipe to the new drainage swale. New PCC pavement is to be installed on top of the completed granular base installation, PCC installation is to include all reinforcement, doweling, finishing, interfaces and joints. Line marking application is to be completed following adequate curing of the new PCC pavement. Restoration of disturbed areas shall be completed with imported topsoil and hydraulic seed and mulch.

1.3.2 Air Side Electric Work:

- .1 The airside electrical work generally includes the removal of equipment being made obsolete by this project. Sawcutting, removal and trenching of existing PCC pavement is required to facilitate the installation of new inset heliport fixtures. Trenching, sand bedding and backfill is required for the supply and installation of new conduit and cabling as noted on the project drawings. Following the removal of PCC pavement, inset fixture conduit and base cans are to be installed and concrete encased. Following installation of new PCC pavement and reinstatement of existing PCC, the inset fixture base cans are to be cored and the fixtures are to be installed on the base cans. A new windsock is to be installed on the existing hangar roof with all associated cabling and pull boxes. Obstruction lights are to be installed as shown on the contract drawings with all associated cabling and pull boxes. A heliport radio control panel is to be installed complete with all associated cabling and pull boxes. New floodlights are also to be installed on the exterior of the hangar complete with fixtures, cabling and all associated mounting.

- .2 Remove the existing perimeter fence in its entirety. The new perimeter fence shall be constructed in accordance with the Owner's preferred vendor specifications and security requirements. Fence location shall be as shown on the drawings and confirmed on site by the surveyor prior to installation. All work shall be coordinated with the Owner to ensure compliance with all security requirements. Materials, layout, and installation methods must meet the standards and direction provided by the Owner and/or their designated representative

1.3.3 Site Electrical Work:

- .1 Work is as described in the contract documents.
- .2 Provide new back-up generator and connection box for load bank and portable generator on concrete housekeeping pad and feeder to new Automatic Transfer Switch (ATS).
- .3 Provide empty conduit raceways serving electronic security devices and equipment.
- .4 Power and rough-ins to serve the pedestrian access gates and motorized vehicle gates and removal of existing.

1.3.4 Site Data/Communications Work:

- .1 Work is as described in the contract documents.
- .2 Provide hybrid fiber/copper cabling system to outdoor electronic security devices and equipment

1.3.5 Interior Renovations:

- .1 Interior renovations are limited to patching and making good all surfaces as indicated on the drawings and as directed by the Owner. The building comprises a hangar area and two levels of office space, originally constructed in 2015 and currently in good condition.
- .2 All existing finishes are to remain in place. Patch and make good any areas as required due to construction activities.
- .3 Electrical Scope:
 - .1 Work is as described in the contract documents.
 - .2 Provide new fire alarm system.
 - .3 Provide new Uninterruptible Power Supply (UPS) and UPS fed panelboard.
 - .4 Provide new ATS and modify existing electrical distribution to integrate ATS.
 - .5 Provide rough-ins and wiring for new receptacles, devices, mechanical equipment, information technology (IT) equipment, security equipment, etc., as noted in the contract documents.
 - .6 Provide exhaust fan control panel and coordinate with mechanical contractor for interlock with new exhaust fans and dampers and gas detection system.

- .7 Coordination of all outlet locations to support Owner-supplied furniture.
- .8 All work shall be executed in coordination with the drawings and Owner's direction.
- .4 Data & Communications:
 - .1 Work is as described in the contract documents.
 - .2 Provide data drops and network cabling for all new workstations, wall displays, boardroom table, etc. as identified in the drawings and specifications.
 - .3 Install owner-supplied data rack and rack-mounted equipment.
 - .4 Provide new 48-port patch panel and installed in the data rack.
 - .5 Coordinate data and power requirements with final furniture layouts provided by the Owner.
- .5 Mechanical Scope:
 - .1 Mechanical work is as described in the contract documents.
 - .2 Provide new split air conditioning (AC) system to serve IT room on second floor. Condensing unit to be installed outside on grade.
 - .3 Provide new exhaust fans and louvers serving the hangar area and van storage area.
 - .4 Provide new gas detection system in hangar area and coordinate with electrical contractor for interlock with new exhaust fans and dampers.
 - .5 Provide new ductwork and piping to serve new and modified HVAC systems.
- .6 General Requirements:
 - .1 All construction areas and surrounded areas are to be protected from damage.
 - .2 Contractor shall coordinate closely with the Owner regarding sequencing and access to ensure minimal disruption to ongoing operations.

1.4 SUBMITTALS

- 1.4.1 Submit in accordance with Section [01 33 00 - Submittal Procedures]
- 1.4.2 Submit Project construction progress schedule in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.

1.5 WORK SEQUENCE

- 1.5.1 Construct Work in stages to accommodate Owner's continued use of premises during construction.

1.5.2 Co-ordinate Progress Schedule and co-ordinate with Owner Occupancy during construction.

1.5.3 Maintain fire access/control.

1.5.4 Protect workers and public safety.

1.6 CONTRACTOR USE OF PREMISES

1.6.1 Unrestricted use of site until Substantial Performance.

1.6.2 Limit use of premises for Work, for storage, and for access, to allow:

.1 Owner occupancy.

.2 Partial owner occupancy.

.3 Work by other contractors.

1.6.3 Co-ordinate use of premises under direction of Owner.

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

1.6.5 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.

1.6.6 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Owner.

1.6.7 Ensure that operations conditions of exiting work at completion are still the same, equal to or better than that which existed before new work started.

1.7 OWNER OCCUPANCY

1.7.1 Owner will occupy premises during entire construction period for execution of normal operations.

1.7.2 Co-operate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.8 PARTIAL OWNER OCCUPANCY

1.8.1 Schedule and substantially complete designated portions of Work for Owner's occupancy prior to Substantial Performance of entire Work.

1.8.2 Designated areas for Owner's occupancy are as follows:

1.8.3 Owner will occupy designated areas for purpose of storage of furnishings and equipment.

1.8.4 Execute Certificate of Substantial Performance for each designated portion of Work prior to Owner occupancy. Contractor shall allow:

- .1 Access for Owner personnel.
 - .2 Use of parking facilities.
 - .3 Operation of HVAC and electrical systems.
- 1.8.5 On occupancy, Owner will provide for occupied areas:
 - .1 Operation of HVAC and electrical systems.
 - .2 Maintenance.
 - .3 Security.
- 1.8.6 Execute Partial Interim Certificate of Completion for each designated portion of Work prior to Owner occupancy. Contractor shall allow:
 - .1 Access for Owner personnel.
 - .2 Use of parking facilities.
 - .3 Operation of HVAC and electrical systems.
- 1.9 PRE-ORDERED PRODUCTS OR PRE-BID WORK**
- 1.9.1 Verify with Owner if they have placed orders pre-bid tendered work with suppliers for specific products, to expedite Work and for other purposes in Owner's interests.
- 1.9.2 Take responsibility for purchasing, handling, and installing of pre-ordered products same as for other Contractor-furnished products.
- 1.9.3 Obtain necessary shop drawings from Owner for inclusion in maintenance manual in accordance with Section [01 33 00 - Submittal Procedures].
- 1.10 PRE-PURCHASED EQUIPMENT**
- 1.10.1 Ensure that the purpose for pre-purchasing this equipment is to ensure delivery to Site within required Project completion schedule.
- 1.10.2 Obtain necessary shop drawings from Consultant and proceed to co-ordinate details for installation, expedite, receive, unload, install, connect and test specified equipment, and be responsible for warranty.
- 1.10.3 Include equipment specifications for pre-purchased items at end of project specification, printed on coloured paper for confirmation only.
- 1.11 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**
- 1.11.1 Execute work with least possible interference or disturbance to occupants and normal use of premises. Arrange with Owner to facilitate execution of work.

1.12 EXISTING SERVICES

- 1.12.1 Notify, Owner and utility companies of intended interruption of services and obtain required permission.
- 1.12.2 Where Work involves breaking into or connecting to existing services, give Owner one (1) weeks notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to users.
- 1.12.3 Establish location and extent of service lines in area of work before starting Work. Notify Owner of findings.
- 1.12.4 Submit schedule for approval by Consultant/Owner for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- 1.12.5 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.
- 1.12.6 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- 1.12.7 Record locations of maintained, re-routed and abandoned service lines.

1.13 DOCUMENTS REQUIRED

- 1.13.1 Maintain at job site, one copy of each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.

2 PRODUCTS

2.1 NOT USED

2.1.1 Not used.

3 EXECUTION

3.1 NOT USED

3.1.1 Not used.

END OF SECTION

1 GENERAL

1.1 ACCESS AND EGRESS

- 1.1.1 Design, construct and maintain temporary “access to” and “egress from” work areas, including stairs, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

1.2 USE OF SITE AND FACILITIES

- 1.2.1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Owner’s Representative to facilitate work as stated.
- 1.2.2 Maintain existing services to building and provide for personnel and vehicle access.
- 1.2.3 Where security is reduced by work, inform Consultant/Owner to arrive upon a feasible solution with the support and involvement of PRP Corporate Security Services.
- 1.2.4 General Contractor to have portable potties on-site. Owner facilities not to be used by Contractor’s personnel.
- 1.2.5 Closures: protect work temporarily until permanent enclosures are completed.

1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- 1.3.1 Execute work with least possible interference or disturbance to building operations, occupants, public and normal use of premises. Arrange with Owner’s Representative to facilitate execution of work.

1.4 EXISTING SERVICES

- 1.4.1 Notify, Owner’s Representative and utility companies of intended interruption of services and obtain required permission.
- 1.4.2 Where Work involves breaking into or connecting to existing services, give Owner’s Representative (1) Week of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, during weekday and/or weekends.
- 1.4.3 Provide for personnel, and vehicular traffic.
- 1.4.4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.5 SPECIAL REQUIREMENTS

- 1.5.1 Submit schedule in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.
- 1.5.2 Ensure Contractor’s personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- 1.5.3 Keep within limits of work and avenues of ingress and egress.

- 1.5.4 Ingress and egress of Contractor vehicles at site is limited to direction of Owner's Representative.

1.6 SECURITY

- 1.6.1 Where security has been reduced by Work of Contract, inform Consultant/Owner to arrive upon a feasible solution with the support and involvement of PRP Corporate Security Services.

- 1.6.2 Security clearances:

- .1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require to enter premises.
- .2 Obtain requisite clearance, as instructed, for each individual required to enter premises.
- .3 Pass is provided once to workers prior to project commencement to keep for full duration of construction. The pass is only returned at the end of construction.

1.7 BUILDING SMOKING ENVIRONMENT

- 1.7.2 Comply with smoking restrictions. Smoking is not permitted.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

- 3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

1.1.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC 2-2020, Stipulated Price Contract.

1.2 CASH ALLOWANCES

1.2.1 [Refer to CCDC 2, GC 4.1].

1.2.2 Include in Contract Price specified cash allowances.

1.2.3 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, handling, unloading, storage, installation and other authorized expenses incurred in performing Work.

1.2.4 Peel Regional Police as a public safety agency is exempt from paying tariffs to Canada Border Services Agency (CBSA) at least until October of this year per “*Customs Notice 25-19: United States Surtax Remission Order (2025)*”.

1.2.5 Contract Price, and not cash allowance, includes Contractor’s overhead and profit in connection with such cash allowance.

1.2.6 Contract Price will be adjusted by written order to provide for excess or deficit to each cash allowance.

1.2.7 Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for excess incurred and substantiated plus allowance for overhead and profit as set out in Contract Documents.

1.2.8 Include progress payments on accounts of work authorized under cash allowances in monthly certificate for payment.

1.2.9 Prepare schedule jointly with Consultant and Contractor to show when items called for under cash allowances must be authorized by Consultant for ordering purposes so that progress of Work will not be delayed.

1.2.10 List the amount of each allowance, for each work specified in each respective specification Section as follows:

.1 Section 32 31 16 Welded Wire Fences and Gates include allowance of \$800,000 for purchase and installation of Non Air-Side Site Work, existing fence removal and new fence gates installation.

.2 Section 10 14 00 Signage include allowance of \$50,000 for purchase and installation of Signage (vendor).

.3 Division 26 Electrical include allowance of \$150,000 for purchase and installation of Backup Generator, ATS, Load Bank, Connection Box.

1.3 CONTINGENCY ALLOWANCE

1.3.1 [Refer to CCDC 2, GC 4.2].

1.3.2 Do not include in Contract Price, additional contingency allowances for products, installation, overhead or profit.

1.3.3 Expenditures under contingency allowance will be authorized in accordance with procedures provided in CCDC 2, GC 6.1 - Changes CCDC 2, 6.2 Change Order and CCDC 2, 6.3 Change Directive.

2 PRODUCTS

2.1 NOT USED

2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

- 1.1.1 Canadian Construction Documents Committee (CCDC)
- .1 CCDC 23-2018, A Guide to Calling Bids and Awarding Contracts.

1.2 REQUIREMENTS

- 1.2.1 Referenced specification Sections stipulate pertinent requirements for products and methods to achieve Work stipulated under each Alternative.
- 1.2.2 Co-ordinate affected related Work and modify surrounding Work to integrate Work under each Alternative.

1.3 AWARD/SELECTION OF ALTERNATIVES

- 1.3.1 Indicate variation of Bid Price for Alternatives described below and listed in Bid Form. Note that this form requests a 'difference' in Bid. Price by adding to or deducting from base Bid price.
- 1.3.2 Bids will be evaluated on 'Base Bid' price. After determination of preferred Bidder, consideration will be given to Alternatives and Bid Price adjustments. In accordance with CCDC Document No. 23 - A Guide to Calling Bids and Awarding Contracts, low Bid will be determined on basis of lowest Bid in accordance with Contract Documents on which Project is to be actually constructed, including those alternatives for which prices have been invited and which are to be incorporated in Work.
- 1.3.4 Refer to Owner for all clearances required for this project.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

- 3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

1.1.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC 2-2020, Stipulated Price Contract.

1.2 APPLICATIONS FOR PROGRESS PAYMENT

1.2.1 Refer to CCDC 2.

1.2.2 Make applications for payment on account as monthly as Work progresses.

1.2.3 Date applications for payment last day of agreed 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.

1.2.4 Submit to Consultant, at least 14 days before first application for payment. Schedule of values for parts of Work, aggregating total amount of Contract Price, to facilitate evaluation of applications for payment.

1.3 SCHEDULE OF VALUES

1.3.1 Refer to CCDC 2.

1.3.2 Provide schedule of values supported by evidence as Consultant may reasonably direct and when accepted by Consultant, be used as basis for applications for payment.

1.3.3 Include statement based on schedule of values with each application for payment.

1.3.4 Support claims for products delivered to Place of Work but not yet incorporated into Work by such evidence as Consultant may reasonably require to establish value and delivery of products.

1.4 PREPARING SCHEDULE OF UNIT PRICE TABLE ITEMS

1.4.1 Submit separate schedule of unit price items of Work requested in Bid form.

1.4.2 Make form of submittal parallel to Schedule of Values, with each line item identified same as line item in Schedule of Values. Include in unit prices only:

.1 Cost of material.

.2 Delivery and unloading at site.

.3 Sales taxes.

.4 Installation.

1.4.3 Ensure unit prices multiplied by quantities given equal material cost of that item in Schedule of Values.

1.5 PROGRESS PAYMENT

- 1.5.1 Refer to CCDC 2.
- 1.5.2 Consultant will issue to Owner, no later than 10 days after receipt of an application for payment, certificate for payment in amount applied for or in such other amount as Consultant determines to be due. If Consultant amends application, Consultant will give notification in writing giving reasons for amendment.

1.6 SUBSTANTIAL PERFORMANCE OF WORK

- 1.6.1 Refer to CCDC 2.
- 1.6.2 Prepare and submit to Consultant comprehensive list of items to be completed or corrected and apply for a review by Consultant to establish Substantial Performance of Work or substantial performance of designated portion of Work when Work is substantially performed if permitted by lien legislation applicable to Place of Work designated portion which Owner agrees to accept separately is substantially performed. Failure to include items on list does not alter responsibility to complete Contract.
- 1.6.3 No later than 10 days after receipt of list and application, Consultant will review Work to verify validity of application, and no later than 7 days after completing review, will notify Contractor if Work or designated portion of Work is substantially performed.
- 1.6.4 Consultant: state date of Substantial Performance of Work or designated portion of Work in certificate.
- 1.6.5 Immediately following issuance of certificate of Substantial Performance of Work, in consultation with Consultant, establish reasonable date for finishing Work.

1.7 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK

- 1.7.1 Refer to CCDC 2.
- 1.7.2 After issuance of certificate of Substantial Performance of Work:
- .1 Submit application for payment of holdback amount.
 - .2 Submit sworn statement that accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred in Substantial Performance of Work and for which Owner might in be held responsible have been paid in full, except for amounts properly retained as holdback or as identified amount in dispute.
- 1.7.3 After receipt of application for payment and sworn statement, Consultant will issue certificate for payment of holdback amount.
- 1.7.4 Where holdback amount has not been placed in a separate holdback account, Owner will, 10 days prior to expiry of holdback period stipulated in lien legislation applicable to Place of Work, place holdback amount in bank account in joint names of Owner and Contractor.
- 1.7.5 Amount authorized by certificate for payment of holdback amount is due and payable on day following expiration of holdback period stipulated in lien legislation applicable to Place

of Work. Where lien legislation does not exist or apply, holdback amount is due and payable in accordance with other legislation, industry practice, or provisions which may be agreed to between parties. Owner may retain out of holdback amount sums required by law to satisfy liens against Work or, if permitted by lien legislation applicable to Place of Work, other third party monetary claims against Contractor which are enforceable against Owner.

1.8 PROGRESSIVE RELEASE OF HOLDBACK

1.8.1 Refer to CCDC 2.

1.8.2 Where legislation permits, if Consultant has certified that Work of subcontractor or supplier has been performed prior to Substantial Performance of Work, Owner will pay holdback amount retained for such subcontract Work, or products supplied by such supplier, on day following expiration of holdback period for such Work stipulated in lien legislation applicable to Place of Work.

1.8.3 In addition to provisions of preceding paragraph, and certificate wording, ensure that such subcontract Work or products is protected pending issuance of final certificate for payment and be responsible for correction of defects or Work not performed regardless of whether or not such was apparent when such certificates were issued.

1.9 FINAL PAYMENT

1.9.1 Refer to CCDC 2, GC 5.7.

1.9.2 Submit application for final payment when Work is completed.

1.9.3 Consultant will, no later than 10 days after receipt of application for final payment, review Work to verify validity of application. Consultant will give notification that application is valid or give reasons why it is not valid, no later than 7 days after reviewing Work.

1.9.4 Consultant will issue final certificate for payment when application for final payment is found valid.

1.9.5 Payment is issued to Contractor via electronic fund transfer (EFT).

2 PRODUCTS

2.1 NOT USED

2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 ADMINISTRATIVE

- 1.1.1 Schedule and administer project meetings throughout the progress of the work at the call of Owner's Representative.
- 1.1.2 Prepare agenda for meetings.
- 1.1.3 Distribute written notice of each meeting four days in advance of meeting date to Owner's Representative.
- 1.1.4 In-Person Site Meetings that will take place on site.
- 1.1.5 Preside at meetings.
- 1.1.6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- 1.1.7 Reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants and, affected parties not in attendance.
- 1.1.8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

- 1.2.1 Within 5 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- 1.2.2 Senior representatives of Owner's Representative, Consultant, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
- 1.2.3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- 1.2.4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- 1.2.5 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.

- .5 Delivery schedule of specified equipment in accordance with Section 23, 26 ,27.
- .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .7 Proposed changes, change orders, procedures, approvals required, time extensions, overtime, administrative requirements.
- .8 Owner provided products.
- .9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .12 Monthly progress claims, administrative procedures, photographs, hold backs.
- .13 Appointment of inspection and testing agencies or firms.
- .14 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- 1.3.1 During course of Work and four weeks prior to project completion, schedule progress meetings weekly.
- 1.3.2 Contractor, major Subcontractors involved in Work and Owner's Representative Consultant are to be in attendance.
- 1.3.3 Notify parties minimum four days prior to meetings.
- 1.3.4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within three days after meeting.
- 1.3.5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.

- .9 Review submittal schedules: expedite as required.
- .10 Maintenance of quality standards.
- .11 Review proposed changes for affect on construction schedule and on completion date.
- .12 Other business.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

- 3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 DEFINITIONS

- 1.1.1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- 1.1.2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.
- 1.1.3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- 1.1.4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission. Seven or Six days Work Week is also permitted, Contractor to include in base bid in order to meet the Substantial Performance of July 30th, 2025.
- 1.1.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- 1.1.6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- 1.1.7 Milestone: significant event in project, usually completion of major deliverable.
- 1.1.8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- 1.1.9 Project Planning, Monitoring and Control System: overall system operated by Owner's Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

- 1.2.1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- 1.2.2 Plan to complete Work in accordance with prescribed milestones and time frame.
- 1.2.3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- 1.2.4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- 1.3.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- 1.3.2 Submit to Owner's Representative within 5 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- 1.3.3 Submit Project Schedule to Owner's Representative within 5 working days of receipt of acceptance of Master Plan.

1.4 PROJECT MILESTONES

- 1.4.1 Project milestones form interim targets for Project Schedule.
 - .1 Interim Certificate (Substantial Completion) within 30 working days of Award of Contract date.

1.5 MASTER PLAN

- 1.5.1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- 1.5.2 Owner's Representative will review and return revised schedules within 2 working days.
- 1.5.3 Revise impractical schedule and resubmit within 2 working days.
- 1.5.4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.6 PROJECT SCHEDULE

- 1.6.1 Develop detailed Project Schedule derived from Master Plan.
- 1.6.2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
 - .1 Award.
 - .2 Shop Drawings, Samples.
 - .3 Permits.
 - .4 Mobilization.
 - .5 Plumbing.
 - .6 Lighting.
 - .7 Electrical.
 - .8 Piping.
 - .9 Controls.

- .10 Heating, Ventilating, and Air Conditioning.
- .11 Fire Systems.
- .12 Testing and Commissioning.
- .13 Supplied equipment long delivery items.
- .14 Engineer supplied equipment required dates.

1.7 PROJECT SCHEDULE REPORTING

- 1.7.1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.
- 1.7.2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.8 PROJECT MEETINGS

- 1.8.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- 1.8.2 Weather related delays with their remedial measures will be discussed and negotiated.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not used.

3 EXECUTION

3.1 NOT USED

- 3.1.1 Not used.

END OF SECTION

1 GENERAL

1.1 ADMINISTRATIVE REQUIREMENTS

1.1.1 Submit to Owner's Representative submittals listed for review. Submit within 3 days of receipt of Notice of Award, and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.1 The General Contractor shall utilize a construction management platform approved by the Owner's Representative for all submittals, including but not limited to shop drawings, product data, photos of samples, and photos of mock-ups. All submissions shall be uploaded to the designated platform in an organized and timely manner to ensure efficient review and coordination.

1.1.2 Do not proceed with Work affected by submittal until review is complete.

1.1.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

1.1.4 Where items or information is not produced in SI Metric units converted values are acceptable.

1.1.5 Review submittals before submission to Owner's Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

1.1.6 Notify Owner's Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

1.1.7 Verify site measurements and affected adjacent Work are coordinated.

1.1.8 Contractor's responsibility for errors and omissions in submission is not relieved by Owners Representative's review of submittals.

1.1.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Owner's Representative review.

1.1.10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

1.2.1 Refer to CCDC 2 GC 3.11.

1.2.2 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

1.2.3 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.

- 1.2.4 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to Contract drawings and specifications.
- 1.2.5 Allow two days for Owner Representative's review of each submission.
- 1.2.6 Adjustments made on shop drawings by Owner's Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Owner's Representative before to proceeding with Work.
- 1.2.7 Make changes in shop drawings as Owner's Representative may require, consistent with Contract Documents. When resubmitting, notify Owner's Representative in writing of revisions other than those requested.
- 1.2.8 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data, and sample.
 - .5 Other pertinent data.
- 1.2.9 Submissions to include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of site measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified site dimensions and clearances.

- .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- 1.2.10 After Owner Representative's review, distribute copies.
- 1.2.11 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Owner's Representative may reasonably request.
- 1.2.12 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Owner's Representative where shop drawings will not be prepared due to standardized manufacture of product.
- 1.2.13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Owner's Representative.
- .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of Contract complete with project name.
- 1.2.14 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Owner's Representative.
- .1 Pre-printed material describing installation of product, system or material, including special notices and Safety Data Sheets concerning impedances, hazards and safety precautions.
- 1.2.15 Submit electronic copies of Manufacturer's Site Reports for requirements requested in specification Sections and as requested by Owner's Representative.
- 1.2.16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- 1.2.17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Owner's Representative.
- 1.2.18 Delete information not applicable to project.
- 1.2.19 Supplement standard information to provide details applicable to project.

- 1.2.20 If upon review by Owner's Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.3 SAMPLES

- 1.3.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- 1.3.2 Deliver samples prepaid to Owner Representative's office. Coordinate with Owner.
- 1.3.3 Notify Owner Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- 1.3.4 Where colour, pattern or texture is criterion, submit full range of samples. Match existing where applicable.
- 1.3.5 Adjustments made on samples by Owner's Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Owner's Representative before proceeding with Work.
- 1.3.6 Make changes in samples which Owner's Representative may require, consistent with Contract Documents.
- 1.3.7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 MOCK-UPS

- 1.4.1 Erect mock-ups in accordance with section 01 43 00 - Quality Assurance.

1.5 PHOTOGRAPHIC DOCUMENTATION

- 1.5.1 Submit electronic colour digital photography in jpg format, standard resolution monthly with progress statement and as directed by Owner's Representative.
- 1.5.2 Project identification: name and number of project and date of exposure indicated.
- 1.5.3 Number of viewpoints: 2 locations.
- .1 Viewpoints and their location as determined by Owner's Representative.
- 1.5.4 Frequency of photographic documentation: weekly as directed by Owner's Representative.
- .1 Upon completion of framing and services before concealment, of Work, and as directed by Owner's Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

- 1.6.1 Immediately after award of Contract, submit Workers' Compensation Board status.

- 1.6.2 Submit transcription of insurance immediately after award of Contract.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

- 3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 SUMMARY

- 1.1.1 This Section references laws, bylaws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction (AHJ), and other legally enforceable requirements applicable to the Work and that are or become enforced during performance of the Work.
- 1.1.2 This Contract shall be governed by the General Conditions, CCDC 2 (2020) – Stipulated Price Contract (including CCDC 41 – CCDC Insurance Requirements), except as such conditions are amended in the following:
- .1 The Regional Municipality of Peel Supplementary Conditions to Contractor CCDC2-2020
 - .2 These Supplementary Conditions
 - .3 Section 00 73 10 - Supplementary Conditions – Unit Prices
- 1.1.3 If there is direct conflict between the intent of any of these sections, priority will be given to each section in the order shown above. In the case of any numbering conflicts, the Contract shall be interpreted to include the intent of each clause.

1.2 DEFINITIONS

- 1.2.1 Reference Standards: Means consensus standards, trade association standards, guides, and other publications expressly referenced in the Contract Documents.

1.3 REFERENCE STANDARDS AND REFERENCE DOCUMENTS

- 1.3.1 If specified referenced standards do not indicate an edition or version, the latest edition or revision issued by the publisher at the time of bid closing shall apply, except as follows:
- .1 If a particular edition or revision date of a specified standard is referenced in an applicable code or other regulatory requirement, the edition or version in the regulatory reference shall apply.
- 1.3.2 The specified reference standards establish minimum requirements. If Contract Documents indicate requirements that conflict with a reference standard, the more stringent requirements shall apply.
- 1.3.3 If multiple reference standards are specified and the standards establish different requirements, the most stringent requirement shall apply.
- 1.3.4 In case of discrepancy or uncertainties, refer to Owner's Representative for interpretation or clarification.

1.4 CODES

- 1.4.1 Building Code: Perform Work in accordance with the Ontario Building Code (OBC) 2024 including amendments up to the time of bid closing and other codes of provincial or local application.

- 1.4.2 Fire Code: Perform Work in accordance with the National Fire Code of Canada (NFC) 2020 including amendments up to the time of bid closing and other codes of provincial or local application.
- 1.4.3 Energy Code: Perform Work in accordance with the National Building Code, including amendments up to the time of bid closing and other codes of provincial or local application.
- 1.4.4 Plumbing Code: Perform Work in accordance with National Building Code, including amendments up to the time of bid closing and other codes of provincial or local application.
- 1.4.5 If there is a conflict or discrepancy between codes, the most stringent requirements shall apply.
- 1.4.6 Specific design and performance requirements listed in Specifications and indicated on Drawings may exceed minimum requirements established by referenced Codes; these requirements will govern over the minimum requirements listed in the referenced Codes.

1.5 FEES

- 1.5.1 Regulatory Requirements: Except as otherwise specified, Contractor shall apply for, obtain, and pay fees associated with permits, licenses, certificates, and approvals required by regulatory requirements and Contract Documents, based on General Conditions of Contract and the following:
 - .1 Regulatory requirements and fees in force at the time of bid closing, and
 - .2 A change in regulatory requirements or fees scheduled to become effective after the time of bid closing and of which public notice has been given before the time of bid closing.

2 PRODUCTS

2.1 EASEMENTS AND NOTICES

- 2.1.1 Owner will obtain permanent easements and rights of servitude that may be required for performance of the Work.
- 2.1.2 Contractor shall give notices required by regulatory requirements.

2.2 PERMIT REQUIREMENTS

- .1 No Permit required for this building as it falls under Federal zone – Airport.

3 EXECUTION

3.1 NOT USED

- 3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 DEFINITIONS

- 1.1.1 Mock-up: A full-size physical example that demonstrates materials, finishes, interrelationship of materials and assemblies, aesthetic effects, and execution. A mock-up may demonstrate coordination of multiple Subcontractors' work. A mock-up establishes a standard by which the Work will be judged. Mock-ups are not samples.
- 1.1.2 Quality Assurance: Procedures for preventing defects and deficiencies before and during execution of the Work.
- 1.1.3 Quality Audit: Systematic and independent examination to determine if quality requirements have been fulfilled as planned. A quality audit will examine processes, products and services to determine if they have been implemented effectively to achieve their specified objective.

1.2 REFERENCE STANDARDS

- 1.2.1 ASTM International (ASTM):
- .1 ASTM E329-23 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
- 1.2.2 International Organization for Standardization (ISO):
- .1 ISO 9001: 2024, Quality Management Systems – Requirements

1.3 SECTION INCLUDES

- 1.3.1 This Section describes administrative and procedural requirements for proactive Contractor activities to assure the quality of construction before and during execution of the Work.

1.4 ADMINISTRATIVE REQUIREMENTS

- 1.4.1 Contractor is responsible for self-performed testing and inspections and submittal of test reports to Owner's Representative.
- 1.4.2 Owner will employ and pay for quality audit services performed through third-party observation and testing to validate the Contractor's performance of the Work .

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- 1.5.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- 1.5.2 Submit certificates for products, process and system for verification by Owner's Representative.
- 1.5.3 Submit formal testing and inspections reports per ASTM E329 as indicated in technical specification Sections to Owner's Representative in accordance with contractual agreement.

- 1.5.4 Submit one digital copy of each quality assurance inspection and test report to Owner's Representative, except where a technical specification Section indicates otherwise.

1.6 QUALIFICATIONS

1.6.1 Manufacturers' Qualifications:

- .1 specializes in manufacturing the products specified in the technical Section of the Project's construction specification.
- .2 minimum 3 years documented experience with a record of successful performance

1.6.2 Suppliers' Qualifications:

- .1 authorized to distribute manufacturer's products
- .2 has capacity to supply required products without delaying the Project

1.6.3 Fabricators' Qualifications:

- .1 experienced in producing products required for this Project
- .2 successful record of in-service performance
- .3 sufficient production capacity to fabricate required products without delaying the Project

1.6.4 Installer Qualifications:

- .1 firm or individual experienced in design and installation, application, and erection of materials to the extent required for this Project
- .2 successful record of in-service performance

1.6.5 Testing and Inspecting Agency Qualifications:

- .1 accredited organizations by the Standards Council of Canada for testing and inspection
- .2 capable of reliably performing testing of building products and inspections of construction activities in accordance with ASTM E329.

1.6.6 Licensed Professionals Qualifications:

- .1 individual registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

1.7 CERTIFICATIONS

- 1.7.1 Ensure that certification of products, processes, and systems includes physical and examination testing as specified in ASTM E329 to confirm compliance with Specifications requirements.

1.8 COORDINATION

- 1.8.1 Coordinate and schedule tests and inspections with accredited testing inspection agencies as indicated in Contract Documents and in accordance with ASTM E329 requirements.
- 1.8.2 Obtain Owner's Representative approval before proceeding with tests and inspections, and additional tests and inspections as may be reasonably requested by Owner's Representative.
- 1.8.3 Coordinate testing and inspections schedule with Sub-Contractor, testing agencies, and other affected parties.

1.9 SITE SAMPLES

- 1.9.1 Obtain Owner Representative's acceptance to proceed with the sampling process.
 - .1 Testing agency is responsible for obtaining representative samples of those materials required to be tested and evaluated as directed by Owner's Representative in accordance with the Contractual Documents.
- 1.9.2 Ensure testing agency performs sampling in accordance with ASTM E329.
 - .1 When sampling collection is required by testing agency, ensure proper protection, handling and storing of samples.
- 1.9.3 Testing agency to document procedures and appropriate techniques to select samples.
- 1.9.4 Record details of environmental conditions present during the sampling, such as rain or freezing weather that may affect testing of sample or interpretation of test results.

1.10 Mock-ups

- 1.10.1 Mock-ups can be used as a reference for assessing quality of workmanship and site-applied finishes as requested in the project's Contract Documents.
- 1.10.2 Obtain Owner Representative's acceptance of mock-ups installation before beginning to install those portions of the Work represented by the mock-up.
- 1.10.3 Assemble mock-ups in locations acceptable to Owner's Representative, or where location is indicated in the technical specification Section.
- 1.10.4 Schedule mock-ups ready for Owner's Representative's review and in orderly sequence, to avoid delays in Work.
 - .1 Failure to prepare mock-ups in ample time is not considered sufficient reason to request an extension of Contract Time. Claims for extension of Contract Time by reason of such default will not be considered.
- 1.10.5 If requested, Owner's Representative will assist in scheduling dates for construction of mock-ups.

- 1.10.6 Construct mock-ups using materials, finishes, colours, and methods proposed for the completed Work. Mock-ups to demonstrate proposed workmanship and range of aesthetic appearance.
- 1.10.7 Where a mock-up represents or affects multiple specification Sections, coordinate activities of these Subcontractors to ensure mock-ups are complete.
- 1.10.8 Modify or replace mock-ups when unacceptable to Owner's Representative.
- 1.10.9 Maintain acceptable mock-ups in an undisturbed condition as a standard for judging the completed Work.
- 1.10.10 Mock-ups may remain as part of Work, unless indicated otherwise in a technical specification Section.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

- 3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 SUMMARY

- 1.1.1 This Section describes administrative and procedural requirements for reactive activities to verify that completed Work conforms to Contract Documents requirements.
- 1.1.2 Having inspection and testing agencies by Contractor does not relieve the Contractor of their responsibility to perform Work in accordance with Contract Documents.

1.2 ADMINISTRATIVE REQUIREMENTS

- 1.2.1 Cash Allowances for independent inspection and testing services to be retained and paid for by the Contractor as described in Section 01 21 00 – Allowances. This Cash Allowance(s) excludes any inspection and testing that is for the Contractor's own quality control, and excludes inspection and testing required by authority having jurisdiction.
- 1.2.2 Allow and coordinate access to Work on site, manufacturing off site, and fabrication off site with inspection and testing agencies.
- 1.2.3 Retain and pay for inspection and testing that are designated for Contractor's own quality control plan, and when testing and inspection are required by AHJ.
- 1.2.4 Give advanced notice to Owner's Representative and to each inspection/testing agency for inspection and testing required by Contract Documents or by AHJ.
- 1.2.5 In advance of each test, notify appropriate agency and Owner's Representative in the order that attendance arrangements can be made.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- 1.3.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- 1.3.2 Submit schedule of testing and inspection activities to Owner's Representative, applicable Subcontractors, testing agencies, and other affected parties. Include the following:
 - .1 List each testing and inspection agency
 - .2 Identify types of tests and inspections for each agency, and cross reference to applicable specification Section number-title in Contract Documents
 - .3 Description of test and inspection
 - .4 Identify applicable reference standard
 - .5 Identify test and inspection method
 - .6 Indicate number of each test and inspection required
- 1.3.3 Submit one digital copy of each quality assurance inspection and test report to Owner's Representative, except where a technical specification Section indicates otherwise.

- 1.3.4 Submit reports for inspection and testing required by Contract Documents or by AHJ and performed by Contractor-retained inspection and testing agencies within five (5) days after inspection or test is completed, except where a technical specification Section indicates a different time period.
- 1.3.5 Submit one digital copy of each quality control inspection and test report to Owner's Representative, except where a technical specification Section indicates otherwise.
- 1.3.6 Deliver copies of quality control reports to Subcontractor of work being inspected or tested.

1.4 SITE QUALITY CONTROL PROCEDURES

- 1.4.1 Provide labour, Construction Equipment, and temporary facilities to obtain and handle test samples and materials on site. Arrange for sufficient space to store and cure test samples.
- 1.4.2 Deliver samples and materials required for testing, as requested in technical specification Sections. Submit within five (5) business days and in an orderly sequence to avoid delays in Work.

1.5 TESTING AND INSPECTION SERVICES

- 1.5.1 Owner will retain and pay for independent inspection and testing agencies to inspect, test, or perform other quality control reviews of parts of the work, except where indicated otherwise.
- 1.5.2 Provide equipment required for executing inspection and testing by appointed agencies.
- 1.5.3 Correct defects and deficiencies when they are revealed during inspection or testing as advised by Owner's Representative at no change to Contract Price or Contract Time. Pay costs for retesting and re-inspection. Appointed agency will request additional inspections or tests to ensure full degree of defects or deficiencies are revealed and corrected.
- 1.5.4 Quality control testing and inspection reports to include the following:
 - .1 Project name and number
 - .2 Testing/Inspection agency's name, address, telephone number, and website
 - .3 Date of issuing report
 - .4 Dates and locations of tests, inspections, or samples
 - .5 Description of the Work and test and inspection method
 - .6 Numbers and titles of associated specification Sections
 - .7 Test and inspection data and interpretation of test results (e.g., pass or fail)
 - .8 Ambient conditions at time of test, inspection, or sampling
 - .9 Recommendations on re-testing and re-inspecting, if applicable

2 PRODUCTS

2.1 NOT USED

2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

- 1.1.1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2020, Stipulated Price Contract.
- 1.1.2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
 - .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- 1.1.3 CSA Group (CSA)
 - .1 CSA-A23.1/A23.2-2024, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-O121-17 (R2022), Douglas Fir Plywood.
 - .3 CAN/CSA-S269.2-16 (R2021), Access Scaffolding for Construction Purposes.
 - .4 CAN/CSA-Z321-96 (R2001), Signs and Symbols for the Occupational Environment.
- 1.1.4 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.
- 1.1.5 United States Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

- 1.3.1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- 1.3.2 Identify areas which must be gravelled to prevent tracking of mud.
- 1.3.3 Indicate use of supplemental or other staging area.
- 1.3.4 Provide construction facilities to execute work expeditiously.
- 1.3.5 Remove from site all such work after use.

1.4 SCAFFOLDING

- 1.4.1 Scaffolding in accordance with CAN/CSA-S269.2-16 (R2021).
- 1.4.2 Provide and maintain scaffolding, ramps, ladders, platforms, and temporary stairs.

1.5 SITE STORAGE/LOADING

- 1.5.1 Refer to CCDC 2, GC 3.12.
- 1.5.2 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- 1.5.3 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.6 CONSTRUCTION PARKING

- 1.6.1 Parking will be permitted on site provided it does not disrupt performance of Work.
- 1.6.2 Provide and maintain adequate access to project site.

1.7 OFFICES

- 1.7.1 Provide marked and fully stocked first-aid case in a readily available location.
- 1.7.2 Subcontractors to provide their own offices as necessary. Direct location of these offices.

1.8 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

1.9 SANITARY FACILITIES

- 1.9.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- 1.9.2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.10 CONSTRUCTION SIGNAGE

- 1.10.1 No other signs or advertisements, other than warning signs, are permitted on site.
- 1.10.2 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- 1.10.3 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Owner's Representative.

1.11 PROTECTION AND MAINTENANCE OF TRAFFIC

- 1.11.1 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- 1.11.2 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- 1.11.3 Construct access and haul roads necessary.
- 1.11.4 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- 1.11.5 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- 1.11.6 Dust control: adequate to ensure safe operation at all times.
- 1.11.7 Location, grade, width, and alignment of construction and hauling roads: subject to approval by Owner's Representative.
- 1.11.8 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- 1.11.9 Provide snow removal during period of Work.
- 1.11.10 Remove, upon completion of work, haul roads designated by Owner's Representative.

1.12 CLEAN-UP

- 1.12.1 Remove construction debris, waste materials, packaging material from work site daily.
- 1.12.2 Clean dirt or mud tracked onto paved or surfaced roadways.
- 1.12.3 Store materials resulting from demolition activities that are salvageable.
- 1.12.4 Stack stored new or salvaged material not in construction facilities.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not Used.

3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

END OF SECTION

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1 GENERAL

1.1 REFERENCE STANDARDS

1.1.1 Canadian General Standards Board (CGSB)

- .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.

1.1.2 CSA Group (CSA)

- .1 CSA-O121-17 (R2022), Douglas Fir Plywood.

1.1.3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

1.2 INSTALLATION AND REMOVAL

1.2.1 Provide temporary controls in order to execute Work expeditiously.

1.2.2 Remove from site all such work after use.

1.3 GUARD RAILS AND BARRICADES

1.3.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.

1.3.2 Provide as required by governing authorities.

1.4 ACCESS TO SITE

1.4.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.5 FIRE ROUTES

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

1.6 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

1.6.1 Protect surrounding private and public property from damage during performance of Work.

1.6.2 Be responsible for damage incurred.

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1.7 PROTECTION OF BUILDING FINISHES

- 1.7.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- 1.7.2 Provide necessary screens, covers, and hoardings.
- 1.7.3 Confirm with Owner's Representative locations and installation schedule 3 days prior to installation.
- 1.7.4 Be responsible for damage incurred due to lack of or improper protection.

1.8 WASTE MANAGEMENT AND DISPOSAL

- 1.8.1 Separate waste materials for reuse and recycling as directed by Owner's Representative.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

- 3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work in this Section includes requirements for temporary site controls during construction activities, including:

- .1 temporary soil erosion and sediment control,
- .2 temporary pest control,
- .3 temporary environmental control,
- .4 temporary stormwater pollution control,
- .5 temporary site dust control,
- .6 temporary security, and
- .7 monitoring of temporary controls.

1.2 ABBREVIATIONS

1.2.1 ESCP: Erosion and Sedimentation Control Plan

1.2.2 SWPCP: Stormwater Pollution Control Plan

1.3 REFERENCE STANDARDS

1.3.1 Department of Justice Canada (Jus):

- .1 Canadian Environmental Protection Act (CEPA), 1999

1.3.2 Green Building Initiative (GBI):

- .1 Green Globes for New Construction 2024 Technical Reference Manual

1.3.3 United States Environmental Protection Agency (U.S. EPA):

- .1 Construction General Permit (CGP), 2022

1.3.4 United States Environmental Protection Agency (EPA):

- .1 Construction General Permit (CGP), 2022
- .2 National Pollutant Discharge Elimination System (NPDES), Stormwater Discharges from Construction Activities, 2017

1.4 TEMPORARY EROSION AND SEDIMENT CONTROL

1.4.1 Create and implement a site-specific erosion and sedimentation control plan (ESCP) in accordance with EPA, Construction General Permit and NPDES, Stormwater Discharges

from Construction Activities as the basis of the plan. Include additional municipal requirements where they are more stringent than Construction General Permit and NPDES, Stormwater Discharges from Construction Activities. ESCP shall:

- .1 Identify area of disturbance
 - .2 Summarize design requirements that include amount, frequency, intensity, and duration of precipitation
 - .3 Identify stormwater runoff and run-on at the site, including expected flow and controls to minimize peak and total stormwater volume
 - .4 Provide information on soils present on the site
 - .5 Describe stormwater discharge areas to maximize infiltration and increase sediment removal
 - .6 Summarize installation of stormwater controls for each phase of earth disturbance. Include good engineering practice and adherence to manufacturer's recommendations.
 - .7 Include plans for erosion and sediment control maintenance during construction, including inspection and repair schedules.
- 1.4.2 Create and implement a training program to educate persons on site about ESCP protocols.
- 1.4.3 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil bearing water runoff or prevent airborne dust to adjacent properties, roadways and walkways in accordance with requirements of authority having jurisdiction (AHJ) and as indicated in the Sedimentation Control Plan.
- 1.4.4 Temporary Vehicle Wash-Down Area:
- .1 Prevent mud and soil from accumulating on public roadways.
 - .2 Establish a wash down area for vehicles to remove mud and soil before crossing walkways or entering roadways.
 - .3 Equip wash down area with sedimentation control devices and temporary water supply.
 - .4 Establish a filtering system to prevent harmful fluids (antifreeze, diesel fuel, gasoline) from being flushed into surface drainage system.
- 1.4.5 Temporary Sedimentation Control Basins, Silt Fences, and Erosion Control Blankets:
- .1 Establish one of the following:
 - .1 A sedimentation pond of sufficient size.
 - .2 Geotextile filtering system to control sedimentation from entering surface drainage.

- .3 Street drainage and sewerage systems.
 - .2 Regularly remove silt accumulations. Dispose off-site at a recognized waste facility.
 - .3 Reapply erosion control polymer as it biodegrades or when worn away.
 - .4 Firmly embed silt fence posts in ground. Secure erosion control fabric to posts.
 - .5 Weigh and peg erosion control blankets so that blankets are in full contact with ground.
- 1.4.6 Temporary Stabilized Construction Entrance:
 - .1 Establish a clean gravel pad at each construction entrance of sufficient length and depth to trap clay and excavation debris.
 - .2 Clean gravel on a regular basis to prevent build-up of clay and prevent sediment from being tracked onto roadways.
- 1.5 TEMPORARY PEST CONTROL**
 - 1.5.1 Perform pest control to minimize attraction and harboring of rodents, insects, and other pests. Perform extermination and control procedures at regular intervals.
 - 1.5.2 Project shall be free of pests and their residues at Substantial Performance of the Work.
 - 1.5.3 Perform pest control in accordance with integrated pest management principles with no hazardous or toxic substances released into stormwater or environment.
- 1.6 TEMPORARY ENVIRONMENTAL CONTROLS**
 - 1.6.1 Use construction methods that comply with environmental regulations and minimize possible air, waterway, and subsoil contamination and pollution.
 - 1.6.2 Meetings: Train persons on equipment fuelling, spill prevention and response, good housekeeping protocols, material handling, and waste material handling before their first day on site.
 - 1.6.3 Management:
 - .1 Monitor and repair leaks of polluting liquids on vehicles. Prevent leaks of antifreeze, brake fluid, diesel fuel, gasoline, oil, transmission fluid, and other liquids that may be harmful to the environment or storm drainage systems.
 - .2 Store petroleum products in clearly labelled sealed containers. Provide spill kits and impermeable tarps at fuelling and maintenance areas.
 - .3 Supply a collection skid or similar material for waste materials.
 - .4 Tightly seal and store paint containers, sealers, and curing compounds in a protected location when not required. Prevent excess materials from discharging into storm drainage system.

- .5 Prevent concrete trucks from discharging surplus concrete or drum wash water on site.
- .6 Place absorbent materials to soak up excess form release agents. Replace absorbent materials when saturated
- .7 When applying fertilizer, minimize the discharge of pollutants into stormwater.

1.7 TEMPORARY STORMWATER POLLUTION CONTROL

- 1.7.1 Create and implement a site-specific stormwater pollution control plan (SWPCP) in accordance with Construction General Permit and NPDES, Stormwater Discharges from Construction Activities as the basis of the plan. When more stringent, include additional municipal requirements.
- 1.7.2 Include a description of SWPCP theory and goals.
- 1.7.3 Create and implement an education program for persons on site about the SWPCP protocols.

1.8 TEMPORARY SITE DUST CONTROL

- 1.8.1 Provide measures to prevent airborne dust to adjacent properties and walkways according to requirements of AHJ and meeting requirements of Construction General Permit and NPDES, Stormwater Discharges from Construction Activities.
- 1.8.2 Create and implement a site-specific dust control plan.
- 1.8.3 Dust Control Windbreaks: Geotextile fabric attached to snow or temporary site fencing with fence posts and tie wires. Other measures will be considered.

1.9 TEMPORARY SECURITY

- 1.9.1 Temporary Site Security:
 - .1 Site Fencing: Before beginning excavation and before construction activities begin, provide temporary site enclosure fencing with lockable gates to prevent unauthorized access.
 - .2 Extent of Fencing: To enclose entire Project site or a portion sufficient to accommodate construction activities.
 - .3 Distribute gate keys to authorized personnel only. Supply Owner's Representative with one set of keys.

1.10 ACTION AND INFORMATIONAL SUBMITTALS

- 1.10.1 Submit information in accordance with Section 01 33 00 - Submittal Procedures.
- 1.10.2 Before starting work of this Section, submit the following:
 - .1 Stormwater Pollution Control Plan (SWPCP): Submit SWPCP indicating methods, plans, and details of controls including:

- .1 SWPCP coordinator information and their responsibilities
- .2 Stormwater pollution prevention team to assist in implementation of SWPCP during construction
- .3 Description of existing site conditions, including:
 - .1 existing land use of the site, such as wooded areas, grassed areas, pavements, buildings, and other structures,
 - .2 location of surface waters on or adjacent to Project site, such as lakes, ponds, rivers, streams, wetlands, and similar water features,
 - .3 soil types on Project site,
 - .4 water bodies that will receive site runoff, including the eventual main body of water that receives stormwater, and
 - .5 drainage areas and potential stormwater contaminants.
- .4 Stormwater management controls and various Best Management Practices required to reduce erosion, sediment, and pollutants in stormwater discharge.
- .5 Proposed wastewater management equipment and materials.
- .6 Facility monitoring plan and how controls will be coordinated with construction activities.
- .7 Schedule and allowances to amend the plan if required.
- .8 Sample inspection log.
- .2 Erosion and Sedimentation Control Plan:
 - .1 Submit drawings indicating location of erosion and dust control methods,
 - .2 Describe methods for maintaining, cleaning and repairing erosion and dust control methods, and
 - .3 Submit product data indicating actual materials including:
 - .1 Measures used to prevent soil loss by stormwater runoff and wind erosion.
 - .2 Methods used to protect soil stockpiles and berms.
 - .3 Methods used to prevent loss of sediment into storm sewers or adjacent waterways.
 - .4 Methods to prevent site dust and particulate matter pollution.
- 1.10.3 During the course of work, submit detailed digital photographs indicating temporary sediment and erosion control measures.
- 1.10.4 Site Quality Control Submittals: Submit logs of inspection and maintenance of control measures.

2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- 2.1.1 Protect storm sewers and roadways in accordance with local municipal requirements.
- 2.1.2 Protect waterways and ground water in accordance with AHJ.

2.2 TEMPORARY MATERIALS

- 2.2.1 Erosion and Dust Control Polymer: Polymer-based, biodegradable, non-dissipating, non-leaching, non-tracking soil stabilizer and dust control agent that binds soil particles. Specifically manufactured for maximum bonding to clay soil particles to decrease erosion potential of exposed earth excavations.
- 2.2.2 Steep Slope Erosion Control: Biodegradable geotextile erosion control blanket suitable for medium to steep slope applications designed for short term (less than 3 months), midterm (greater than 3 months; less than 1 year) installation. Use biodegradable anchors and weights to prevent wind displacement and to maintain contact with soil.
- 2.2.3 Sediment Traps: Geotextile filter fabric, straw bales, or other similar filtration materials, or silt fence assembly held in place and bound to wood stakes.
- 2.2.4 Storm Drain Inlet Protection: Permeable plastic berm designed specifically for erosion and sediment control with erosion control blanket to reduce water velocity and trap sediment.

3 EXECUTION

3.1 CLOSEOUT ACTIVITIES

- 3.1.1 Remove temporary control measures shortly before Substantial Performance of the Work or when acceptable to Owner's Representative.
- 3.1.2 Restore landscape areas that were damaged by temporary control measures.

3.2 MAINTENANCE

- 3.2.1 Inspection and Maintenance:
 - .1 Inspect, repair, and maintain temporary control measures during construction.
 - .2 Inspect control measures weekly to prevent unwanted situations such as odours, mosquitoes, and weeds. Confirm control measures are working properly. Repair or replace when required.
 - .3 Repair silt fences and erosion control fabric when damaged.
 - .4 Perform non-routine inspection and maintenance arising from unplanned incidents such as repairs after severe weather and accidental damage.
 - .5 Record each inspection and maintenance event in a daily log. Keep a copy of logs at the Project site. Maintain permanent file of logs until final acceptance of the Work.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

- 1.1.1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2020, Stipulated Price Contract.
- 1.1.2 Within text of each specifications section, reference may be made to reference standards.
- 1.1.3 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- 1.1.4 If there is question as to whether products or systems are in conformance with applicable standards, Owner's Representative reserves right to have such products or systems tested to prove or disprove conformance.
- 1.1.5 Cost for such testing will be born by Owner's Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

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

1.3 AVAILABILITY

- 1.3.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Owner's Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- 1.3.2 In event of failure to notify Owner's Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Owner's Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 STORAGE, HANDLING AND PROTECTION

- 1.4.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- 1.4.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- 1.4.3 Store products subject to damage from weather in weatherproof enclosures.
- 1.4.4 Store cementitious products clear of earth or concrete floors, and away from walls.
- 1.4.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- 1.4.6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- 1.4.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- 1.4.8 Remove and replace damaged products at own expense and to satisfaction of Owner's Representative.
- 1.4.9 Touch-up damaged factory finished surfaces to Owner Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

- 1.5.1 Pay costs of transportation of products required in performance of Work.
- 1.5.2 Transportation cost of products supplied by Owner will be paid for by Owner's Representative. Unload, handle and store such products.

1.6 MANUFACTURER'S INSTRUCTIONS

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

- 1.6.2 Notify Owner's Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Owner's Representative will establish course of action.
- 1.6.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Owner's Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

- 1.7.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Owner's Representative if required Work is such as to make it impractical to produce required results.
- 1.7.2 Do not employ anyone unskilled in their required duties. Owner's Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- 1.7.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Owner's Representative, whose decision is final.

1.8 CO-ORDINATION

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

1.9 CONCEALMENT

- 1.9.1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- 1.9.2 Before installation inform Owner's Representative if there is interference. Install as directed by Owner's Representative.

1.10 REMEDIAL WORK

- 1.10.1 Refer to CCDC 2 and Section 01 73 00 - Execution Requirements.
- 1.10.2 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- 1.10.3 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

- 1.11.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- 1.11.2 Inform Owner's Representative of conflicting installation. Install as directed.

1.12 FASTENINGS

- 1.12.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- 1.12.2 Prevent electrolytic action between dissimilar metals and materials.
- 1.12.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- 1.12.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- 1.12.5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- 1.12.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.13 FASTENINGS - EQUIPMENT

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

1.14 PROTECTION OF WORK IN PROGRESS

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

1.15 EXISTING UTILITIES

- 1.15.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.
- 1.15.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

2 PRODUCTS

2.1 NOT USED

2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- 1.1.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- 1.1.2 Submit the following before work begins at the work site:
 - .1 Service locations: Document locations and extents of service lines in the work area.
- 1.1.3 Submit the following informational submittals as work progresses:
- 1.1.4 Land surveyor information: Name, address, and registration information.
- 1.1.5 Test reports: For manufacturer-recommended pre-installation site tests.
 - .1 Indicate test results meet manufacturer's requirements and recommendations.
 - .2 When manufacturer's requirements are not met, submit manufacturer's corrective recommendations for review.
- 1.1.6 Land surveys: Prepared and issued by a qualified land surveyor.
 - .1 Maintain a log of control and land survey work as it progresses. Record locations with horizontal and vertical data.
 - .2 Submit when required by authority having jurisdiction (AHJ).
- 1.1.7 Submit the following when requested by the Owner's Representative:
 - .1 Site quality control submittals: Documentation to verify accuracy of site engineering work.

1.2 CLOSEOUT SUBMITTALS

- 1.2.1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- 1.2.2 Land Surveys: Prepared and issued by a qualified land surveyor.
 - .1 Document locations of maintained, re-routed, and abandoned service lines.
- 1.2.3 Land Survey Certificate: Indicate where elevations and locations of completed Work are in conformance, or non-conformance, with Contract Documents.

1.3 QUALIFICATION ASSURANCE

- 1.3.1 Surveyor Qualifications: Registered land surveyor, licensed to practice at the Place of the Work.

2 PRODUCTS

2.1 NOT USED

2.1.1 Not Used.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Existing Services:

- .1 Confirm locations and extent of service lines in work area before beginning work on site. Submit findings.
- .2 Immediately notify the Owner's Representative if unknown services are encountered. Confirm findings in writing.
- .3 Record locations of maintained, re-routed, and abandoned service lines after completion of the Work. Submit findings.

3.1.2 Verify substrate and other conditions are acceptable for installation of materials, assemblies, and systems in accordance with required tolerances and manufacturer's instructions and recommendations.

- .1 Examine conditions, with installers, for defects affecting performance of the Work. Where work of one Section depends on work of other Sections being properly completed, verify that work is complete and suitable to receive the subsequent work.
- .2 Verify substrate surfaces are clean, dimensionally-stable, cured, and free of contaminants.
- .3 Proceed with installation after unacceptable conditions are remedied.
- .4 Starting to cut, patch, or install work will be considered Contractor's acceptance of existing conditions.
- .5 Monitor conditions as Work proceeds, including items subject to damage or movement during cutting and patching.

3.1.3 Perform manufacturer-recommended pre-installation site tests.

3.2 PREPARATION

3.2.1 Protection of In-Place Conditions:

- .1 Protect Work and items to remain from damage.
- .2 Do not load, or permit to be loaded, anything with a weight or force that may endanger the safety or integrity of the Work or items to remain.
- .3 Support structural integrity of surroundings.

- .4 Protect exposed work from weather and other potentially damaging conditions. Keep excavations free of water.
- .5 Promptly remove, replace, clean, or repair elements damaged due to inadequate protection, as acceptable to the Owner's Representative, and at no change to the Contract Price or Contract Time.

3.2.2 Surface Preparation:

- .1 Clean surfaces thoroughly before installation.
- .2 Prepare surfaces using manufacturer-recommended methods to achieve acceptable substrates under project conditions.

3.3 SURVEY REQUIREMENTS

3.3.1 Land Survey Reference Points:

- .1 Existing base horizontal and vertical reference points are indicated on land survey.
- .2 Locate and confirm permanent reference points before starting site work. Protect permanent reference points during construction.
- .3 Notify the Owner's Representative, in writing, if a reference point requires relocation due to changes in grades or locations.
 - .1 Obtain written acceptance of proposed relocations from Owner's Representative.
 - .2 Register new reference points with AHJ.
- .4 Notify the Owner's Representative, in writing, if a reference point is lost or destroyed.
 - .1 Replace reference points in accordance with original land survey.

3.3.2 Establish sufficient permanent benchmarks on site by referring back to established benchmarks based on survey reference points.

3.3.3 Establish initial lines and levels for layout of the Work.

END OF SECTION

1 GENERAL

1.1 SECTION INCLUDES

- 1.1.1 Common requirements for installing, applying, and erecting products. Includes procedures and submittals for cutting and patching to existing conditions, and required repairs arising from tests and destructive inspections.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- 1.2.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- 1.2.2 Submit proof of anchor and fastener load carrying capacity for a work result, when requested.
- 1.2.3 Submit written request before cutting or altering to existing conditions which may affect the following:
- .1 structural integrity of existing elements: Submit structural details and calculations performed by a professional structural engineer registered or licensed in Ontario, Canada. Include evidence of unsatisfactory structural integrity of the elements according to Owner's Representative.
 - .2 integrity of weather-exposed and moisture-resistant elements
 - .3 efficiency, maintenance, safety, or accessibility of operational elements
 - .4 visual qualities of sight-exposed elements.
 - .5 Work of Owner, and/or other contractor(s)
- 1.2.4 Submit a request for cutting or altering which includes:
- .1 identification of the Project; and
 - .2 location and description of affected existing conditions including changes to structural elements, function of elements, and visual appearance of existing elements; and the location and identification of utilities that will be temporarily out of service during cutting and patching activities.
- 1.2.5 Submit site plan drawings indicating relative location of various services and equipment upon the request of Owner's Representative.
- 1.2.6 Submit a work plan including:
- .1 a statement why cutting or altering is unavoidable and describe alternatives to cutting and patching if available;
 - .2 a description of proposed work and proposed Products;
 - .3 the effect of cutting or altering on work by Owner or other contractors;

- .4 written acknowledgement by other contractors affected by cutting or altering, if applicable; and
- .5 proposed date(s) and time(s) work will be executed.

1.3 QUALIFICATIONS

- 1.3.1 Licensed Professionals: Engage a structural engineer licensed at the Place of the Work, to submit details and calculations when altering existing structural elements.

2 PRODUCTS

2.1 MATERIALS

- 2.1.1 Patching Materials: If possible, use the same materials found in the existing conditions, except in fire-resistance rated materials and assemblies.
- 2.1.2 Materials Visible from the Floor Area: Use materials that visually match existing adjacent surfaces, and match existing functional performance if required.

3 EXECUTION

3.1 COMMON INSTALLATION/APPLICATION/ERECTION REQUIREMENTS

- 3.1.1 Fit several parts together, to integrate with other Work.
 - 3.1.2 Remove and replace defective and non-conforming Work.
 - 3.1.3 Unless otherwise indicated in specifications, install, or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
 - 3.1.4 Notify Owner's Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Owner's Representative will establish course of action.
 - 3.1.5 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Owner's Representative to require removal and re-installation at no increase in Contract Price or Contract Time.
 - 3.1.6 Provide openings in non-structural elements for penetrations of mechanical and electrical work.
 - 3.1.7 Conceal pipes, ducts and wiring in floor, wall, partition, and ceiling assemblies in finished areas, except where indicated otherwise.
 - 3.1.8 In addition to the manufacturer's recommendations for safety, access, accessibility, and maintenance, locate equipment, fixtures, and distribution systems where it shall provide minimal interference and shall maximize on usable space.
- .1 Location of equipment, fixtures, and outlets indicated on Drawings and specifications are approximate.

- .2 Notify Owner's Representative of impending installation and obtain approval for actual locations.

3.2 BRACING AND ANCHORING

3.2.1 Anchors and Fasteners: Unless otherwise indicated elsewhere:

- .1 Provide any necessary anchors and fasteners to fasten each component securely for its intended purpose. Allow for building movement, including from thermal expansion and contraction of materials and assemblies;
- .2 prevent electrolytic reaction between dissimilar metals and materials;
- .3 Provide stainless steel anchors and fasteners for securing exterior work;
- .4 locate anchors and fasteners within individual load limit or shear capacity. Ensure anchors and fasteners are permanently secured;
- .5 Where exposed to view, evenly distribute anchors and fasteners in a single area; and
- .6 Where exposed to view, provide metal anchors, fasteners, and related accessories with the same texture, colour, and finish as adjacent materials.

3.2.2 Non-Conforming Work: Anchors and fasteners installed which cause substrate cracks or spalling is not acceptable.

3.3 CUTTING AND PATCHING

3.3.1 Proceed with cutting and patching after the review and acceptance by the Owner's Representative of all submittals listed in Article 1.03, Actions and Informational Submittals.

3.3.2 Perform cutting, fitting, and patching including excavation and fill, to complete Work in accordance with related technical specification Sections.

3.3.3 Use special techniques to avoid damaging existing conditions that will remain, and which will result in proper surfaces to receive patching and finishing.

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

3.3.5 Cut rigid materials using masonry saw, core drill, or other tool recommended by the product manufacturer or applicable industry association. Pneumatic or impact tools are not allowed on masonry work without the approval of Owner's Representative.

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

3.3.7 Refinish surfaces to match adjacent finishes. Refinish continuous surfaces to nearest intersection (e.g., edges of partition). Refinish assemblies by refinishing entire unit. Provide entire surface with uniform finish, colour, and texture.

3.4 ADJUSTING

- 3.4.1 Remove and replace patching that is visually unsatisfactory to Owner's Representative.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

1.1.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC 2-2020, Stipulated Price Contract.

1.2 PROJECT CLEANLINESS

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

1.2.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Owner's Representative. Do not burn waste materials on site, unless approved by Owner's Representative.

1.2.3 Clear snow and ice from access to building, bank/pile snow in designated areas only.

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

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

1.2.6 Provide and use marked separate bins for recycling. Refer to Section 01 74 19 - Waste Management and Disposal.

1.2.7 Dispose of waste materials and debris off site.

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

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

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

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

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

1.3 FINAL CLEANING

1.3.1 Refer to CCDC 2, GC 3.14.

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

- 1.3.3 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- 1.3.4 Prior to final review remove surplus products, tools, construction machinery and equipment.
- 1.3.5 Remove waste products and debris other than that caused by Owner or other Contractors.
- 1.3.6 Remove waste materials from site at regularly scheduled times or dispose of as directed by Owner's Representative. Do not burn waste materials on site, unless approved by Owner's Representative.
- 1.3.7 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- 1.3.8 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- 1.3.9 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fittings, walls, and floors.
- 1.3.10 Clean lighting reflectors, lenses, and other lighting surfaces.
- 1.3.11 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- 1.3.12 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- 1.3.13 Inspect finishes, fittings and equipment and ensure specified workmanship and operation.
- 1.3.14 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- 1.3.15 Remove dirt and other disfiguration from exterior surfaces.
- 1.3.16 Clean and sweep roofs, gutters, areaways, and sunken wells.
- 1.3.17 Sweep and wash clean paved areas.
- 1.3.18 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- 1.3.19 Clean roofs, downspouts, and drainage systems.
- 1.3.20 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- 1.3.21 Remove snow and ice from access to building.

1.4 WASTE MANAGEMENT AND DISPOSAL

- 1.4.1 Separate waste materials for reuse and recycling as directed by Owner's Representative.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

- 3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

1.1.1 Canadian Construction Documents Committee (CCDC)

- .1 CCDC 2- 2020, Stipulated Price Contract.

1.1.2 Canadian Environmental Protection Act (CEPA)

- .1 SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations.

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Acceptance of Work Procedures:

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

- .1 Notify Owner's Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.

- .2 Request Owner's Representative inspection.

1.2.2 Owner's Representative Inspection:

- .1 Owner's Representative and Contractor to inspect Work and identify defects and deficiencies.

- .2 Contractor to correct Work as directed.

1.2.3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:

- .1 Work: completed and inspected for compliance with Contract Documents.
- .2 Defects: corrected and deficiencies completed.
- .3 Equipment and systems: tested, adjusted and balanced and fully operational.
- .4 Certificates required by Fire Commissioner, Utility companies: submitted.
- .5 Operation of systems: demonstrated to Owner's personnel.
- .6 Commissioning of mechanical systems: completed in accordance with 01 91 13 - General Commissioning Requirements and Division 23 Mechanical and copies of final Commissioning Report submitted to Departmental Representative.
- .7 Work: complete and ready for final inspection.

1.2.4 Final Inspection:

- .1 When completion tasks are done, request final inspection of Work by Owner's Representative, and Contractor.
 - .2 When Work incomplete according to Owner and Owner's Representative, complete outstanding items and request re-inspection.
- 1.2.5 Declaration of Substantial Performance: when Owner's Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
- 1.2.6 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
- 1.2.7 Final Payment:
 - .1 When Owner's Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
 - .2 Refer to CCDC 2: when Work deemed incomplete by Owner's Representative, complete outstanding items and request re-inspection.
- 1.2.8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

1.3 FINAL CLEANING

- 1.3.1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

- 3.1.1 Used.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

1.1.1 Canadian Environmental Protection Act (CEPA):

- .1 SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-warranty Meeting:

- .1 Convene meeting one week before Contract completion with Owner's Representative, contractor's representative and Consultant, in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify Project requirements.
 - .2 Review manufacturer's installation instructions and warranty requirements.
- .2 Owner's Representative to establish communication procedures for:
 - .1 Notifying construction warranty defects.
 - .2 Determine priorities for type of defects.
 - .3 Determine reasonable response time.
- .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
- .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3.2 Two weeks before Substantial Performance of the Work, submit to the Owner's Representative and Consultant, two final copies of operating and maintenance manuals in English.

1.3.3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

1.3.4 Provide evidence, if requested, for type, source and quality of products supplied.

1.4 FORMAT

1.4.1 Organize data as instructional manual.

- 1.4.2 Binders: Vinyl, hard covered, 3 'D' ring, loose leaf [219 x 279] mm with spine and face pockets.
- 1.4.3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
- 1.4.4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- 1.4.5 Arrange content by systems, process flow, under Section numbers and sequence of Table of Contents.
- 1.4.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- 1.4.7 Text: manufacturer's printed data, or typewritten data.
- 1.4.8 Drawings: Provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.
- 1.4.9 Provide 1:1 scaled CAD files in dwg format on USB.
- 1.5 CONTENTS - PROJECT RECORD DOCUMENTS**
- 1.5.1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
- 1.5.2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- 1.5.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- 1.5.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- 1.5.5 Typewritten Text: As required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- 1.5.6 Training: Refer to Section 01 79 00 - Demonstration and Training.

1.6 AS-BUILT DOCUMENTS AND SAMPLES

1.6.1 Maintain one record copy of:

- .1 Contract Drawings.
- .2 Specifications.
- .3 Addenda.
- .4 Change Orders and other modifications to Contract.
- .5 Reviewed shop drawings, product data, and samples.
- .6 Site test records.
- .7 Inspection certificates.
- .8 Manufacturer's certificates.

1.6.2 Store record documents and samples in site office apart from documents used for construction.

- .1 Provide files, racks, and secure storage.

1.6.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.

- .1 Label each document "PROJECT RECORD" in neat, large, printed letters.

1.6.4 Maintain record documents in clean, dry and legible condition.

- .1 Do not use record documents for construction purposes.

1.6.5 Keep record documents and samples available for inspection by Owner's Representative.

1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

1.7.1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Consultant.

1.7.2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

1.7.3 Record information concurrently with construction progress.

- .1 Do not conceal Work until required information is recorded.

1.7.4 Contract Drawings and shop drawings: mark each item to record actual construction, including:

- .1 Measured depths of elements of foundation in relation to finish first floor datum.

- .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Site changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 Referenced Standards to related shop drawings and modifications.
- 1.7.5 Specifications: mark each item to record actual construction, including:
- .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- 1.7.6 Other Documents: Maintain manufacturer's certifications, inspection certifications, site test records, required by individual specifications Sections.
- 1.7.7 Provide digital photos, if requested, for site records.
- 1.8 FINAL SURVEY**
- 1.8.1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.
- 1.9 EQUIPMENT AND SYSTEMS**
- 1.9.1 For each item of equipment and each system include description of unit or system, and component parts.
- .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- 1.9.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- 1.9.3 Include installed colour coded wiring diagrams.
- 1.9.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
- .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.

- 1.9.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- 1.9.6 Provide servicing and lubrication schedule, and list of lubricants required.
- 1.9.7 Include manufacturer's printed operation and maintenance instructions.
- 1.9.8 Include sequence of operation by controls manufacturer.
- 1.9.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- 1.9.10 Provide installed control diagrams by controls manufacturer.
- 1.9.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
- 1.9.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- 1.9.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- 1.9.14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and Section 01 91 13 - General Commissioning Requirements.
- 1.9.15 Aboveground storage tank inspection documentation, registration, forms, decommissioning and removal in accordance with CEPA SOR/2008-197.
- 1.9.16 Additional requirements: As specified in individual specification Sections.

1.10 MATERIALS AND FINISHES

- 1.10.1 Building products, applied materials, and finishes: Include product data, with catalogue number, size, composition, and colour and texture designations.
 - .1 Provide information for re-ordering custom manufactured products.
- 1.10.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- 1.10.3 Moisture-protection and weather-exposed products: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- 1.10.4 Additional requirements: As specified in individual specifications Sections.

1.11 MAINTENANCE MATERIALS

- 1.11.1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification Sections.
 - .2 Provide items of same manufacture and quality as items in Work.

- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items.
 - .1 Submit inventory listing to Owner's Representative.
 - .2 Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit before final payment.

1.11.2 Extra Stock Materials:

- .1 Provide maintenance and extra materials, in quantities specified in individual specification Sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items.
 - .1 Submit inventory listing to Owner's Representative.
 - .2 Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit before to final payment.

1.11.3 Special Tools:

- .1 Provide special tools, in quantities specified in individual specification Section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items.
 - .1 Submit inventory listing to Owner's Representative.
 - .2 Include approved listings in Maintenance Manual.

1.12 DELIVERY, STORAGE, AND HANDLING

- 1.12.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- 1.12.2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- 1.12.3 Store components subject to damage from weather in weatherproof enclosures.
- 1.12.4 Store paints and freezable materials in a heated and ventilated room.
- 1.12.5 Remove and replace damaged products at own expense and for review by

1.13 WARRANTIES AND BONDS

- 1.13.1 Develop warranty management plan to contain information relevant to Warranties.
- 1.13.2 Submit warranty management plan, [30] days before planned pre-warranty conference, to Owner's Representative and consultant approval.
- 1.13.3 Warranty management plan to include required actions and documents to assure that Owner's Representative consultant receives warranties to which it is entitled.
- 1.13.4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- 1.13.5 Submit, warranty information made available during construction phase, to Owner's Representative and consultant for approval before each monthly pay estimate.
- 1.13.6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by Subcontractors, suppliers, and manufacturers, within five days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- 1.13.7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- 1.13.8 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, Consultant.
- 1.13.9 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, Subcontractors, manufacturers, or suppliers involved.
 - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include HVAC balancing, and commissioned systems, alarm systems, lightning protection systems.
 - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.

- .2 Model and serial numbers.
- .3 Location where installed.
- .4 Name and phone numbers of manufacturers or suppliers.
- .5 Names, addresses and telephone numbers of sources of spare parts.
- .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
- .7 Cross-reference to warranty certificates as applicable.
- .8 Starting point and duration of warranty period.
- .9 Summary of maintenance procedures required to continue warranty in force.
- .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
- .11 Organization, names and phone numbers of persons to call for warranty service.
- .12 Typical response time and repair time expected for various warranted equipment.
- .4 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.
- .5 Procedure and status of tagging of equipment covered by extended warranties.
- .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- 1.13.10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- 1.13.11 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Owner's Consultant to proceed with action against Contractor.

1.14 WARRANTY TAGS

- 1.14.1 Tag, at time of installation, each warranted item. Provide durable, oil- and water-resistant tag approved by Owner's Representative and Consultant.
- 1.14.2 Attach tags with copper wire and spray with waterproof silicone coating.
- 1.14.3 Leave date of acceptance until project is accepted for occupancy.
- 1.14.4 Indicate the following information on tag:

- .1 Type of product/material.
- .2 Model number.
- .3 Serial number.
- .4 Contract number.
- .5 Warranty period.
- .6 Inspector's signature.
- .7 Construction Contractor.

2 PRODUCTS

2.1 NOT USED

2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 ADMINISTRATIVE REQUIREMENTS

1.1.1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks before date of substantial performance.

1.1.2 Owner: Provide list of personnel to receive instructions, and coordinate their attendance at agreed-upon times.

1.1.3 Preparation:

- .1 Verify conditions for demonstration and instructions comply with requirements.
- .2 Verify designated personnel are present.
- .3 Ensure equipment has been inspected and put into operation in accordance with Division 23 & 26.
- .4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning Requirements and equipment and systems are fully operational.

1.1.4 Demonstration and Instructions:

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location.
- .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
- .3 Review contents of manual in detail to explain aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

1.1.5 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system as follows:

- .1 Section 23 05 01 - Cooling and Ventilation System:
- .2 Section 26 05 01 - Electrical System:

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.2.2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks before designated dates, for Owner's Representative's approval.

- 1.2.3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- 1.2.4 Give time and date of each demonstration, with list of persons present.
- 1.2.5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

- 1.3.1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
 - .1 Instruct Owner's personnel.
 - .2 Submit written report that demonstration and instructions have been completed.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not Used.

3 EXECUTION

3.1 NOT USED

- 3.1.1 Not Used.

END OF SECTION

1 GENERAL

1.1 SUMMARY

- 1.1.1 This Section includes general requirements relating to commissioning (Cx) of project components and systems, specifying general requirements for performance verification (PV) of components, equipment, sub-systems, systems, and integrated systems.

1.2 ABBREVIATIONS

- 1.2.1 AFD: Alternate Forms of Delivery, service provider
- 1.2.2 BMM: Building Management Manual
- 1.2.3 Cx: Commissioning
- 1.2.4 EMCS: Energy Monitoring and Control Systems
- 1.2.5 O&M: Operation and Maintenance
- 1.2.6 PI: Product Information
- 1.2.7 PV: Performance Verification
- 1.2.8 TAB: Testing, Adjusting and Balancing

1.3 ADMINISTRATIVE REQUIREMENTS

- 1.3.1 Coordination:
- .1 Owner's Representative will observe some or all commissioning activities at their discretion.
 - .2 Owner's Performance Testing: Performance testing of equipment or systems by Owner's Representative will not relieve Contractor from compliance with specified start-up and testing procedures.
 - .3 Cooperate fully with Owner's Representative during stages of acceptance and occupancy of facility.
 - .4 Coordination with Authorities Having Jurisdiction (AHJ):
 - .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of AHJ, arrange for authority to witness procedures to avoid duplication of tests and to facilitate an earlier acceptance of facility.
 - .2 Obtain certificates of approval, acceptance, and compliance with rules and regulations of AHJ.
 - .3 Submit copies to Owner's Representative within 5 days of test and with Cx report.
- 1.3.2 Commissioning Meetings:

-
- .1 Hold Cx meetings after project meetings in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart and as indicated in this Section.
 - .2 Use Cx meetings to resolve issues, monitor progress, and identify defects and deficiencies relating to Cx.
 - .3 Continue Cx meetings on a regular basis, including during equipment start-up period, and functional testing period until commissioning deliverables have been addressed.
 - .4 At 60% construction completion stage: Owner's Representative will request a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Agenda topics include the following:
 - .1 Review duties and responsibilities of Contractor and Subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of Subcontractors and manufacturer's representatives in the Cx process.
 - .5 Meeting will be chaired by Cx Agent, who will record and distribute minutes.
 - .6 Ensure Subcontractors and relevant manufacturer representatives are present at 60% construction completion stage, at subsequent Cx meetings, and when otherwise required.
- 1.3.3 Observation of Starting and Testing:
- .1 Give 14 days notice before beginning commissioning.
 - .2 Owner's Representative will observe start-up and testing.
 - .3 Owner's Cx Agent to be present at tests performed and documented by Subcontractors, suppliers, and equipment manufacturers.
- 1.3.4 Conflicts:
- .1 Report conflicts between requirements of this Section and other Sections to Owner's Representative and obtain interpretation or clarification before starting commissioning work.
 - .2 Failure to report conflicts and obtain interpretation or clarification will result in application of the more stringent requirement.
- 1.3.5 Excess Administration:
- .1 Contractor shall pay the Owner costs related to Owner Representative's excess contract administration if third and subsequent verifications occur where:
 - .1 Verification of reported results fail to receive Owner Representative's acceptance.
 - .2 Repetition of second verification again fails to receive acceptance.
 - .3 Owner's Representative deems Contractor's request for second verification was premature.

- .2 The cost of the Owner Representative's excess contract administration will be based on a rate set by the Owner Representative.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

- .1 Submit no later than 2 weeks after award of Contract:
 - .1 name of Owner's Cx agent,
 - .2 draft Cx documentation, and
 - .3 preliminary Cx schedule.
- .2 Request changes to submittals in writing to Owner's Representative and obtain written acceptance or rejection at least 8 weeks before start of Cx.
- .3 Where Cx procedures are not specified, submit proposed ones to Owner's Representative and obtain written acceptance or rejection at least 8 weeks before start of Cx.
- .4 Submit additional documentation relating to Cx process as required by Owner's Representative.
- .5 If instruments installed in Contract will be used for Cx of TAB and PV, then submit TAB and PV instrument calibration certificates for review and acceptance.
- .6 Submit EMCS sensor calibration certificates.

1.4.2 Commissioning Schedule:

- .1 Create and submit detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.
- .2 Allow in the schedule adequate time for Cx activities prescribed in technical specification Sections and commissioning Sections including:
 - .1 acceptance of Cx reports
 - .2 verification of reported results
 - .3 repairs, retesting, re-commissioning, and re-verification
 - .4 training

1.4.3 Start-Up Documentation:

- .1 Assemble start-up documentation and submit to Owner's Representative for review and acceptance before beginning commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up checklists.

- .4 Start-up reports.
- .5 Step-by-step description of complete start-up procedures so Owner's Representative can repeat start-up at any time.

1.4.4 Submit for review and acceptance:

- .1 Complete list of proposed instruments and equipment to perform commissioning.
- .2 List data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.

1.4.5 Commissioning Documentation:

- .1 Submit completed Cx documentation to Owner's Representative for review and acceptance.

1.5 MAINTENANCE MATERIALS SUBMITTALS

- 1.5.1 Supply and document maintenance materials, spare parts, and special tools as specified in other specification Sections.

1.6 SITE CONDITIONS

- 1.6.1 Where Cx of weather-dependent, occupancy-dependent, or seasonally-dependent equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions if acceptable to Owner's Representative with manufacturer's assistance in accordance with equipment manufacturer's instructions, data, and approved formulae.

2 PRODUCTS

2.1 NOT USED

- 2.1.1 Not used.

3 EXECUTION

3.1 GENERAL

- 3.1.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Perform Cx after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.

- .1 Objectives: Verify that installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.
- .2 Perform Cx throughout various seasons to calibrate and optimize systems under changing conditions.
- .3 Ensure appropriate documentation is compiled into the BMM.

- .4 Effectively train O&M staff.

- 3.1.2 Contractor shall assist in Cx process, operating equipment and systems, troubleshooting, and making adjustments as required.

- .1 Operate systems at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems should interact with each other as intended in accordance with Contract Documents and design criteria.

- .2 Make adjustments as needed, during these checks, to enhance performance and meet environmental or user requirements.

- 3.1.3 Design Criteria: In accordance with Owner's requirements or as determined by Owner's Representative. To meet Project functional and operational requirements.

3.2 COMMISSIONING OVERVIEW

- 3.2.1 Include Cx as a line item in Contractor's cost breakdown.

- 3.2.2 Cx activities supplement the site quality control and testing procedures described in relevant technical specification Sections.

- 3.2.3 Conduct Cx at the same time as other activities during the construction stage.

- 3.2.4 Cx identifies issues in the Design stages, which are addressed during Construction and Cx stages. This step ensures the built facility meets functional and operational requirements while operating as intended under weather, environmental and occupancy conditions. Cx activities include the transfer of critical knowledge to the Owner's facility operations personnel.

- 3.2.5 Owner's Representative will issue Interim Acceptance Certificate only after:

- .1 Cx documentation has been received, reviewed for suitability, and reviewed and accepted by Owner's Representative,
- .2 equipment, components and systems have been commissioned, and
- .3 O&M training has been completed.

3.3 PRE-COMMISSIONING REVIEW

- 3.3.1 Before Construction:

- .1 Review Contract Documents and confirm in writing to Owner's Representative the following:
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.

- 3.3.2 During Construction:

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

3.3.3 Before Beginning Cx:

- .1 Verify Cx Plan and schedules are up-to-date.
- .2 Verify installation of related components, equipment, systems, and sub-systems are complete.
- .3 Review Cx requirements and procedures.
- .4 Verify documentation used for the Cx process is shelf-ready (bound, organized, indexed, etc.).
- .5 Review design criteria and intent, and special features to ensure full understanding.
- .6 Submit complete start-up documentation to Owner's Representative.
- .7 Verify systems have been cleaned thoroughly.
- .8 Complete TAB procedures on systems and submit TAB reports to Owner's Representative for review and acceptance.
- .9 Verify "As-Built" system schematics are available.

3.3.4 Inform Owner's Representative in writing of defects and deficiencies in installed Work.

3.4 STARTING AND TESTING

3.4.1 Contractor to provide and pay costs of the following:

- .1 inspections, including disassembly and re-assembly after approval, and for starting, testing, adjusting, and;
- .2 temporary testing equipment.

3.5 PERFORMANCE VERIFICATION TOLERANCES

3.5.1 Application Tolerances:

- .1 A specified range of acceptable deviations of measured values from specified values or specified design criteria except for special areas that shall be within +/- 10% of specified values.

3.5.2 Instrument Accuracy Tolerances:

- .1 To be of higher order of magnitude than equipment or system being tested.

3.5.3 Measurement Tolerances During Verification:

- .1 Unless otherwise specified, actual values shall be within +/- 2% of recorded values.

3.6 MANUFACTURER SERVICES

3.6.1 During factory testing, manufacturer to:

- .1 Coordinate time and location of testing.
- .2 Arrange for Owner's Representative to observe testing.
- .3 Submit testing documentation for review and acceptance by Owner's Representative.
- .4 Obtain written acceptance of test results and documentation from Owner's Representative before delivery to site.

3.6.2 Obtain manufacturer's installation, start-up and operations instructions before start-up of components, equipment and systems, and review with Owner's Representative.

- .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
- .2 Modify procedures that may be detrimental to equipment performance and review with manufacturer before start-up.

3.6.3 Integrity of warranties:

- .1 Use manufacturer's trained start-up personnel where specified in other divisions or where required to maintain integrity of warranty.
- .2 Verify with manufacturer that testing as specified will not void warranties.

3.6.4 Qualifications of manufacturer's personnel:

- .1 Experienced in design, installation and operation of equipment and systems.
- .2 Ability to interpret test results accurately.
- .3 Report results in clear, concise, logical manner.

3.7 COMMISSIONING PROCEDURES

3.7.1 Verify that equipment and systems are complete, clean, and operating in a normal and safe manner before conducting start-up, testing and Cx.

3.7.2 Conduct start-up and testing in the following distinct phases:

- .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, reviewed and accepted shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
- .2 Start-up: Follow accepted start-up procedures.

- .3 Operational testing: Document equipment performance.
- .4 System PV: Include repetition of tests after correcting deficiencies.
- .5 Post-Substantial Performance Verification: To include fine-tuning.
- 3.7.3 Correct deficiencies and obtain acceptance from Owner's Representative after distinct phases have been completed and before beginning the next phase.
- 3.7.4 Document required tests on approved PV forms.
- 3.7.5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Owner's Representative. If evaluation report indicates that equipment start-up procedure was deficient and resulted in equipment damage, perform the following:
 - .1 Minor equipment/systems: Perform corrective measures acceptable to Owner's Representative.
 - .2 Major equipment/systems: If evaluation report indicates that equipment damage is minor, perform corrective measures acceptable to Owner's Representative.
 - .3 If evaluation report indicates that major equipment damage has occurred, Owner's Representative will reject equipment.
 - .1 Remove rejected equipment from site and replace with new equipment.
 - .2 Perform specified start-up procedures on new equipment/systems.
- 3.8 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS**
 - 3.8.1 After start-up, operate and maintain equipment and systems as directed or recommended by equipment/system manufacturer.
 - 3.8.2 With manufacturer's assistance, develop written maintenance program and submit to Owner's Representative for review and acceptance before implementation.
 - 3.8.3 Operate and maintain systems for length of time required for commissioning to be completed.
 - 3.8.4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.
- 3.9 TEST RESULTS**
 - 3.9.1 If start-up, testing, or PV produce unacceptable results, repair, replace or repeat specified starting or PV procedures until acceptable results are achieved.
 - 3.9.2 Provide labour and materials, and assume costs for re-commissioning.
- 3.10 START OF COMMISSIONING**
 - 3.10.1 Notify Owner's Representative at least 21 days before start of Cx.

- 3.10.2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

3.11 TEMPORARY INSTRUMENTS AND EQUIPMENT

- 3.11.1 Provide the following instruments and equipment as required:

- .1 2-way radios
- .2 ladders
- .3 other instruments and equipment required to complete commissioning

3.12 COMMISSIONING PERFORMANCE VERIFICATION

- 3.12.1 Carry out Cx:

- .1 under accepted simulated operating conditions, over entire operating range, and in all modes, and
- .2 on independent systems and interacting systems.

- 3.12.2 Cx procedures to be repeatable and reported results are to be verifiable.

- 3.12.3 Follow equipment manufacturer's operating instructions.

- 3.12.4 Make EMCS trending information available as supporting documentation for performance verification.

3.13 EXTENT OF VERIFICATION

- 3.13.1 Laboratory areas:

- .1 Provide labour and instrumentation to verify up to 100% of reported results.

- 3.13.2 Elsewhere:

- .1 Provide labour and instrumentation to verify up to 30% of reported results, unless otherwise specified in other specification Sections.

- 3.13.3 Number and location to be at discretion of Owner's Representative.

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

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

- 3.13.6 Perform additional commissioning until results are acceptable to Owner's Representative.

3.14 INSTALLED INSTRUMENTATION

3.14.1 Use instruments installed under Contract for TAB and PV if:

- .1 Accuracy complies with this specification Section.
- .2 Calibration certificates have been submitted to Owner's Representative.

3.14.2 Calibrated EMCS sensors may be used to obtain performance data if sensor calibration has been completed and accepted.

3.15 PROCEDURES FOR DEFICIENCIES DISCOVERED DURING COMMISSIONING

3.15.1 Correct defects and deficiencies found during the Cx process. Re-verify equipment and components within the defective or deficient system to verify proper performance, including related systems if requested by Owner's Representative.

3.15.2 Costs associated with re-commissioning defective and deficient work is the responsibility of Contractor. Above costs to be in the form of progress payment reductions or hold-back assessments.

3.16 COMMISSIONING CONSTRAINTS

3.16.1 Since access into secure or sensitive areas will be very difficult after occupancy it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

3.17 MISCELLANEOUS CHECKS AND ADJUSTING

3.17.1 Make adjustments and changes which become apparent as Cx proceeds.

3.17.2 Perform static and operational checks as applicable and as required.

3.18 DEFICIENCIES AND DEFECTS

3.18.1 Correct deficiencies and defects found during start-up and Cx to satisfaction of Owner's Representative.

3.18.2 Report concerns, deficiencies, and defects affecting Cx to Owner's Representative in writing. Stop Cx until problems are rectified. Proceed with written acceptance from Owner's Representative.

3.19 CLOSEOUT ACTIVITIES

3.19.1 Completion of Commissioning:

- .1 Upon completion of Cx, leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx before issuance of Interim Certificate of Completion.

- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Owner's Representative.

3.19.2 Activities Upon Completion of Commissioning:

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

3.19.3 Training:

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

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

- .1 This section is limited to portions of the Building Management Manual (BMM) provided to Owner's Representative by Contractor.

1.1.2 Acronyms:

- .1 BMM - Building Management Manual.
- .2 Cx - Commissioning.
- .3 HVAC - Heating, Ventilation and Air Conditioning.
- .4 PI - Product Information.
- .5 PV - Performance Verification.
- .6 TAB - Testing, Adjusting and Balancing.
- .7 WHMIS - Workplace Hazardous Materials Information System.

1.2 GENERAL REQUIREMENTS

1.2.1 Standard letter size paper 216 mm x 279 mm.

1.2.2 Methodology used to facilitate updating.

1.2.3 Drawings, diagrams and schematics to be professionally developed.

1.2.4 Electronic copy of data to be in a format accepted and approved by Owner's Representative.

1.3 APPROVALS

1.3.1 Prior to commencement, co-ordinate requirements for preparation, submission and approval with Owner's Representative.

1.4 GENERAL INFORMATION

1.4.1 Provide Owner's Representative the following for insertion into appropriate Part and Section of BMM:

- .1 Complete list of names, addresses, telephone and fax numbers of contractor, sub-contractors that participated in delivery of project - as indicated in Section 1.2 of BMM.

- .2 Summary of architectural, structural, fire protection, mechanical and electrical systems installed and commissioned - as indicated in Section 1.4 of BMM.
 - .1 Including sequence of operation as finalized after commissioning is complete as indicated in Section 2.0 of BMM.
- .3 Description of building operation under conditions of heightened security and emergencies as indicated in Section 2.0 of BMM.
- .4 System, equipment and components Maintenance Management System (MMS) identification - Section 2.1 of BMM..
- .5 Information on operation and maintenance of architectural systems and equipment installed and commissioned - Section 2.0 of BMM.
- .6 Information on operation and maintenance of fire protection and life safety systems and equipment installed and commissioned - Section 2.0 of BMM.
- .7 Information on operation and maintenance of mechanical systems and equipment installed and commissioned - Section 2.0 of BMM.
- .8 Operating and maintenance manual - Section 3.2 of BMM.
- .9 Final commissioning plan as actually implemented.
- .10 Completed commissioning checklists.
- .11 Commissioning test procedures employed.
- .12 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by Owner's Representative.
- .13 Commissioning reports.

1.5 CONTENTS OF OPERATING AND MAINTENANCE MANUAL

- 1.5.1 For detailed requirements refer to Section 01 78 00 - Closeout Submittals.
- 1.5.2 Owner's Representative to review and approve format and organization within 5 days of award of contract.
- 1.5.3 Include original manufactures brochures and written information on products and equipment installed on this project.
- 1.5.4 Record and organize for easy access and retrieval of information contained in BMM.
- 1.5.5 Include completed PI report forms, data and information from other sources as required.
- 1.5.6 Inventory directory relating to information on installed systems, equipment and components.
- 1.5.7 Approved project shop-drawings, product and maintenance data.

- 1.5.8 Manufacturer's data and recommendations relating: manufacturing process, installation, commissioning, start-up, O&M, shutdown and training materials.
- 1.5.9 Inventory and location of spare parts, special tools and maintenance materials.
- 1.5.10 Warranty information.
- 1.5.11 Inspection certificates with expiration dates, which require on-going re-certification inspections.
- 1.5.12 Maintenance program supporting information including:
 - .1 Recommended maintenance procedures and schedule.
 - .2 Information to removal and replacement of equipment including, required equipment, points of lift and means of entry and egress.

1.6 LIFE SAFETY COMPLIANCE (LSC) MANUAL

- 1.6.1 Samples of LSC Manual will be available from Owner's Representative.
- 1.6.2 Content of Manual:
 - .1 All possible Emergency situations modes including: presence of fire and smoke, power failure, lose of water or pressure, chemical spills and refrigerant release.
 - .2 HVAC emergencies and fuel supply failures.
 - .3 Intrusion and security breach.
 - .4 Emergency provisions for natural disasters, bomb threats and other disruptive situations.
 - .5 Dedicated emergency generators for high security projects, medical facilities and computer systems.
 - .6 Emergency control procedures for fire, power and major equipment failure.
 - .7 Emergency contacts and numbers.
 - .8 Manual to be readily available and comprehensible to non- technical readers.

1.7 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES

- 1.7.1 Provide Owner's Representative supporting documentation relating to installed equipment and system, including:
 - .1 General:
 - .1 Finalized commissioning plan.
 - .2 WHMIS information manual.

- .3 Approved "as-built" drawings and specifications.
 - .4 Procedures used during commissioning.
 - .5 Cross-Reference to specification sections.
 - .2 Architectural and structural:
 - .1 Inspection certificates, construction permits.
 - .2 Roof anchor log books.
 - .3 PV reports.
 - .3 Fire prevention, suppression and protection:
 - .1 Test reports.
 - .2 Smoke test reports.
 - .3 PV reports.
 - .4 Mechanical:
 - .1 Installation permits, inspection certificates.
 - .2 Piping pressure test certificates.
 - .3 Ducting leakage test reports.
 - .4 TAB and PV reports.
 - .5 Charts of valves and steam traps.
 - .6 Copies of posted instructions.
 - .5 Electrical:
 - .1 Installation permits, inspection certificates.
 - .2 TAB and PV reports.
 - .3 Electrical work log book.
 - .4 Charts and schedules.
 - .5 Locations of cables and components.
 - .6 Copies of posted instructions.
- 1.7.2 Assist Owner's Representative with preparation of BMM.

1.8 IDENTIFICATION OF FACILITY

1.8.1 When submitting information to Owner's Representative for incorporation into BMM, use following system for identification of documentation:

.1 Regional Municipality of Peel: Brampton Airport Heliport.

1.9 USE OF CURRENT TECHNOLOGY

1.9.1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.

1.9.2 Obtain Owner Representative's approval before starting Work.

2 PRODUCTS

2.1 NOT USED

2.1.1 Not used.

3 EXECUTION

3.1 NOT USED

3.1.1 Not used.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

1.1.1 Aluminum Association (AA)

- .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.

1.1.2 ASTM International

- .1 ASTM A123/A123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A653/A653M-23, Standard Specification for Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .3 ASTM B32-20, Standard Specification for Solder Metal.
- .4 ASTM B456-17, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

1.1.3 Canadian General Standards Board (CGSB)

- .1 CGSB 31-GP-107Ma-90, Non-Inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.
- .2 CGSB 41-GP-6M-1983, Sheets, Thermosetting Polyester Plastics, Glass Fibre Reinforced.

1.1.4 CSA Group (CSA)

- .1 CSA W47.2-11, Certification of Companies for Fusion Welding of Aluminum.
- .2 CSA W59-24, Welded Steel Construction (Metal Arc Welding).
- .3 CSA W59.2-[M19, Welded Aluminum Construction.

1.1.5 Canadian Sheet Steel Building Institute (CSSBI)

- .1 CSSBI SSF 6-2012, Sheet Steel Facts #6, Metallic Coated Sheet Steel for Structural Building Products.

1.1.6 Green Seal (GS)

- .1 GS-11-2013, Standard for Paints and Coatings.
- .2 GS-36-2013, Adhesives for Commercial Use.

1.1.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Safety Data Sheets (SDS).

1.1.8 South Coast Air Quality Management District (SCAQMD)

- .1 SCAQMD Rule 1113-13, Architectural Coatings.
- .2 SCAQMD Rule 1168-A2011, Adhesive and Sealant Applications.

1.1.9 Master Painters Institute (MPI)

- .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #76, Quick Dry Alkyd Metal Primer.
 - .2 MPI #96, Quick Dry Enamel Gloss.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.2.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for signage and include product characteristics, performance criteria, physical size, finish and limitations.

1.2.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .2 Submit catalogue sheets.
- .3 Indicate materials, thicknesses, sizes, finishes, colours, construction details, removable and interchangeable components, electrical components specifications and power loads, wiring terminal box locations, lamp centres and overlaps, access panels, mounting methods, schedule of signs.
- .4 Submit drawn-to-scale details for individually fabricated or incised lettering indicating word and letter spacing.

1.2.4 Samples:

- .1 Submit representative sample of each type sign, sign image and mounting method including, but not limited to: graphics, cast letters, sign box installation method, channel letters, and wall plates fixed mounting installation method.

1.3 CLOSEOUT SUBMITTALS

1.3.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.3.2 Operation and Maintenance Data: submit operation and maintenance data for illuminated signs for incorporation into manual.

1.4 QUALITY ASSURANCE

1.4.1 Welding Certification in accordance with CSA W47.2.

1.5 DELIVERY, STORAGE AND HANDLING

- 1.5.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- 1.5.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.5.3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect specified materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.1 MATERIALS

- 2.1.1 Aluminum extrusions: to designation AA 6006-T5.
- 2.1.2 Sheet aluminum: utility quality.
- 2.1.3 Prefinished sheet aluminum: embossed utility sheet with manufacturer applied baked enamel finish to designation AA 3105, 0.25 mm thick on face and 0.0076 mm thick on back.
- 2.1.4 Prefinished sheet steel: conforming to CSSBI SSF 6: for corrosive environment: in colours selected from manufacturer's standard range.
- 2.1.5 Galvanized steel sheet to ASTM A653/A653M: Lock Forming Quality with mill phosphatized Z275 coating
- 2.1.6 Casting aluminum: to AA A356.0.
- 2.1.7 Acrylic sheet: polymethylmethacrylate (PMMA) cast sheet suitable for intended use in sign fabrication, colours as indicated.
- 2.1.8 Fibreglass sheet: to CGSB 41-GP-6M, flat sheet, smooth finish, colours as indicated.
- 2.1.9 Engraving sheet: lamicoid 3.2 mm thick plastic sheet, white core.
- 2.1.10 Electrical components: CSA approved.
- 2.1.11 Welding materials: to CSA W59
- 2.1.12 Solder: to ASTM B32, TypeSn50.
- 2.1.13 Self-stick foam tape: 3.2 mm thick, 352.4 kg/m³ density polyurethane open-cell foam tape for sign purposes, with synthetic self-stick adhesive on both sides.
 - .1 Width: to suit sign sizes.

2.1.14 Adhesives, paints, sealants and solvents for acrylic and fibreglass sheet: type recommended by sheet manufacturer for applicable condition.

.1 Maximum VOC limit 70 g/L to SCAQMD Rule 1168.

2.1.15 Acrylic top-coat: clear, non-yellowing, exterior grade, satin finish, acrylic polyester resin protective coating, compatible with surface of type recommended by sheet manufacturer.

.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1113.

2.1.16 Bituminous paint: to MPI.

.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1113.

2.2 VENDORS

2.2.1 Preferred vendors:

.1 Entro

Joe Kiss (ACIDO, Project Director)

T: 416-368-6988 x257

.2 Sign-o-Rama

Alex Chernavski

M: 416-877-2837 B: 905-564-1824

Email: signquote@bellnet.ca

.3 Another Preferred Signage Consultant at the discretion of Regional Municipality of Peel

2.3 SIGN GRAPHICS

2.3.1 Sign graphics: well defined, arranged for balanced appearance, and properly word and letter spaced.

2.3.2 Cut and spray process: mask surfaces, accurately cut-out image, spray apply uniform coating to obtain finish.

2.3.3 Silk screen process: apply 2 multi colour photographic produced silk screen printed images to back side of transparent sign faces; face side of opaque sign faces.

2.3.4 Engraving: apply sign images using pantograph mechanical engraving machine to obtain incised letters.

2.3.5 Self-stick vinyl film: individual letters and numerals [and symbols] die cut from 0.1 mm thick white integral colour, matte finish, exterior grade VC film, with self-stick adhesive backing.

- 2.3.6 Decals: silk screened or printed images on 0.051 mm, clear matte finish, mylar film, with self-stick adhesive backing.

.1 Protect image with laminated film overlay of same material as decal base.

2.4 CUT-OUT LETTERS

- 2.4.1 Cut letters and symbols from plain aluminum sheet.

- 2.4.2 Helvetica typeface, upper and lower case: sizes and thicknesses as indicated.

.1 Make corners cutter radius.

- 2.4.3 Finish, after fabrication aluminum with anodizing.

2.5 CAST LETTERS

- 2.5.1 Cast letters of solid aluminum accurately formed to profiles as detailed; with smooth faces free from surface defects or blemishes.

- 2.5.2 Finish letters, after fabrication with clear anodizing.

2.6 ILLUMINATED SIGN BOXES

- 2.6.1 Fabricate illuminated sign boxes as detailed of extruded aluminum with clear anodized finish.

- 2.6.2 Sign casings:

.1 Design, construct and reinforce sign casing to provide strong, rigid, self-supporting, light-tight housing to accommodate sign faces and electrical components.

.1 Use one piece casing lengths.

.2 Include matching end closures.

.3 Weld intersecting members.

.2 Provide space in front of sign face for 3.2 mm acrylic lift in panel for message image.

.3 Provide access for installation, maintenance, and relamping, through hinged sign face, having concealed latches to prevent unauthorized access.

.4 Provide for thermal movement, heat and moisture dissipation by approved non-staining, concealed methods.

.5 Include clear anodized aluminum reflectors, minimum 1.52 mm thick.

.1 Paint remainder of interior white.

.6 Fabricate wall brackets for installation.

.1 Match exposed materials to sign casing.

.2 Concealed material: steel with galvanized finish.

- 2.6.3 Sign faces: clear acrylic sheet 6 mm thick.

- .1 Support face along top, leaving sides and bottom floating to permit unrestricted thermal movement.
- .2 Join butting sign faces with clear transparent acrylic or PVC joining splines of approved type.
- .3 Installed face to present rigid surface with minimal distortion: to match approved sample method.
- .4 Lift in panels: 3.2 mm clear acrylic panels for each message (pictograph or word).
 - .1 Panels capable of easy placement and removal yet secure when in place.
 - .2 Smooth on edges.

2.6.4 Sign graphics:

- .1 Acrylic sign faces: apply graphics for self-stick vinyl film.

2.7 NON- ILLUMINATED SIGN BOXES

2.7.1 Fabricate sign as detailed of opaque black acrylic, fibreglass 6 mm thick.

2.7.2 Buff exposed edges and make radius corners.

2.7.3 Fabricate wall brackets for installation.

- .1 Exposed materials: compatible with materials used on illuminated signs.
- .2 Concealed materials: steel with galvanized finish to produce reasonably rigid sign.

2.7.4 Sign faces:

- .1 Fabricate sign faces of colour acrylic sheet 6 mm thick.
- .2 Installed face to present rigid surface with minimal distortion: to match approved sample method.

2.7.5 Sign graphics: apply by self-sticking vinyl film.

2.8 FABRICATION

2.8.1 Fabricate signs in accordance with details, specifications and shop drawings.

2.8.2 Build units square, true, accurate to size, free from visual or performance defects.

2.8.3 Fit and securely join sections to obtain tight, closed joints.

2.8.4 Allow for thermal movement without distortion of components.

2.8.5 Exposed inconspicuous fasteners of same finish and colour as base material permitted.

2.8.6 Polish exposed edges of plastic and metal to smooth, slightly convex profile.

2.8.7 Do steel welding to CSA W59 and aluminum welding to CSA W59.2.

- 2.8.8 Finish exposed welds flush and smooth.
- 2.8.9 Apply bituminous paint to aluminum in contact with dissimilar metals, concrete or masonry.
- 2.8.10 Manufacturer's nameplates on sign surface permitted in nonvisible locations in completed work.

2.9 FINISHES

- 2.9.1 Anodized aluminum:
 - .1 Clear finish: to designation AA-M10C22A41 in uncoloured anodized finish with film thickness of 1.0 mil.
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1113.
 - .2 Colour finish: to designation AA-M10C22A42 to match sample.
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1113.
- 2.9.2 Galvanized finish: on irregular shaped articles, 381 g/m² zinc coating to ASTM A123/A123M
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1113.
- 2.9.3 Baked enamel:
 - .1 One coat of conditioner to CGSB 31-GP-107M one coat of MPI #76 primer.
 - .2 At least two coats of MPI # 96.
 - .3 One coat on interior surfaces.
 - .4 Individually bake each coat.
- 2.9.4 Chrome and nickel plating: to ASTM B456, satin finish.
- 2.9.5 Prefinished metals: see PART 2, article on MATERIALS.
- 2.9.6 Bronze finishes: to match sample.

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for signage installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- 3.2.1 Manufacturer's Instructions: compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.

- 3.2.2 Erect and secure signs plumb and level at elevations indicated.

- 3.2.3 Comply with sign manufacturer's installation instructions and approved shop drawings.

- 3.2.4 Mechanical attachment:

- .1 To concrete or solid masonry: use lag screws and expansion bolts or screws and fibre plugs, as appropriate for stresses involved.

- .2 To hollow masonry: use toggle bolts or equivalent.

- .3 To steel: use bolts with nut and lock washers, self-tapping screws.

- .1 Do steel welding to CSA W59 and aluminum welding to CSA W59.2.

- .2 Finish exposed welds flush and smooth.

- .4 To wood: use screws.

- .5 Secure into framing members behind stud walls or above ceilings.

- .6 Mechanical fasteners on exterior: non-staining, non-ferrous type.

- .7 Fabricate special fasteners as required for installation conditions.

- .8 Mechanical fasteners and methods of attachment subject to Consultant's approval.

- .1 Obtain Consultant's approval before fixing to structural steel.

- 3.2.5 Adhesive attachment:

- .1 Use self-stick adhesive foam tape to manufacturer's instructions to fix sign and prevent "rocking".

- .2 Keep tape maximum 1.6 mm from edges.

3.3 CLEANING

- 3.3.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

- .1 Leave Work area clean at end of each day.

- 3.3.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

- .1 Leave signs clean.

- .2 Remove debris from interior of sign boxes.
- .3 Touch up damaged finishes.

END OF SECTION

1 GENERAL**1.1 General Requirements**

- 1.1.1 The requirements of this section shall apply to all sections in Division 23.
- 1.1.2 Conform to Division 1 General Conditions.
- 1.1.3 All material, labour, equipment, and services required under this section shall be the full responsibility of the Mechanical Contractor including any material, labour, equipment, and services provided by their subcontractors.
- 1.1.4 Refer to front end tender documents and mechanical specifications for approved sub-trade lists.
- 1.1.5 Complete and submit the Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of the tender documents.

1.2 Definitions

- 1.2.1 "Supply" shall mean supply only.
- 1.2.2 "Install" shall mean install and connect.
- 1.2.3 "Provide" shall mean supply, install, and connect.
- 1.2.4 "Drawings and Specifications" shall mean Contract Documents.
- 1.2.5 "Authorities" or "Authorities having jurisdiction" shall mean all agencies that enforce the applicable laws, ordinances, rules, regulations, or codes of the Place of Work.
- 1.2.6 "Work" shall mean all equipment, materials, labour, and permits to provide a complete and operational mechanical system as detailed in the drawings and specifications.
- 1.2.7 "Owner" or PRP shall mean The Regional Municipality of Peel

1.3 Related Work

- 1.3.1 Division 1 – General
- 1.3.2 Division 22 - Plumbing
- 1.3.3 Division 26 – Electrical
- 1.3.4 Division 23 specifications form a part of the Contract Documents and shall be read, interpreted, and coordinated with all other Divisions.

1.4 Intent

- 1.4.1 The drawings and specifications are not a detailed set of installation instructions. Drawings and specifications are complementary to one another and that which is shown on one is as binding as that which is shown on both.
- 1.4.2 The Consultant shall be immediately informed of any discrepancies between drawings and specifications leaving in doubt the true intent of the work.
- 1.4.3 Supply all labour, equipment, and materials necessary to install a complete and operational mechanical system described herein and shown on the drawings.
- 1.4.4 It is the intent of these drawings and specifications to provide for a mechanical installation complete and in operating condition. The responsibility for supplying and installing all material necessary to accomplish this, except where specifically noted that such work or materials is not included, shall be part of this section.
- 1.4.5 Assess and be familiar with existing site conditions prior to pricing and construction and allow for same in tender price.
- 1.4.6 All work must be done by qualified, certified and experienced persons in such line of work. Trade certificates must be available on demand.
- 1.4.7 All work shall be in accordance with standard industry practice accepted and recognized by the Consultant and the Trade.
- 1.4.8 This Contractor shall coordinate with and cooperate with all other trades prior to installation. Where work interferes with other trades due to failure to coordinate or cooperate, the work shall be removed and relocated as approved by the Consultant at no extra cost to the Owner.
- 1.4.9 The Consultant shall have the right to reject any work that does not conform to the Contract Documents and accepted standards of practice including but not limited to performance, quietness of operation and finish.

1.5 Codes, Bylaws, Standards, and Regulations

- 1.5.1 The mechanical system shall comply with the latest editions and revisions of applicable codes, bylaws, standards, and regulations including but not limited to:
 - .1 Ontario Building Code
 - .2 ASHRAE
 - .3 SMACNA
 - .4 NFPA
 - .5 Canadian Standards Association

- .6 Canadian Gas Association
- .7 Local Building Bylaws
- .8 Ontario Occupational Health and Safety Act

1.5.2 Provide work in accordance with the requirements of all applicable government codes, local by-laws, underwriter's regulations base building standards, contract documents, and all authorities having jurisdiction.

1.5.3 Where discrepancies occur between contract drawings and specifications and above codes and standards referred to herein, the Contractor is to notify the Consultant in writing and obtain clarification prior to proceeding with the work.

1.5.4 Contractors shall not reduce the requirements on the contract drawings and specifications by applying any codes and standards referred to herein.

1.6 Permits and Fees

1.6.1 Apply for, obtain, and pay for all permits, Notice of Project, fees, connections, inspections, licenses, certificates or charges necessary including all provincial and federal taxes.

1.6.2 Coordinate all required inspections and give necessary notice to all authorities.

1.6.3 Upon completion of project, provide inspection certificates confirming acceptance by all authorities having jurisdiction for all applicable disciplines.

1.7 Contract Breakdown

1.7.1 After the tenders close, submit a breakdown of the price into scope and trades to the satisfaction of the Consultant based on the sections of the specifications.

1.7.2 Breakdown shall include but not be limited to:

- .1 Mobilization and shop drawing submission (maximum \$3,000)
- .2 Demolition
- .3 Plumbing (Division 22)
- .4 HVAC Equipment – Supply
- .5 HVAC Equipment – Installation
- .6 Sheet Metal
- .7 Insulation
- .8 Testing, Startup & Training

.9 Balancing (N/A – by PRP Commissioning Agent)

.10 Close-out Submittals / Manuals & As-Built Drawings (minimum \$2,500)

1.7.3 Progress claims shall be based on the breakdown. Submit in table format showing contract amount, work complete to date as percentage, previous draw, amount this draw and balance for each line item.

1.8 Shop Drawings

1.8.1 Within fifteen (15) days of award, the Contractor shall submit shop drawings of all equipment for the project. Partial submittals will not be accepted.

1.8.2 Prior to ordering of products or delivery of any products to job site, submit shop drawings electronically in PDF format to the Consultant for review and comments. Submit sufficiently in advance of construction to allow ample time for review. Size of shop drawings shall be 8.5x11". 11x17" will be acceptable where appropriate for content and scale.

1.8.3 Submittals shall contain but not be limited to:

.1 Construction information

.2 Product data

.3 Performance data including performance curves

.4 Acoustical sound power data

.5 Dimensional layout and clearances

.6 Mounting arrangements

.7 Certification of compliance to applicable codes

.8 Operating and Maintenance information

.9 Wiring, single line and schematic diagrams (where applicable)

1.8.4 Clearly mark each sheet of printed submittal material, using arrow, underlining or circling, to show particular sizes, dimensions, wiring diagrams, operating clearances, control diagrams, project identification, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable material. Note on the submittal specified features such as special tank linings, pump seals, materials or painting.

1.8.5 Prior to submission to the Consultant, the General and Mechanical Contractor shall review all shop drawings. By this review the Contractor represents that they have determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so and that they have checked and

coordinated each shop drawing with the requirements of the Work and of the Contract Documents.

- 1.8.6 The Contractor's review of each shop drawing shall be indicated by his approval stamp, date and signature on the front of each page. Drawings will not be considered if not previously checked by the Mechanical Contractor.
- 1.8.7 Review comments from the Consultant. If shop drawings are modified, confirm changes before proceeding. If shop drawings are not approved, revise and resubmit changes for approval within one (1) week..
- 1.8.8 Review of the shop drawings by the Consultant does not relieve the Contractor or his Supplier of the responsibility to provide the correct and complete equipment, material or installation.
- 1.8.9 Keep one complete set of shop drawings at the job site during construction.
- 1.8.10 Include stamped reviewed shop drawings in the Maintenance Manuals.

1.9 Product Delivery Schedule

- 1.9.1 Within one (1) week from shop drawing review, a schedule must be submitted by the Contractor showing projected delivery dates of all products to meet required construction schedule.

1.10 Construction Meetings

- 1.10.1 The Mechanical Contractor shall attend all site meetings unless otherwise pre-approved.
- 1.10.2 Sub-trades shall attend site meetings as requested or as required.

1.11 As-Built Drawings

- 1.11.1 Refer to Section 23 05 02.
- 1.11.2 Maintain accurate, neat, and clean As-Built drawings on an **on-going basis** during construction to be reviewed periodically by the Consultant during construction.
- 1.11.3 As-Built drawing mark-ups shall be made available at every site meeting or inspection.
- 1.11.4 As-Built drawings shall include but not be limited to final location of any access doors on same for future service requirements.
- 1.11.5 Upon completion of the work, submit to the Consultant for review, one (1) complete set of clear, legible, certified as-built drawings.

1.12 Reports

- 1.12.1 Provide the following reports upon completion of work by certified Contractors for review and approval by the Consultant:

- .1 Equipment Start-Up Reports
- .2 VFD Start-up Reports
- .3 Piping Pressure Test Reports (Gas, Hot Water Heating, Domestic)
- .4 TSSA Report
- .5 Water Treatment Report
- .6 Other applicable equipment startup reports and test sheets
- .7 Note: Balance Report by Division 1.

1.12.2 All reports shall be dated and signed by the Technician who performed the start-up and/or tests.

1.13 Maintenance Manuals

1.13.1 Refer to Section 23 05 02.

1.13.2 Provide the Owner with one (1) **indexed**, hard cover maintenance manual to local air balance industry standards plus one (1) electronic copy on labeled USB. Manuals shall contain and be tabbed in the following order:

- .1 Table of Contents
- .2 Contractor's, Manufacturer's and Supplier's Contact Information
- .3 Warranty Letter
- .4 Valve schedule
- .5 Colour coding charts for access areas
- .6 Reports as specified herein and as applicable
- .7 Shop drawings (stamped reviewed by Consultant)
- .8 Equipment maintenance instructions and manuals
- .9 Controls as-built drawings(by BAS vendor under GC)
- .10 As-Built drawings

1.13.3 Submit one (1) complete copy to the Consultant for review and approval. Revise based on any comments and resubmit all copies and electronic copy to Consultant.

1.14 Testing and Startup

- 1.14.1 Refer to Sections 23 05 92 under this Division.
- 1.14.2 Test and startup all equipment and work.
- 1.14.3 Fully coordinate all testing and startups with all trades, the Consultant, and authorities having jurisdiction.
- 1.14.4 The Controls Contractor shall be present during all equipment start-ups. Coordinate scheduling with Controls Contractor.
- 1.14.5 Provide adequate notice to all parties.

1.15 1.15 Demonstration

- 1.15.1 Demonstrate to the Owner on proper operation of the system.
- 1.15.2 The Contractor shall arrange for all necessary personnel and equipment specialists to be in attendance for purposes of demonstration.
- 1.15.3 Provide instruction by a manufacturer's representatives as required to fully demonstrate the systems.
- 1.15.4 The Contractor shall arrange and coordinate all demonstration for all equipment including any Owner supplied equipment. Coordination for Owner supplied equipment shall include arrangement with supplier start-up technicians.
- 1.15.5 Demonstration shall include but not be limited to:
 - .1 Demonstration in the normal, abnormal and emergency operation of all systems provided under this Division.
 - .2 Review of all necessary maintenance procedures, including winterization, of all systems provided under this Division.
 - .3 Provision of a documented maintenance program covering all systems provided or modified under this contract.
 - .4 Review of all close-out documentation including complete maintenance manuals and As-Built drawings.
- 1.15.6 Prepare a Demonstration Agenda and Log for signature by all Participants. Submit to Consultant and include in Manuals.
- 1.15.7 Complete and accepted maintenance manuals and As-Built drawings shall be submitted and available for use during the Demonstration.

1.16 Substantial Completion and Performance

- 1.16.1 Substantial completion and performance shall be determined and awarded by the Consultant.
- 1.16.2 Complete the following to the satisfaction of the Consultant prior to request for substantial performance:
 - .1 Fire Dampers and Fire Stopping
 - .2 TSSA inspection and acceptance
 - .3 System Testing and Startups including reports
 - .4 Balancing including report (by PRP)
 - .5 Maintenance Manuals
 - .6 As-Built Drawings
 - .7 Demonstration

1.17 Warranty

- 1.17.1 Provide a one (1) year full parts and labour warranty for the new system from date of substantial completion.
- 1.17.2 . Submit warranty letter on Company letterhead signed by Company representative stating warranty terms including warranty period from date of substantial completion.

2 PRODUCTS**2.1 Materials**

- 2.1.1 All material used shall be new, free from defects, of quality specified, and installed in accordance with manufacturer's instructions.
- 2.1.2 Major equipment shall have nameplates on the exterior of the equipment in a visible location containing manufacturer's name, model number, serial number, performance data, and electrical characteristics.
- 2.1.3 The same manufacturer shall be used for types of equipment used in similar applications.
- 2.1.4 It is the responsibility of the Contractor to store and protect materials supplied by this scope.
- 2.1.5 Materials shall be stored in original containers.

- 2.1.6 Submit to the Consultant and the Owner, current MSDS Sheets for any products being used on the job site where they exist.
- 2.1.7 Remove and dispose of all redundant materials and garbage from site.
- 2.1.8 Supply anchor bolts and templates for installation by other Divisions.

2.2 Selected Products and Equivalents

- 2.2.1 Sections within Division 23 list "Acceptable Manufacturers" which must meet characteristics of the specified equipment and products for each section.
- 2.2.2 Base specified products are specified and/or shown on the drawings, and identified by manufacturer's name, type and catalogue number.
- 2.2.3 Any acceptable manufacturer from base specified products and equipment must equal or exceed the quality, finish and performance of those base specified and/or shown, and not exceed the space requirements allotted on the drawings. Include costs for any associated work to accommodate such substitutions, including the Consultant's time and revisions to the work of other divisions (i.e. electrical changes).
- 2.2.4 If item or material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after the Contract has been awarded.
- 2.2.5 If item of size indicated is unobtainable, supply next larger size without additional charge.

2.3 Quality of Product

- 2.3.1 All products provided shall be listed and/or approved by relevant authorities and new, unless otherwise specified.
- 2.3.2 If products specified are not listed and/or approved, obtain approval of provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- 2.3.3 All products provided shall be new including those not specified and shall be of a quality best suited to the purpose required and their use subject to approval by the Consultant.

2.4 Product Finishes

- 2.4.1 Shop drawings shall indicate finishes. Use standard finish unless otherwise specified.
- 2.4.2 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

2.5 Access Doors

2.5.1 Provide access doors/panels as required for access, adjustment, operation, service, and maintenance.

2.5.2 Minimum size of panels shall be 12" x 18" (300mm x 450mm). Wherever possible 24" x 24" (600mm x 600mm) panels shall be used.

2.5.3 Access doors/panels shall have concealed hinges and screwdriver locking device.

2.5.4 ACCESS DOORS/COVERS - FLUSH ACCESS DOOR – DRYWALL AREA

- .1 **Acudor #DW-5040 Series** flush to surface for drywall, satin coat steel with white baked enamel finish, formed door panel, flanged on four sides, 20 gauge. Galvanized frame with multiple bends and integral taping bead, 26 gauge. Concealed hinge, stainless steel screwdriver operated cam latch.

2.5.5 ACCESS DOORS/COVERS - FLUSH ACCESS DOOR - UNIVERSAL

- .1 **Acudor #UF-5000** Universal Access Doors, 14 GA. (1.7mm) steel, baked enamel prime coat, continuous concealed hinge, with positive and self-opening screwdriver operated lock.

2.6 Guards

2.6.1 Provide guards for unprotected drives.

2.6.2 Guards for belt drives:

- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2 mm (18 gauge) thick sheet metal tops and bottoms.
- .3 40mm (1-1/2") diameter holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.

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

2.6.4 Install belt guards to allow movement of motors for adjusting belt tension.

2.6.5 Guard for flexible coupling:

- .1 "U" shaped, minimum 106 mm (16 gauge) thick galvanized mild steel.
- .2 Securely fasten in place.
- .3 Removable for servicing.

2.6.6 Unprotected fan inlets or outlets:

- .1 Wire or expanded metal screen, galvanized, 20 mm (3/4") mesh.
- .2 Net free area of guard: not less than 80% of fan openings.
- .3 Securely fasten in place.
- .4 Removable for servicing.

2.7 Equipment Supports

- 2.7.1 Equipment supports supplied by equipment manufacturer: specified elsewhere in Division 23.
- 2.7.2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of – Structural Steel Section. Submit structural calculations with shop drawings.
- 2.7.3 Install base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around.

2.8 Sleeves

- 2.8.1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated.
- 2.8.2 Schedule 40 steel pipe.
- 2.8.3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
 - .2 Where sleeve extends above finished floor.
 - .3 Through fire rated walls and floors.
- 2.8.4 Sizes: minimum 6mm (1/4") clearance all around, between sleeve and un-insulated pipe or between sleeve and insulation.
- 2.8.5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25mm (1") above other floors.
- 2.8.6 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.

- .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
- .4 Fill future-use sleeves with lime plaster or other easily removable filler.
- .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Amdt-Mar-78.

2.8.7 Provide minimum 20-gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25 mm clearance all around or to the requirements of the authority having jurisdiction. Seal at all as indicated.

2.9 Fire Stopping

2.9.1 This Contractor shall work with all other Contractors on the project in providing one common method of fire stopping all penetrations made in the fire rated assemblies.

2.9.2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.

2.9.3 Do not use cementitious or rigid seals around penetrations for pipe, ductwork, or other mechanical items.

2.9.4 Insulated pipes and ducts; ensure integrity of insulation and vapour barrier at fire separation.

2.9.5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.

2.9.6 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.

2.9.7 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide "fire wrap" blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.

2.9.8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.

2.9.9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.

2.9.10 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.

2.9.11 Firestopping shall be inspected and approved by local authority prior to concealment of enclosure.

- 2.9.12 Install material and components in accordance with ULC certification, manufacturer's instructions and local authority.
- 2.9.13 Submit product literature and insulation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and Consultant.
- 2.9.14 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.
- 2.9.15 Acceptable Manufacturers:
- .1 Fryesleeve Industries Inc.
 - .2 General Electric Pensil Firestop Systems
 - .3 International Protective Coatings Corp.
 - .4 Rectorseal Corporation (Metacaulk)
 - .5 Proset Systems
 - .6 3M
 - .7 AD Systems
 - .8 Hilti
- 2.9.16 Ensure firestop manufacturer representative performs on-site inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.

2.10 Escutcheons

- 2.10.1 On pipes and ductwork passing through walls, partitions, floors and ceilings in finished areas.
- 2.10.2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.
- 2.10.3 Outside diameter to cover opening or sleeve.
- 2.10.4 Inside diameter to fit around finished pipe.

2.11 Spare Parts

- 2.11.1 Provide spare parts as specified under this Division.
- 2.11.2 Provide list of equipment in maintenance manuals indicating corresponding spare parts required. List of spare parts to be signed off by receiving personnel.

2.12 Special Tools

- 2.12.1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Maintenance Materials Special Tools and Spare Parts.

3 EXECUTION**3.1 Site Examination**

- 3.1.1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.
- 3.1.2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.
- 3.1.3 Report to the Consultant any unsatisfactory conditions which may adversely affect the proper completion of this work.

3.2 Interference and Coordination Drawings

- 3.2.1 Examine the drawings and all divisions of the specifications.
- 3.2.2 Prepare interference and equipment layout drawings to ensure all components will be properly accommodated within the spaces provided.
- 3.2.3 Lay out the work and equipment with due regard to architectural, structural and electrical features, and service requirements.
- 3.2.4 Submit interference drawings to the Consultant.
- 3.2.5 Before commencing any work, obtain a ruling from the Consultant if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.

3.3 Separation of Services

- 3.3.1 Contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.
- 3.3.2 All pipes, ductwork and wiring shall be supported from permanent building structure. Use of other services for support is not permitted

3.4 Workplace Safety

- 3.4.1 The workplace must be kept safe at all times.
- 3.4.2 Conform to all ministries of labour, and health and safety regulations at all times.

- 3.4.3 Use ladders and proper techniques as approved by the ministry of labour to perform all work.
- 3.4.4 Cover all holes/openings and provide barriers around hazards, etc. to ensure occupants and workers are not at risk.
- 3.4.5 Where work does not conform to such regulations, stop work immediately and report the situation to the Owner's representative or Consultant or rectify the situation immediately.
- 3.4.6 Report any hazards or concerns to the Owner's representative immediately.
- 3.4.7 Conform to Owner's safety requirements and construction regulations.

3.5 Temporary Requirements

- 3.5.1 All temporary requirements to complete mechanical work during construction shall be the responsibility of the Mechanical Contractor except temporary power or water.

3.6 Location of Equipment

- 3.6.1 Approximate distances and dimensions may be obtained by scaling off the drawings. Figured dimensions shall govern over scaled dimensions.
- 3.6.2 Equipment locations shown on the drawings are approximate. Locations may be revised to suit construction and equipment arrangements provided design intent is not jeopardized and there is no additional cost to the Owner.

3.7 Mounting Heights

- 3.7.1 Mounting height of equipment is from finished floor to equipment unless otherwise specified or indicated. Coordinate with block coursing if applicable.
- 3.7.2 Where mounting heights are not indicated on the drawings, obtain verification from the Consultant before proceeding.

3.8 Repairs, Cutting and Restoration

- 3.8.1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
- 3.8.2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
- 3.8.3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

- 3.8.4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

3.9 Painting

- 3.9.1 Refer to other Divisions for Painting unless otherwise specified herein.
- 3.9.2 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- 3.9.3 Prime and touch up marred finished paintwork to match original.
- 3.9.4 Restore to new condition, or replace equipment at discretion of Consultant, finishes which have been damaged too extensively to be merely primed, painted and touched up.

3.10 Concealment

- 3.10.1 All equipment, components, piping, and conduit shall be concealed in ceiling spaces, bulkheads or walls in finished areas.
- 3.10.2 Exposed equipment, components, piping, and conduit installed in unfinished areas, shall be installed as high as possible. Run piping and conduit parallel to building lines, tight to roof deck and down columns.

3.11 Access Doors

- 3.11.1 .1 Provide access doors as required for access, adjustment, operation, service, and maintenance.

3.12 Clearances and Accessibility

- 3.12.1 Install all work for easy access for adjustment, operation, service, and maintenance.
- 3.12.2 Maintain clearances for all equipment as per local codes and manufacturer's instructions.
- 3.12.3 Access panels shall be Acudor or equivalent with concealed hinges and screwdriver locking device.
- 3.12.4 Provide access panels of adequate size as required to access equipment and components in concealed areas. Do not install access doors in specialty walls or ceilings.
- 3.12.5 Provide fire rated access doors where installed in fire separations to match rating of separation.
- 3.12.6 Install all services in exposed areas so that a minimum head clearance of 2200mm (88") is maintained.

3.13 Equipment and System Protection

- 3.13.1 Protect equipment and materials from damage in storage and on site before, during, and after installation until final acceptance.
- 3.13.2 Protect equipment and system openings from dust and debris with appropriate covers that will withstand through the construction.
- 3.13.3 Where equipment and system components become dirty or damaged, clean and repair to new condition to the satisfaction of the Consultant and the Owner at no expense to the Owner.

3.14 Supports

- 3.14.1 Provide all miscellaneous metals and materials as required for support, hanging, anchoring, and guiding of all equipment, ductwork, piping, and all other work in Division 23.
- 3.14.2 All supports must be securely mounted to structures.
- 3.14.3 Refer to Section 23 05 29.

3.15 Fire Stopping

- 3.15.1 Refer to Part 2 herein.

3.16 Cleaning

- 3.16.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units prior to turn over to Owner.
- 3.16.2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.

3.17 Owner Supplied Equipment

- 3.17.1 Connect to equipment supplied by the Owner and make operable.

3.18 Identification and Labeling

- 3.18.1 All equipment, valves, panels and devices shall be labeled under this Division.
- 3.18.2 Refer to Section 23 05 53.

3.19 TSSA Inspection

- 3.19.1 Prior to final completion of the project, this Contractor shall make application, arrange, and pay for a TSSA Inspection of all piping systems and equipment installations, including, but not limited to refrigeration, fuel piping, heating plant, and associated equipment installed under the contract.

3.19.2 Provide a copy of the TSSA Report in the maintenance manuals for each system.

3.20 Demonstration

3.20.1 Refer to 1.15 herein.

3.21 Field Review and Deficiencies

3.21.1 The Contractor shall notify the Consultant when the job is ready for field review at various stages including rough-in stages.

3.21.2 During the course of construction, the Consultants will monitor construction and provide written reports of work progress, discussions and deficiencies.

3.21.3 The Contractor shall correct all deficiencies within the work period prior to the next review.

3.21.4 The Contractor shall not conceal any work until inspected. Where work was concealed, the Contractor shall remove and replace tiles, coverings or other obstructions to allow proper inspection at the Contractor's expense.

3.21.5 Upon completion of the project the Consultant will do a final review. Upon receiving the final inspection report, the Contractor must correct and sign back the inspection report indicated all deficiencies are completed. A re-inspection will only be done once the Consultant receives this in writing. Where the Consultant performs the re-inspection and the work is not complete, the Contractor is responsible for reimbursing the Consultant for the field review. The fee for additional reviews will be at the Consultant's hourly rates plus mileage and applicable taxes to be paid directly to the Consultant prior to performing the next field review.

END OF SECTION

1 GENERAL

1.1 Work Included

- 1.1.1 Operating and Maintenance Manuals
- 1.1.2 Assembly of equipment details sheets and shop drawings including Owner supplied equipment
- 1.1.3 Assembly of equipment and systems operating and maintenance instructions
- 1.1.4 Assembly of equipment start up and performance tests and reports
- 1.1.5 Assembly of Balancing Report (by PRP)
- 1.1.6 Assembly of final inspection certificates
- 1.1.7 As-Built Drawings

1.2 Related Work

- 1.2.1 Division 1
- 1.2.2 General HVAC Requirements – Section 23 05 01.

2 PRODUCTS

2.1 Operation and Maintenance Materials

- 2.1.1 Provide one (1) 8½" x 11", 3 ring type catalogue binder, labeled front and spine, with plastic tab dividers and Table of Contents. Also provide one (1) complete manual in electronic PDF format on labeled USB.
- 2.1.2 Manufacturer's data section is to be indexed and ordered to exactly match the sections of the specifications. Each section of the manufacturer's data section is to include an up to date copy of the equipment schedule for that section. The schedule is to be revised to suit all addenda, change orders and field changes, as well as manufacturers and model numbers matching the equipment supplied.
- 2.1.3 Assemble or develop complete and correct documentation for the operation and maintenance information for equipment and systems provided.
- 2.1.4 Assemble or develop copies of all certified shop drawings and material required to complete the documentation. This generally includes but is not limited to the following:

- .1 Table of Contents

- .2 Contractor's, Manufacturer's and Supplier's Contact Information
- .3 Warranty Letter
- .4 Valve schedule
- .5 Colour coding charts for access areas
- .6 Reports:
 - .1 Equipment Start-Up Reports
 - .2 Piping Pressure Test Reports (Gas, Hot Water Heating, Domestic)
 - .3 TSSA Report
 - .4 Other applicable equipment startup reports and test sheets
 - .5 Note: Balance Report by Balance agent/contractor at end of project
- .7 Shop drawings (stamped reviewed by Consultant)
- .8 Maintenance instructions, requirements and schedule
- .9 Demonstration Logs
- .10 As-Built drawings

2.2 As-Built Drawings

- 2.2.1 As-Built drawings shall be kept up-to-date on an ongoing basis during construction for periodic review by the Consultant. As-Built drawings shall always be kept in the same location on site known to the Consultant.
- 2.2.2 Contractors shall certify that final reproducible As-Built drawings to be correct by notation and signature on the drawings.
- 2.2.3 As-Built drawings shall precisely identify the configuration, size and location of all systems and equipment installed under this Division, including but not limited to:
 - .1 Heating: shut off valves, balancing valves, piping, access doors.
 - .2 Controls: controllers, panels, devices, relay cabinets, sensors, thermostats, valve operators, wiring and conduit runs complete with legend.
 - .3 Miscellaneous: actual room names and numbers, schematic diagrams, riser diagrams.
- 2.2.4 Submit to the Consultant for review, one (1) complete set of clear, legible, certified as-built drawings.

2.2.5 Redlined drawings will be transferred to AutoCAD by the Consultant.

2.3 Balance Reports

2.3.1 Refer to Section 23 05 93 – Balancing. Balancing to be arranged by PRP

2.3.2 Include a copy of Balance Report in Operating and Maintenance Manuals.

2.4 Test and Start-Up Reports

2.4.1 Refer to section 23 05 92 – Testing, and Section 23 05 01 – General Mechanical Requirements.

2.4.2 Include a copy of all test and start-up reports in Operating and Maintenance Manuals.

2.4.3 Obtain final copies of any 3rd Party test reports for inclusion in Operating and Maintenance Manuals.

2.5 Demonstration Reports/Logs

2.5.1 Refer to Section 23 05 01 – General Mechanical Requirements

2.5.2 Include a copy of all Demonstration literature in the Operating and Maintenance Manuals.

2.5.3 Include a copy of the signed and dated Demonstration Log.

3 EXECUTION

3.1 General

3.1.1 A hard copy of the maintenance manual shall be provided immediately upon completion of startup and testing for review by the Consultant and for use during the Demonstration. The Manual shall include all test and start-up reports. Substantial Completion will not be awarded until the manual is submitted and accepted.

3.1.2 The Consultant will review the manual and provide any comments or changes required. The Contractor shall revise and finalize all manuals within one (1) weeks.

3.1.3 Substantial Performance will not be granted until the final hard copy and electronic copy of the complete manual have been submitted by the Contractor and reviewed and accepted by the Consultant.

3.1.4 Submit a draft copy of the manual to the Consultant for review prior to final submission of final copy.

3.1.5 Provide one (1) final hard copy and one (1) electronic copy in PDF format to the Consultant for final acceptance.

3.2 As-Built Drawings

- 3.2.1 Prior to Substantial Performance submit one (1) complete set of clear, legible, certified as-built drawings.
- 3.2.2 Substantial performance will not be granted until the As-Built drawings have been submitted to the Consultant.

END OF SECTION

1 GENERAL**1.1 Manufacturer**

- 1.1.1 Provide valves of same manufacturer throughout where possible.
- 1.1.2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

1.2 Quality Assurance

- 1.2.1 Valves for gas service shall be trimmed and approved for specified service.
- 1.2.2 All valves shall meet all MSS, ANSI and ASME manufacturing standards.

1.3 Submittals

- 1.3.1 Refer to Section 23 05 01 – HVAC General Requirements.
- 1.3.2 Manufacturer's data and shop drawings for all valves and accessories including dimensions, pressure ratings, materials, service acceptability.

2 PRODUCTS**2.1 General**

- 2.1.1 All valves must be of threaded or flanged type.
- 2.1.2 Valves 300mm (12") and larger located with stem in the horizontal position shall be drilled and taped to accommodate a drain valve and equalizing bypass valve assembly.
- 2.1.3 No yellow brass valves will be allowed.
- 2.1.4 Wafer style valves (except check valves) are not allowed.

2.2 Valve Connections

- 2.2.1 Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.
- 2.2.2 Thread pipe sizes 50mm (2") and smaller.
- 2.2.3 Flange pipe sizes 63mm (2½") and larger.
- 2.2.4 Solder or screw to solder adaptors for copper piping.
- 2.2.5 Use grooved body valves with mechanical grooved jointed piping where approved only.

2.2.6 Provide butterfly valves with tapped lug body when used for isolating service.

2.3 Check Valves

2.3.1 Bronze, swing disc, solder or screwed ends.

2.3.2 Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends.

2.3.3 Iron body, bronze trim, spring loaded, renewable composition disc, flanged ends.

2.3.4 Acceptable Models:

.1 Jenkins 587J

.2 NH T651

.3 Kitz #78

.4 Red & White (Toyo) #435

2.3.5 Grooved end fittings shall not be used.

2.4 Butterfly Valves

2.4.1 Iron body, lug pattern, bronze or stainless steel disc, resilient replaceable EPDM liner seat, plain flanged or grooved ends.

2.4.2 Acceptable Models:

.1 Jenkins 2232ELJ (Lever) 2232EGJ (Gear)

.2 NH 45-313321 (Lever) 45-313322 (Gear)

.3 Kitz #6122-EL (Lever) #6122-EG (Gear)

.4 Kitz #6141-EL (Lever) #6141-EG (Gear)

.5 Red & White (Toyo) #918BESL (Lever) #918-BESG (Gear)

.6 Crane Model 44

2.4.3 Grooved end fittings shall not be used.

2.5 Control Valves

2.5.1 Refer to Section 23 09 23.

2.5.2 Control valves to be supplied by the Controls Contractor and turned over to the HVAC Contractor for installation.

2.6 Ball Valves

2.6.1 Up to 38mm (1½"): Forged bronze body, delrin seat and seals, chrome plated ball, forged steel pin, screwed ends, 1206 kPa (175 psi). Acceptable material: Victaulic Series 722.

2.6.2 Tail piece supply isolation valves: ball type valves, angle configuration, screw driver operated, compression fittings or threaded as required, chrome plated if exposed.

2.6.3 Acceptable Models:

- .1 Jenkins
- .2 NH
- .3 Kitz #58 and #59
- .4 Red & White (Toyo) #5044A and #5049A
- .5 MAS #B3 and #B4

2.7 Gate Valves

2.7.1 Bronze, inside screw, double wedge or disc, solder or screwed ends.

2.7.2 Over 100mm (4"): Iron body, bronze trim, rising stem, OS&Y solid wedge, flanged ends.

2.7.3 Acceptable Models:

- .1 Jenkins 454J
- .2 NH T504
- .3 Kitz #72
- .4 Red & White (Toyo) #421

2.8 Globe or Angle Valves

2.8.1 Bronze, renewable composition disc, solder or screwed ends.

2.8.2 Over 100mm (4"): Iron body, bronze trim, rising stem, OS&Y, renewable composition disc, flanged ends.

2.8.3 Acceptable Models:

- .1 Jenkins 2342J
- .2 NH T731
- .3 Kitz #726

- .4 Red & White (Toyo) #400

2.9 Circuit Balancing Valves (CBV)

2.9.1 Valves shall be Y-pattern globe style design with provision for connecting a portable differential (ft. of head) pressure meter.

2.9.2 Valves shall have all metal parts of nonferrous, pressure die cast, nonporous Ametal.

2.9.3 The valves shall be suitable for the following functions:

- .1 Precise flow measurement
- .2 Precise flow balancing
- .3 Positive shut-off with no drip seat eliminating the need of an additional isolation valve.
- .4 Drain connection using $\frac{3}{4}$ " NPT hose end thread.

2.9.4 Valves shall have four (4) 360° adjustment turns of the handwheel for precise setting with hidden memory to provide a temper-proof balancing setting. Handwheel shall have digital readout. The handwheel can be installed in any position without affecting performance.

2.9.5 For sizes $\frac{1}{2}$ " to 2":

- .1 300 PSI, Y-pattern, globe type with soldered or threaded ends, non-ferrous Ametal brass copper alloy body, EPDM o-ring seals.
- .2 4-turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections to portable differential meter.
- .3 Acceptable Manufacturer: TA Hydronic Series 786 STAS (solder), 787 STAD (threaded) or 78K (MxF).

2.9.6 For sizes 2½" to 16":

- .1 300 PSI, Y-pattern, globe type with flanged or grooved ends, ASTM A536 ductile iron body, all other parts of Ametal brass copper alloy, EPDM o-ring seals.
- .2 8, 12, 16, 20 or 22 turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections to portable differential meter.
- .3 Acceptable Manufacturer: TA Hydronic Series 788 STAF (flanged) only.

2.9.7 Acceptable Manufacturers

- .1 Tour & Anderson

2.9.8 Circuit Balancing Valve sizing (schedule based on Tour & Anderson):

	Nominal Flow			
Size	Min.	Max.	Min.	Max.
(in)	(gpm)	(gpm)	(l/s)	(l/s)
½	0.6	2.8	0.038	0.177
¾	2.0	6.0	0.126	0.379
1	3.9	10.0	0.246	0.631
1-¼	5.0	15.0	0.316	0.947
1-½	6.6	20.0	0.416	1.262
2	12.6	36.0	0.795	2.272
2-½	38.0	100.0	2.398	6.310
3	31.0	130.0	1.956	8.203
4	68.0	200.0	4.291	12.62
5	90.0	320.0	5.679	20.19
6	182.0	450.0	11.48	28.39
8	367.0	820.0	23.16	51.74
10	540.0	1300.0	34.07	82.03
12	960.0	1500.0	60.58	94.65

2.10 Pressure Reducing Valves – Water

2.10.1 Listed to ASSE 1003 and IAPMO and certified to CSA B356.

2.10.2 Low Pressure

- .1 Adjustable Reduced Pressure Range: 10 to 35psi
- .2 Maximum Working Pressure: 200psi (14 bar)
- .3 NPT Threaded female union inlet x NPT female outlet
- .4 Bronze body construction
- .5 SS Integral strainer
- .6 High temperature resistant diaphragm
- .7 Renewable stainless steel seat
- .8 Serviceable in-line
- .9 Sealed spring cage, corrosion-resistant adjusting & cage screws for waterworks pit installations

.10 Equal to U5B-LP

2.10.3 High Pressure

- .1 Pressure reduced from as high as 300psi (20.7 bar) to 50psi (345 kPa) or lower
- .2 Sealed spring cage and stainless steel corrosion resistant adjusting cage screws for accessible outdoor or pit installations
- .3 Integral stainless steel strainer
- .4 Replaceable seat module
- .5 Bronze body construction
- .6 Serviceable in line
- .7 Bypass feature controls thermal expansion pressure
- .8 High temperature resistant reinforced diaphragm for hot water
- .9 Equal to Watts U5B-Z3

2.10.4 Less than 100mm (4"): Bronze body, brass bonnet, composition rubber diaphragm, plated or stainless steel spring, internal strainer.

2.10.5 100mm (4") and over: High tensile cast iron body and bonnet, seat, composition disc and diaphragm, bronze needle control pilot valve with small pressure regulating valve. Flanged body and bonnet.

2.11 Relief Valves

2.11.1 Provide ASME rated direct spring loaded type, lever operated nonadjustable factory set discharge pressure as indicated.

2.12 Drain Valves

2.12.1 Bronze compression stop with ¾" hose threaded.

2.12.2 Brass ball valve with ¾" hose thread.

2.12.3 Provide hose thread connection on valve or piping.

2.12.4 Equal to #868C (LEAD FREE), KITZ #68AC (NON-LEAD FREE)

2.13 Double Check Valve Assembly - Reduced Pressure Type

2.13.1 Bronze or red brass body, stainless steel springs, composition diaphragm.

2.13.2 Independent acting spring loaded double internal disc valve, three chamber, discharge to atmosphere.

2.13.3 Acceptable Models:

- .1 Watts 009 QT
- .2 Zurn 975 XL
- .3 Febco 825 Y
- .4 Combraco 40-200

2.13.4 Non-electronic testing apparatus including gauge, hoses, fittings, accessories, and case. Maximum temperature 104.4°C (220°F), maximum pressure 1034 kPa (150 psi). Equal to Watts TK-9A.

2.14 Strainers

2.14.1 Strainers 50mm (2") and smaller shall be constructed for 250 psig operating pressure at 406 degrees F and shall have a cast iron threaded body and 20 mesh Type 304 stainless steel screen.

2.14.2 Strainers larger than 50mm (2") shall be constructed for 125 psig @ 150 degrees F and shall have a cast iron flanged body and a 3/64" perforated Type 304 stainless steel screen up to 75mm (3") and a 1/8" perforated Type 304 stainless steel screen on 100mm (4") and larger.

2.14.3 Screen free area shall be minimum three times area of inlet pipe. Provide valved drain and hose connection off strainer bottom.

2.14.4 Strainers 50mm (2") and smaller shall have straight thread and gasketed caps and plugged blow-off connections.

2.14.5 Strainers larger than 50mm (2") shall include drain connections complete with ball valve, cap and chain.

2.14.6 Grooved end fittings shall not be used.

2.15 Pressure Ratings

2.15.1 Unless otherwise indicated, use valves suitable for minimum 860 kPa (125 psi) and 232°C (450°F).

2.15.2 Use valves for fire protection suitable for 1206 kPa (175 psi).

2.16 Manual Valve Operators

2.16.1 Provide suitable handwheels for gate, globe or angle, radiation and drain valves.

- 2.16.2 Provide one plug cock wrench for every plug cock valve.
- 2.16.3 Butterfly Valves: Provide lever lock handle with toothed plate for shutoff service.
- 2.16.4 Provide valves sized 4" and larger located more than 8 feet from floor in equipment room areas with chain operated sheaves. Extend chains to approximately 60" above floor and hook to clips arranged to clear walking aisles.

3 EXECUTION

3.1 General

- 3.1.1 All valves shall be located such that the removal of their bonnets is possible.
- 3.1.2 Install valves with stems upright or horizontal, not inverted.
- 3.1.3 All flanged valves in horizontal lines with the valve stem in the horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position.
- 3.1.4 Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position.
- 3.1.5 All valves shall be installed to allow for ease of access, service and reading of devices from the floor.

3.2 Application

- 3.2.1 Use ball valves for gas service. Plug cocks are not to be used for gas isolation service.
- 3.2.2 Use ball valves on pressure gauges.
- 3.2.3 Use plug cocks, globe valves, ball valves, butterfly valves, and metering valves in water systems for throttling service.

3.3 Isolation Valves

- 3.3.1 Isolation valves are to be ball type valves, pipe size as required, but in no case less than 13mm (½") diameter.
- 3.3.2 For equipment removal purposes, isolation valves are to be installed with companion screwed unions on piping less than 75mm (3") diameter, or flanged connections on piping 75mm (3") and larger. Grooved mechanical couplings may be used for equipment removal, subject to accessibility, suitability and where approved by specification terms for that piping system or equipment.
- 3.3.3 Install valves as close as possible to isolated equipment in order to minimize the amount of water lost during maintenance, replacement or drain down operations.

- 3.3.4 Isolation drain valves are to be provided with combination air inlet fitting as required to relieve vacuum during draining operations.
- 3.3.5 Install gate valves or ball valves where approved for shutoff and isolating service, or to isolate equipment, parts of systems or vertical risers.
- 3.3.6 Provide drain valves at main shutoff valves, low points of piping and equipment.

3.4 Control Valves

- 3.4.1 Control valves to be supplied by the Controls Contractor and turned over to the HVAC Contractor for installation.
- 3.4.2 Install valves to allow proper access and clearance and so actuators are in horizontal position visible from the floor. All valves shall be installed so actuators are in horizontal position.
- 3.4.3 Provide a union at all connections to each control valve.

3.5 Circuit Balancing Valves (CBV)

- 3.5.1 The Contractor shall size and install balancing valves according to design flow.
- 3.5.2 Install CBVs in accordance with manufacturer's instructions.
- 3.5.3 Use flanged type for 2½" and over in areas where welded pipe is to be used.
- 3.5.4 Valves shall be installed with flow in the direction of the arrow on the valve body.
- 3.5.5 Five pipe diameters upstream of the CBV shall be free from any fittings..
- 3.5.6 Two pipe diameters downstream of the CBV shall be free from any fittings.
- 3.5.7 Install such that easy and unobstructed access to the valve handwheel and metering port for adjustment and measurement is provided. Handwheel shall be in the horizontal 90 degree position.
- 3.5.8 Mounting in valve in piping must prevent sediment build-up in metering ports.
- 3.5.9 Mark up set of as-built drawings indicating balanced flow value and CBV setting.
- 3.5.10 Label ceiling grid at all CBVs concealed above ceilings.

3.6 Pressure Reducing Valve

- 3.6.1 Install as per manufacturer's recommendations.
- 3.6.2 Install in vertical position only.

3.7 Relief Valves

- 3.7.1 Provide relief valves at pressure tanks, low pressure side of reducing valves, heating convertors, expansion tanks and where indicated.
- 3.7.2 Pipe relief valve to nearest floor drain.
- 3.7.3 System relief valve capacity shall equal make up pressure reducing valve capacity. Equipment relief valve capacity shall exceed input rating of connected equipment.
- 3.7.4 Where one line vents several relief valves, cross sectional area shall equal sum of individual vent areas.

3.8 Drain Valves

- 3.8.1 Provide ball valves for drains on open systems.
- 3.8.2 Provide unions downstream of the valve to allow breaking the piping system.
- 3.8.3 Provide hose thread connection on drain valve and piping.

3.9 Double Check Valve Assembly

- 3.9.1 Install reduced pressure double check valve assembly to isolate domestic system from hydronic system, where indicated on drawings and as required by code.
- 3.9.2 Install double check valve assembly at no more than 1.5m (5') above finished floor and to allow a minimum of 1m (40") clearance above the device for connection and operation of testing equipment.
- 3.9.3 Pipe overflow to drain with air gap.
- 3.9.4 Provide shutoff valves and unions on both sides of double check valve assembly for testing purposes.

3.10 Strainers

- 3.10.1 Install on the inlet of all pumps.
- 3.10.2 Install on the inlet of all coils.

END OF SECTION

1 GENERAL**1.1 Quality Assurance**

- 1.1.1 Domestic water pipe supports shall meet the requirements of Ontario Building Code.
- 1.1.2 Natural gas pipe supports shall meet the requirements of CGA B149.1, Gas Installation Code.
- 1.1.3 Hydronic water pipe supports shall meet the requirements of ANSI B31.
- 1.1.4 Duct hangers shall follow the recommendations of the SMACNA Duct Manuals.

1.2 General Requirements

- 1.2.1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade and provide for expansion and contraction.
- 1.2.2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
- 1.2.3 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
- 1.2.4 Obtain approval prior to drilling for inserts and supports for piping systems.
- 1.2.5 Obtain approval prior to using percussion type fastenings.
- 1.2.6 Use of other piping or equipment for hanger supports is not permitted.
- 1.2.7 Use of perforated band iron, wire or chain as hangers is not permitted.

1.3 1.3 Firestop Sealants and Collars

- 1.3.1 Standard method of fire tests of firestop system CAN4-S115-M85.
- 1.3.2 UL Classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (UL1479).
- 1.3.3 Seals, assemblies and materials for penetration of fire rated surfaces shall be listed by FM and certified by UL or ULC for the service application.

1.4 Submittals

- 1.4.1 Firestop materials: Submit service limitations, installation instructions, UL certification and FM listing.

- 1.4.2 Fire rated penetration seals: Submit dimensional data, service limitations, installation instructions, UL certification and FM listing.

2 PRODUCTS

2.1 Inserts

- 2.1.1 Inserts shall be malleable iron case or galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.

- 2.1.2 Size inserts to suit threaded hanger rods.

2.2 Suspended Mechanical Equipment:

- 2.2.1 Suspend mechanical equipment from structure with adjustable length steel rods, threaded both ends or continuous threaded, complete with lock nuts on both ends. Provide spreader beams to distribute weight.

- 2.2.2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

- 2.2.3 Provide anchors, bolts and accessories required for mounting and anchoring equipment.

2.3 Pipe Hangers and Supports

- 2.3.1 Pipe hangers shall wrap around outside of insulation for all sizes, except in limited ceiling clearance applications. Piping shall be provided with insulation flashing of heavy gauge metal to prevent crushing and hanger sized for exterior of insulation.

- 2.3.2 Hangers:

- .1 Pipe Sizes 13mm (½") to 38mm (1½"): Adjustable wrought steel ring, or plated strap.
- .2 Pipe Sizes 50mm (2") and over: Adjustable wrought steel clevis.
- .3 Hanger Rods: Provide steel hanger rods, threaded both ends or continuous threaded, complete with lock nuts on both ends.
- .4 Saddles shall wrap around the outside of the insulation for all piping and be sized accordingly.
- .5 In limited ceiling clearance applications for pipe sizes up to and including 38mm (1½"), split ring standoff hangers or adjustable band hangers shall be acceptable. Obtain pre-approval from Consultant prior installation on site.

- .6 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe sizes 150mm (6 ") and over.
- .7 Wall Support:
- .8 Pipe Sizes to 75mm (3"): Cast iron hook, or fabricated bracket of 1"x1"x¼" angle bar.
- .9 Pipe Sizes 100mm (4") and over: Welded steel bracket and wrought steel clamp.
- .10 Vertical Support:
- .11 Steel riser clamp.
- .12 Floor Support:
- .13 Fabricated stand and pipe clamp or saddle.

2.4 Natural Gas Piping Roof Supports

2.4.1 Gas pipe support systems shall be continuous block channel supports equal to "DURA-BLOK" DB-Series or DB6-Series as supplied by Cooper B-Line, Inc.

2.4.2 Alternate products must meet or exceed the same physical and performance characteristics as per the following:

- .1 Density: 0.52 oz/cu in ASTM C642
- .2 Durometer Hardness: 67.2A ± 1 ASTM D2240
- .3 Tensile Strength: 231 psi minimum ASTM D412
- .4 Compression Deformation: 5% at 70psi and 72°F ASTM D395
- .5 Brittleness at Low Temp: -50°F ASTM D746
- .6 Freeze and thaw when exposed to deicing chemicals: No loss after 50 cycles ASTM C672
- .7 Coefficient of Thermal Expansion: 8 x 10⁻⁶ in/in/°F (min) ASTM C531
- .8 Weathering: 70 hours at 120°F ASTM D573
- .9 Hardness retained: 100% (±5%)
- .10 Compressive strength: 100% (±5%)
- .11 Tensile strength: 100% (±5%)

.12 Elongation retained: 100% ($\pm 5\%$)

2.4.3 Curb base shall be made of 100% recycled rubber and polyurethane prepolymer with a uniform load capacity of 500 pounds per linear foot of support. Each base to have a reflective yellow stripe.

2.4.4 Dimensions: 6-inches wide by 5/6.75 inches tall by 9.6/20.2/30.8/41.4/52.0 inches long to suit pipe size.

2.4.5 Steel frame: Steel, 14ga strut galvanized per ASTM A653 or 12ga strut galvanized per ASTM A653 for bridge series.

2.4.6 Attaching hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633.

2.5 Duct Hangers and Supports

2.5.1 . Hangers:

.1 Concealed - Round Duct: Galvanized steel band iron.

.2 Concealed - Rectangular Duct: Galvanized steel band iron or rolled angle and 9mm rods.

.3 Exposed - Round Duct: continuous galvanized steel band iron secured to single 9mm (1/4") hanger rod.

2.5.2 Wall Supports: Galvanized steel band iron or fabricated angle brackets.

2.5.3 Vertical Support at Floor: Rolled angle.

2.5.4 Support rectangular ducts 1530mm and less in width or depth with 25mm wide 1.3mm or heavier galvanized bent hangers fastened to the side and bottom of the duct at a spacing of not greater than 2240mm using bolts, rivets, or metal screws.

2.5.5 Support duct over 1530mm in width or depth with 10mm vertical hanger rods, bolted to galvanized steel angles at 610mm intervals.

2.5.6 Support round ducts up to 910mm with 25mm wide, 1.0mm thick single galvanized steel traps and 9mm diameter rods. Support larger ducts with 25mm wide, 1.6mm thick double, horizontally split galvanized steel strap and two (2) 9mm diameter rods. Space support at 3600mm intervals.

2.5.7 Where vertical ducts pass through floors, support with galvanized steel angles riveted and/or bolted to the cut and bearing on the structure.

2.6 Equipment Bases and Curbs

- 2.6.1 Equipment bases and curbs shall be provided by the Mechanical Contractor under this Division.
- 2.6.2 Equipment bases shall be formed concrete housekeeping pads minimum 100mm (4") high, extended 150mm (6") minimum beyond machinery bedplates.
- 2.6.3 Provide mounting plates to be formed into pads.
- 2.6.4 Curbs shall be formed concrete minimum 100mm (4") high around all ducts and pipes through mechanical room floors.

2.7 Flashing

- 2.7.1 Steel Flashing: 26 gauge galvanized steel.
- 2.7.2 Aluminum flashing: 26 gauge sheet aluminum.

2.8 Firestop Sealants and Collars

- 2.8.1 Firestop Sealants and collars for penetrations utilizing nonmetallic cables or combustible pipe insulations as the penetrant.
- 2.8.2 Intumescent insert: Flexible, elastomeric strip, two stage expansion, designed to firestop penetrations in fire-rated walls and floors and floor/ceiling assemblies.
- 2.8.3 Provide a minimum of 15 time free expansion.
- 2.8.4 Contain no water soluble expansion ingredients.

2.9 Roof Jacks

- 2.9.1 Aluminum: Compatible with SBS torch down roofing materials and methods, 12 gauge aluminum, 12mm round flange, oversize tube neck TIG welded to flange, aluminum flashing cap.

3 EXECUTION**3.1 Inserts**

- 3.1.1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
- 3.1.2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100mm (4") or ducts over 1500mm (60") wide.

- 3.1.3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
- 3.1.4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.
- 3.1.5 Expansion bolt type connections will be approved under certain conditions. Obtain approval from the Consultant. Generally, pipe 50mm (2") or smaller, and ducts less than 600mm x 300mm (24" x 12") will be approved, subject to adequate number of support points.

3.2 Suspended Mechanical Equipment:

- 3.2.1 Suspend mechanical equipment from structure with adjustable length steel rods. Provide spreader beams to distribute weight.
- 3.2.2 The threaded rod shall be secured to trusses or to steel angle bars spanning the building trusses. The steel spanning bars are to be provided by this Division.
- 3.2.3 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- 3.2.4 Provide anchor bolts and accessories required for mounting and anchoring equipment.
- 3.2.5 Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment.

3.3 Pipe Hangers and Support

- 3.3.1 Fasten hangers and supports to building structure or inserts in concrete construction.
- 3.3.2 Support horizontal metallic piping as follows:

<u>Nominal Pipe Size</u>	<u>Distance Between Supports</u>	<u>Hanger Rod Diameter</u>
13mm (½")	1.8m (6')	9.5mm (⅜")
19 to 38mm (¾" to 1½")	2.4m (8')	9.5mm (⅜")
50 to 63mm (2" to 2½")	3.0m (10')	9.5mm (⅜")
63 to 100mm (3" to 4")	3.6m (12')	13mm (½")
150 to 300mm (6" to 12")	4.3m (14')	13mm (½")

350 to 450mm (14" to 18") 5.0m (16')

25mm (1")

- 3.3.3 Install hangers to provide minimum 32mm (1¼") clear space between finished covering and adjacent work.
- 3.3.4 Place a hanger within 300mm (12") of each horizontal elbow.
- 3.3.5 Use hangers which are vertically adjustable 38mm (1½") minimum after piping is erected.
- 3.3.6 Support vertical piping at every floor.
- 3.3.7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- 3.3.8 Where practical, support riser piping independently of connected horizontal piping.
- 3.3.9 Exposed piping, with less than 2.6m (8½ ft) clearance to floors shall be provided with two times the number of hangers normally required. Spacing shall be equal or adjusted for maximum benefit.
- 3.3.10 Provide copper plated hangers and supports for copper piping or provide nonferrous packing between hanger support and piping.
- 3.3.11 Large capacity piping with vibration potential shall not be suspended from any building structure that will allow transfer of vibrations to the occupied spaces.
- 3.3.12 Obtain preapproval from Consultant for the use of split ring standoff hangers or adjustable band hangers for use in limited ceiling clearance applications only. Hanger shall not be required to wrap around outside of insulation in this application only.

3.4 Natural Gas Piping Roof Supports

- 3.4.1 Install in accordance with manufacturer's instructions and recommendations.
- 3.4.2 If gravel top roof, gravel must be removed around and under pipe support.
- 3.4.3 Where possible, consult roofing manufacturer for roof membrane compression capacities. If necessary, a compatible sheet of roofing material (rubber pad) may be installed under rooftop support to disperse concentrated loads and add further membrane protection.
- 3.4.4 Space in conformance with Gas Code and local authorities.
- 3.4.5 Use properly sized clamps to suit pipe sizes.

3.5 Duct Hangers and Supports

3.5.1 Hanger minimum sizes:

- .1 Up to 750mm (30") wide or 330mm (13") diameter: 1¼" x 16 gauge at 3m (10ft) spacing.
- .2 750mm (30") to 1200mm (48") wide or up to 450mm (18") diameter: 1½" x 16 gauge at 3m (10ft) spacing.
- .3 Over 1200mm (48") wide: 1½" x 16 gauge at 3m (10ft) spacing.

3.5.2 Horizontal duct on wall supports minimum sizes:

- .1 Up to 450mm (18") wide: 1½" x 16 gauge or 1" x 1" x 1/8" at 3m (10') spacing.
- .2 450mm (18") to 1000mm (40") wide: 1½" x 1½" x 2" at 1.8m (6') spacing.

3.5.3 Vertical duct on wall supports minimum sizes:

- .1 Riveted or screwed to duct:
 - .1 Up to 1500mm (60") wide: 1½" x 1½" x 3"
 - .2 Over 1500mm (60") wide: 2" x 1/8"

3.5.4 Vertical duct floor supports minimum sizes:

- .1 Riveted or screwed to duct:
 - .1 Up to 1500mm (60") wide: 1½" x 1½" x 1/8"
 - .2 Over 1500mm (60") wide: 2" x 2" x 1/8"

3.6 Equipment Bases and Curbs

3.6.1 Coordinate installation of concrete housekeeping pads for all new floor mounted equipment with supplied equipment.

3.6.2 Pads shall be 100mm (4") high minimum, extended 150mm (6") minimum beyond machinery bedplates. Obtain templates, anchor bolts and accessories required for mounting and anchoring equipment.

3.6.3 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

3.6.4 Provide rigid anchors for pipes immediately after vibration connections to equipment.

3.6.5 Provide curbs around all ducts and pipes through mechanical room floors.

3.6.6 Paint all concrete equipment bases with two (2) coats of yellow paint.

3.7 Flashing

3.7.1 Where mechanical equipment passes through weather or waterproofed walls and roofs, roofing, flashing and counter flashing shall be provided under this Division.

3.7.2 Curbs must be minimum 600mm (24") higher than the top of the roof, unless noted otherwise. Flash and counterflash with galvanized steel, to make waterproof.

3.7.3 Flash floor drains over finished areas by extending flashing 250mm (10") clear on sides. Fasten flashing to drain clamp device. Use lead sheet or approved nonmetallic waterproofing membrane.

3.8 Firestop Sealants and Collars

3.8.1 Clean all concrete, masonry and stone penetrations of all contaminants and impurities, concrete form release agents, water repellents, oils, surface dirt and rust, scale, all old sealants and other surface treatments.

3.8.2 Metal surfaces shall be cleaned by wiping them with an oil- free absorbent cloth saturated with solvent such as xylol or toluol. Do not use alcohols.

3.8.3 Do not apply to polycarbonates or to building materials that bleed oils, plasticizers or solvents, or where sealant is not exposed to atmospheric moisture, or to surfaces which have been or will be painted.

3.8.4 Collars are to be installed with steel fasteners or steel expansion anchors. Low melting temperature anchors of lead, plastic or aluminum are not approved.

3.8.5 Installation only when temperatures are between 4°C (40°F) and 37°C (98°F).

3.9 Roof Jacks

3.9.1 Provide roof jacks as required, and in compliance with the roofing specifications. Generally, SBS torch down roofing requires aluminum roof jacks. Conventional bituminous roofing accepts lead or aluminum roof jacks.

3.9.2 Flash pipes projecting above finished roof surface with approved material.

3.9.3 Gas pipes projecting through the roof shall be provided with approved roof jack and flashing flange.

END OF SECTION

1 GENERAL

1.1 References

1.1.1 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-1.60-M89, Interior Alkyd Gloss Enamel.
- .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.1.2 Canadian Standards Association (CSA)

- .1 Natural Gas Installation Code CSA B149.1-00

1.2 Product Data

- 1.2.1 Submit product data in accordance with Division 1
- 1.2.2 Product data to include paint colour chips, all other products specified in this section.

1.3 Product Literature

- 1.3.1 Submit product literature in accordance with Division 1.
- 1.3.2 Product literature to include nameplates, labels, tags, lists of proposed legends.

2 PRODUCTS

2.1 Manufacturer's Equipment Nameplates

- 2.1.1 Metal or plastic lamacoid nameplate mechanically fastened to each piece of equipment by manufacturer.
- 2.1.2 Lettering and numbers to be raised or recessed.
- 2.1.3 Information to include, as appropriate:
 - .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 System Nameplates

- 2.2.1 Colours:
 - .1 Hazardous: red letters, white background

- .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes)

2.2.2 Construction:

- .1 3mm (1/8") thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

2.2.3 Sizes:

- .1 Conform to the following table:

Size	Dimensions mm (")	No. of Lines mm (")	Height of Letters mm (")
1	10 x 50 (3/8" x 2")	1 (3/64")	3 (1/8")
2	15 x 75 (1/2" x 3")	1 (3/64")	6 (1/4")
3	15 x 75 (1/2" x 3")	2 (5/64")	3 (1/8")
4	20 x 100 (3/4" x 4")	1 (3/64")	10 (3/8")
5	20 x 100 (3/4" x 4")	2 (6/64")	6 (1/4")
6	20 x 200 (3/4" x 8")	1 (3/64")	10 (3/8")
7	25 x 125 (1" x 5")	1 (3/64")	15 (1/2")
8	25 x 125 (1" x 5")	2 (5/64")	10 (3/8")
9	32 x 200 (1-1/4" x 8")	1 (3/64")	20 (3/4")

- .2 Use maximum of 25 letters/numbers per line.

.3 Locations:

- .1 Terminal cabinets, control panels: Use size #5.
- .2
- .3 Equipment in Mechanical Rooms: Use size #9.
- .4
- .5 Rooftop equipment: Use size #9.

- .6 Equipment above ceiling: Use size #1 riveted to ceiling suspension system.

2.3 Piping Systems Governed by Code

2.3.1 Natural Gas:

- .1 Natural gas: To CSA B149.1 and authority having jurisdiction and as indicated elsewhere.
- .2 Gas piping shall be painted with 2 coats around complete circumference of piping. Use of bands or markers is not acceptable.
- .3 Paint indoor gas piping with **2 coats** of yellow paint.
- .4 Paint outdoor gas piping with **2 coats** of weatherproof paint.
- .5 Colour to match building colour where visible from meter and to be yellow where not visible from meter (i.e. roof).
- .6 Yellow colour shall be Benjamin Moore Metal & Wood Alkyd Enamel (K133) Safety Yellow #343.
- .7 Provide labels on any gas piping of any pressure over 14" (i.e. 2LB, 5LB, etc.)

2.4 Identification of Piping Systems

- 2.4.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

2.4.2 Legend:

- .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.

2.4.3 Arrows showing direction of flow:

- .1 Outside diameter of pipe insulation less than 75 mm (3"): 100 mm (4") long x 50 mm (2") high.
- .2 Outside diameter of pipe or insulation 75 mm (3") and greater: 150 mm (6") long x 50 mm (2") high.
- .3 Use double-headed arrows where flow is reversible.

2.4.4 Extent of background colour marking:

- .1 To full circumference of pipe or insulation.
- .2 Length to accommodate pictogram, full length of legend and arrows.

2.4.5 Materials for background colour marking, legend, arrows:

- .1 Pipes and tubing 20 mm (3/4") and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
- .2 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating suitable for ambient of 100% RH and continuous operating temperature of 150°C (300°F) and intermittent temperature of 200°C (395 °F).

2.4.6 Colours and Legends:

- .1 Where not listed, obtain direction from Consultant.

- .1 Colours for legends, arrows:

<u>Background colour</u>	<u>Legend</u>	<u>Arrows</u>
Yellow	White	Black
Green	White	Black
Red	White	Black

2.5 Concrete Pads for Mechanical Equipment

- 2.5.1 The General Contractor shall paint tops and sides of all concrete pads for mechanical equipment with two (2) coats of yellow paint.

2.6 Identification Ductwork Systems

- 2.6.1 50mm (2") high stenciled letters and directional arrows 150 mm (6") long x 50 mm (2") high.

- 2.6.2 Colours: Black, or coordinated with base colour to ensure strong contrast.

2.7 Valves, Controllers

- 2.7.1 Brass tags with 15mm (1/2") stamped identification data filled with black paint.
- 2.7.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
- 2.7.3 Provide coloured adhesive label indication on ceiling grid to locate valves/equipment above. Label description to match device. Size, colour and description to be pre-approved by Consultant. Provide red dots for heating and chilled water piping, yellow dots for gas valves and green dots for any balancing dampers.

2.8 Controls Components Identification

- 2.8.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- 2.8.2 Inscriptions to include function and (where appropriate) fail-safe position.
- 2.8.3 Provide yellow adhesive label indication on ceiling grid to locate control devices above. Label description to match device. Size and description to be pre-approved by Consultant.

2.9 Mechanical Ceiling Components Identification

- 2.9.1 Identify all other mechanical components in ceiling space with system nameplates specified in this section.
- 2.9.2 Inscriptions to include description.
- 2.9.3 Provide lamacoid nameplate or adhesive label indication on ceiling grid to locate component above. Label description to match device. Size and description to be pre-approved by Consultant.

2.10 Language

- 2.10.1 Identification to be in English.

3 PART 3 - EXECUTION**3.1 Timing**

- 3.1.1 Provide identification only after all painting specified has been completed.

3.2 Installation

- 3.2.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- 3.2.2 Provide ULC and/or CSA registration plates as required by respective agency.

3.3 Nameplates

- 3.3.1 Locations:
- 3.3.2 In conspicuous location to facilitate easy reading and identification from operating floor.
- 3.3.3 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.

3.3.4 Protection:

- .1 Do not paint, insulate or cover in any way.

3.4 Location of Identification on Piping and Ductwork Systems

- 3.4.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels not more than 1.7 m (5'-8") intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- 3.4.2 Adjacent to each change in direction.
- 3.4.3 At least once in each small room through which piping or ductwork passes.
- 3.4.4 On both sides of visual obstruction or where run is difficult to follow.
- 3.4.5 On both sides of separations such as walls, floors, partitions.
- 3.4.6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
- 3.4.7 At beginning and end points of each run and at each piece of equipment in run.
- 3.4.8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- 3.4.9 Identification to be easily and accurately readable from usual operating areas and from access points. Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 Valves, Controllers

- 3.5.1 Valves and operating controllers, except at radiation or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or close "S" hooks.
- 3.5.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- 3.5.3 Number valves in each system consecutively.

END OF SECTION

1 GENERAL

1.1 Quality Assurance

1.1.1 Test equipment and material where specified required by authorities having jurisdiction to demonstrate its proper and safe operation.

1.1.2 Test procedures shall be in accordance with applicable portions of:

- .1 Canadian Gas Association (CGA)
- .2 Ontario Building Code
- .3 National Fire Protection Association (NFPA)
- .4 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .5 Sheet Metal and Air Conditioning National Association (SMACNA)
- .6 American Society of Mechanical Engineers
- .7 Ontario Ministry of Health
- .8 Local codes and ordinances
- .9 Other recognized test codes

1.1.3 Provide additional tests and re-testing as required and requested by the Consultant or Owner.

1.2 Submittals

1.2.1 Obtain certificates of approval and acceptance from authorities having jurisdiction and include in Operating and Maintenance Manuals.

1.2.2 On completion of mechanical installation, provide certification of tests with detailed data as required. Itemize tests as to time performed and personnel responsible. Include a copy of field data in Operating and Maintenance Manuals.

1.3 Liability

1.3.1 During tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration.

2 PRODUCTS

- 2.1.1 All equipment and products necessary to perform tests shall be covered under this Division at no cost to the Owner.

3 EXECUTION**3.1 Pressure Tests**

- 3.1.1 Piping, fixtures or equipment shall not be concealed or covered until inspected and approved by the Consultant.
- 3.1.2 Provide equipment, materials and labour for tests. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy.
- 3.1.3 Test equipment and material where specified required by authorities having jurisdiction to demonstrate its proper and safe operation.
- 3.1.4 Provide four (4) days notice to the Consultant before tests.
- 3.1.5 Carry out hydraulic tests for eight (8) hours and maintain pressure. Where leakage occurs, repair and retest.
- 3.1.6 Natural Gas Piping: Conduct a 1 hour test of all gas piping systems up to 11" pressure and a 24 hour chart test at 50 psi of all gas piping systems over 11" pressure. The Contractor shall perform a soap test and electronic test. Arrange and pay for a gas inspection by the local TSSA Inspector.
- 3.1.7 Hydronic Piping: Test to 1-1/2 times maximum working pressure or minimum 1034 kPa (150 psi).

3.2 Equipment Tests

- 3.2.1 Perform testing of all equipment as per manufacturer's recommendations and requirements under full operational ranges and submit reports.
- 3.2.2 Use the services of a qualified Technician and submit report.

3.3 Test Reports

- 3.3.1 Submit all test reports to Consultant as specified herein within one (1) week of each test completion.
- 3.3.2 Include a copy of all test reports in the manuals.

END OF SECTION

1 GENERAL

1.1 Work Included

1.1.1 Balancing will be carried out by a Balancing Agent as arranged by Division 01..

1.1.2 All costs for balancing will be covered by the Owner.

END OF SECTION

1 GENERAL**1.1 Work Included**

1.1.1 Thermal duct insulation

1.1.2 Acoustic duct insulation

1.1.3 Recovering jacket

1.2 Quality Assurance

1.2.1 All workers engaged in the application of insulation shall be journeymen, or indentured apprentices working under a journeyman who is on the site.

1.3 Job Conditions

1.3.1 Deliver material to job site in original nonbroken factory packaging, labeled with manufacturer's density and thickness.

1.3.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.4 Material Test Criteria

1.4.1 Insulation, adhesives, coatings, finishes, sealers, and tapes:

- .1 maximum flame spread rating of 25 to CAN/ULC-S102,
- .2 maximum smoke developed rating of 50 to CAN/ULC-S102.
- .3 Exception: vapor barrier mastics installed outside of building.

2 PART 2 - PRODUCTS**2.1 General**

2.1.1 Adhesives, Insulation, Coatings, Sealers and Recovering Jackets shall have composite fire and smoke hazard ratings not exceeding 25 for flame spread and 50 for smoke developed.

2.1.2 Adhesives, coatings and sealers shall be waterproof.

2.2 Thermal Duct Insulation

2.2.1 Insulation shall be precovered, preformed insulation complete with foil or kraft all purpose jacket unless otherwise noted.

2.2.2 Use 25 millimeter (1 inch) thick insulation unless otherwise noted.

2.2.3 Exposed Rectangular Ducts: Rigid fibrous glass insulation, "K" value at 0.24 BTU per inch per square foot per degree Fahrenheit per hour with factory applied reinforced aluminum foil vapour barrier.

2.2.4 Round Ducts and Concealed Rectangular Ducts: Flexible fibrous glass insulation, "K" value at 0.26 BTU per inch per square foot per degree Fahrenheit per hour with factory applied reinforced aluminum foil vapour barrier.

2.2.5 Recovering Jackets (Interior): U.L.C. listed "Thermo Canvas", treated cotton fabric. Alternatively, U.L.C. listed PVC recovering jacket. PVC recovering jacket shall be suitable for use in plenum (flame spread and smoke developed ratings)

2.2.6 Acceptable Manufacturers:

- .1 Fibreglass Canada
- .2 Knauf
- .3 Mason
- .4 Owens Corning
- .5 Johns Manville

2.3 Thermal Duct Insulation – Exterior to Building

2.3.1 Insulation: 3.0 PCF density, 50mm (2") thick rigid fiberglass insulation board with factory applied fsk facing. Equal to Knauf insulation board with ecose technology.

2.3.2 Jacket: Weatherproof flexible jacket equal to Alumaguard 60.

2.4 Acoustic Duct Insulation

2.4.1 Fiberglass insulation with "K" value at 0.26 b.t.u. per inch per square foot per degree Fahrenheit per hour absolute roughness of exposed surface not to exceed 0.033 millimeters coated to prevent fibre erosion at air velocities up to 400 f.p.m.

2.4.2 All substrate material to be non-darkened, contrasting colour from liner layer.

2.4.3 Use 25 millimeter (1 inch) thick insulation unless otherwise noted.

3 EXECUTION

3.1 Preparation

3.1.1 Do not install covering before ductwork and equipment has been tested and approved.

3.1.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 Installation - General

3.2.1 In non fire rated surfaces, ensure insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation material properly sealed.

3.2.2 Finish insulation neatly at hangers, supports and other protrusions.

3.2.3 Locate insulation or cover seams in least visible locations.

3.3 Thermal Duct Insulation

3.3.1 Provide insulation on:

- .1 All new supply air ductwork, except where internally insulated.
- .2 All new exhaust air ductwork within 2.4 meters (8 feet) of insulated surface penetration, including plenums
- .3 All return air ducts within unconditioned spaces
- .4 All outside air ducts and plenums between exterior walls and air handling units, including plenums

3.3.2 Exposed Rectangular Ducts: Secure rigid insulation with 50 percent coverage of adhesive and 12 gauge galvanized impale anchor tabs on 400 millimeter (16 inch) centres. Seal joints with 100 millimeter (4 inch) wide foil tape.

3.3.3 Round Ducts and Concealed Rectangular Ducts: Adhere flexible insulation to ductwork with adhesive applied in 150 millimeter (6 inch) wide strips on 400 millimeter (16 inch) centres. Provide 16 gauge annealed tie wire, or polypropylene twine, spiral wound or half hitched at 100 millimeter (4 inch) centres for securing duct insulation until adhesive sets. Butt insulation and seal joints and breaks with 100 millimeter (4 inch) foil tape.

3.4 Acoustic Duct Insulation

3.4.1 Apply to interior of:

- .1 First 1.5m (5') of supply AND return ducts on inlet and discharge of air handling units.
- .2 Transfer ducts and elbows.
- .3 As indicated on drawings.

3.4.2 Secure to ductwork with adhesive using 50 percent coverage and 12 gauge impale anchor tabs on 400 millimeter (16 inch) centres. Cut off excess fastener length and cover with brush coat of sealer.

3.4.3 Shop fabrication cuts shall be coated with J.M.'s SuperSeal Duct Butter and Edge Treatment products.

3.5 Canvas Recovering Jacket

3.5.1 Provide recovering jackets on exposed insulation throughout including but not limited to Mechanical Rooms.

3.5.2 Coat recovering jacket with two coats of waterproof fire retardant coating.

3.5.3 Alternatively, provide PVC recovering jacket on all exposed insulation.

END OF SECTION

1 GENERAL

1.1 Scope

- 1.1.1 Provide a complete installation of a Carbon Monoxide/Nitrogen Dioxide (CO /NO2) toxic gas detection system including stand-alone dual point capable transmitters and audible/visual alarm devices that can monitor two different CO/NO2 gas sensors.
- 1.1.2 The system shall include, but not be limited to, the following:
 - .1 Future expandability
 - .2 Display of toxic gas concentration
 - .3 Ability to modify alarm set points
 - .4 Automatic and manual fan start/stop
 - .5 Display of alarm status

2 PRODUCTS

2.1 Detectors

- 2.1.1 E³Point by Honeywell Analytics
- 2.1.2 Transmitter will be powered by 24 V AC/DC an 120 Vac. The gas transmitter must be capable of monitoring a second gas detection point when equipped with an E3SRM remote sensor. The gas transmitter will incorporate a gas specific electrochemical cell for toxic gas monitoring. Unit sensing cell must compensate for variations in relative humidity and temperature to maintain high levels of accuracy.
- 2.1.3 The transmitter will be capable of transmitting gas concentrations to a DDC system through its 4-20 mA output. For local activation of fans or louvers (or other equipment), two on-board DPDT relays 5 A, 30 Vdc or 250 Vac (resistive load) will be activated at programmable set points (and programmable time delays). An LCD display will provide local gas concentration readings.
- 2.1.4 Transmitter will be capable of operating within relative humidity ranges of 5-95% non-condensing and temperature ranges of -4° F to 104° F (-20° C to 40° C).
- 2.1.5 Unit will be certified to ANSI/UL 61010-1 label and CAN/CSA-C22.2 No. 61010-1. Transmitter must be manufactured in an ISO 9001-2000 production environment.
- 2.1.6 The transmitter should have a plug-in capability for a gas cartridge with a smart sensor capable of self-testing to ensure sensor operation.

2.1.7 For local activation of audible alarms, the transmitter shall have an on-board device able to generate an audible output of 85 dBA @ 10 ft (3m).

2.1.8 Detector alarm levels are to be activated and the unit is to be installed in accordance with the following parameters:

GASES	1st ALARM SET POINT (TLV-TWA)	2nd ALARM SET POINT (TLV-STEL)	MOUNTING HEIGHT	COVERAGE RADIUS
Carbon Monoxide (CO)	25 PPM	100 PPM	900mm – 1200mm (3ft – 4 ft) above finished floor	15 meters (50 ft)
Nitrogen Dioxide(NO ₂)	0.7 PPM	2 PPM	300mm – 1000mm (1ft – 3 ft) From ceiling	15 meters (50 ft)

2.1.9 Local Building Codes recommendations take precedence over these parameters. Coverage can differ depending on application

2.2 Accessories

2.2.1 Detector Guards E3PT- GUARD

- .1 The protective grid is made of a 9-gauge steel wire. The guard must be designed to allow calibration without removing the guards.

3 EXECUTION

3.1 Installation

- 3.1.1 Install hazardous gas monitoring equipment including sensors, audible alarms, as specified and as shown on Contract Drawings, and as recommended by manufacturer of equipment, and as required by authorities having jurisdiction.
- 3.1.2 Install conduit and wiring from sensors to control panel and to the Fan, dampers, HVAC control panel as recommended by manufacturer of equipment.

3.2 Sequence of Operation

3.2.1 Level Alarm

- .1 If any Carbon Monoxide (CO) sensor point detects 25 PPM gas, fans operate and dampers open. Low Alarm LED lights for point in alarm.
- .2 If any Nitrogen Dioxide (NO₂) sensor point detects 0.7 PPM gas, fans operate and dampers open. Low Alarm LED lights for point in alarm.

3.2.2 High Level Alarm

- .1 If Carbon Monoxide (CO) gas concentration levels continue to rise and any sensor detects 100 PPM gas, with ventilation contacts continuing to operate, the unit Audible Alarm sounds and High Alarm indicator lights on the main unit display.
- .2 If Nitrogen dioxide (NO₂) gas concentration levels continue to rise and any sensor detects 2 PPM gas, with ventilation contacts continuing to operate, the unit Audible Alarm sounds and High Alarm indicator lights on the main unit display

3.3 Commissioning

- 3.3.1 After installation, test and calibrate equipment to demonstrate operation of functions described above under sequence of operation by manufactures certified service technician

3.4 Warranty

3.4.1 Limited Warranty

- .1 Honeywell Analytics, Inc. warrants to the original purchaser and/or ultimate customer ("Purchaser") of Vulcain products ("Product") that if any part thereof proves to be defective in material or workmanship within twelve (12) months, such defective part will be repaired or replaced, free of charge, at Honeywell Analytics' discretion if shipped prepaid to Honeywell Analytics at 4005 Matte Blvd., Unit G, Brossard, Quebec, Canada, J4Y 2P4, in a package equal to or in the original container. The Product will be returned freight prepaid and repaired or replaced if

it is determined by Honeywell Analytics that the part failed due to defective materials or workmanship. The repair or replacement of any such defective part shall be Honeywell Analytics' sole and exclusive responsibility and liability under this limited warranty.

END OF SECTION

1 GENERAL**1.1 Welding**

1.1.1 Welding materials and labour shall conform to ASME Code and the provincial Regulations.

1.1.2 Use welders fully qualified and licensed by Provincial Authorities.

1.2 Quality Assurance

1.2.1 Gas piping shall meet the requirements of the latest CSA Gas Installation Code.

1.2.2 Water piping shall meet the requirements of the Ontario Building Code and Municipal Codes.

1.2.3 Pipe fittings shall conform to the following standards:

- .1 ANSI B36.10, ASTM-197-47 (Materials)
- .2 ANSI B16.24, ANSI/ASME B16.15, ANSI B16.8, ANSI/ASME B16.22 (Copper Fittings)
- .3 ANSI B16.3 (Malleable Iron Fittings, Threaded)
- .4 ANSI B16.9 (Wrought Carbon Steel Fittings, Butt Weld)
- .5 ANSI B16.5 (Forged Carbon Steel Flanges, Threaded, Weld Neck or Slip-on)
- .6 ANSI B18.2.1 (Carbon Steel Bolts, Hex Head, Course Thread)
- .7 ANSI B18.2.2 (Carbon Steel Nuts, Heavy Hex, Course Thread)
- .8 ANSI B16.20 (Gaskets)
- .9 ANSI B16.39 (Unions)
- .10 CSA B242 [M1980(R1998)] (Groove and Shoulder Type Mechanical Pipe Couplings)

1.3 Reference Standards and Codes

1.3.1 Ontario Building Code

1.3.2 ASTM

1.3.3 CSA

- 1.3.4 CGA
- 1.3.5 ANSI
- 1.3.6 NFPA
- 1.3.7 ULC
- 1.3.8 Local Codes and Requirements

2 PRODUCTS

2.1 Hydronic Piping

- 2.1.1 Piping up to and including 2": Piping shall be Black Steel Schedule 40 with malleable steel threaded screwed fittings. Piping shall not be less than 3/4" (19mm) except as final connection to equipment with 1/2" (13mm) connections.
- 2.1.2 Piping 2½" and over: Piping shall be Black Steel Schedule 40 with welded fittings. **Grooved fittings are not acceptable.**
- 2.1.3 Brass adapters shall be provided at all connections between copper tubing and ferrous piping.
- 2.1.4 Provide expansion loops in piping systems as indicated on drawings and specified herein.

2.2 Condensate Piping

- 2.2.1 Black Steel Schedule 40 with malleable steel threaded screwed fittings or
- 2.2.2 Type K or L hard copper complete with cast brass or wrought copper drainage fittings with solder joints or
- 2.2.3 IPEX XFR.

2.3 Equipment Drains (except boiler breeching drains)

- 2.3.1 Galvanized steel schedule 40 with galvanized threaded fittings or
- 2.3.2 Type K or L hard copper complete with cast brass or wrought copper drainage fittings with solder joints or

2.4 Connections

- 2.4.1 Unions

- .1 Use extra heavy duty pattern unions with ground joints, brass seats and threads to ANSI B1.20.1 for connections 50mm (2") and under.
- .2 Rated for minimum 150 psi.

2.4.2 Flanges

- .1 Use standard weight type flanges to ANSI B16.1 with neoprene gaskets for connections 63mm (2½") and over.
- .2 Rated for minimum 125 psi.

2.4.3 Adapters

- .1 Brass adapters shall be provided at all connections between copper tubing and ferrous piping.

2.5 Firestop Sealants and Collars

- 2.5.1 Provide firestop sealants around all pipe penetrations through rated separations.
- 2.5.2 Provide firestop collars for all combustible pipe penetrations through rated separations (where combustible piping is approved).
- 2.5.3 Intumescent insert: Flexible, elastomeric strip, two stage expansion, designed to firestop penetrations in fire-rated walls and floors and floor/ceiling assemblies.
- 2.5.4 Provide a minimum of 15 time free expansion.
- 2.5.5 Sealants shall not contain water soluble expansion ingredients.

3 EXECUTION

3.1 General

- 3.1.1 Apply for permit before beginning any work. Have drawings approved for construction by authorities having jurisdiction or local agencies prior to beginning work.
- 3.1.2 Review all inverts and elevations before beginning any installation.
- 3.1.3 Pipe fittings for pipe up to and including 2" shall be malleable steel threaded. Pipe fittings for pipe 2½" and over shall be welded (grooved fittings are not acceptable). Piping shall not be less than ¾" (19mm) except as final connection to equipment with ½" (13mm) connections.
- 3.1.4 Have entire installation inspected, at various stages where required, to ensure approval at completion of project.

- 3.1.5 Provide clearance for proper installation of insulation and for access to components including but not limited to valves, air vents, drains and unions.
- 3.1.6 Maintain proper grades on piping for proper drainage and provide valves at all low points.
- 3.1.7 All exposed piping to run parallel to walls and in a neat and orderly fashion to maintain headroom. Group piping where possible.
- 3.1.8 Do not run combustible or non-approved pipe through fire separations or return air ceiling plenums. Use approved materials and methods only.
- 3.1.9 Provide drain valves and air vents at low and high points respectively where required.
- 3.1.10 All gas piping installations shall comply with CGA code CAN 1-B149, gas safety branch bulletins, local codes and NFPA 96. Provide a CGA approved ball valve where new equipment is to be connected.
- 3.1.11 Install gas piping in open or ventilated spaces. Pitch lines and provide drip legs for condensation collection points. Where gas piping is run in a concealed space, provide ventilation grilles as required.
- 3.1.12 Make connections to equipment with unions or flanges. Provide dielectric unions or couplings at all connections between copper tubing and ferrous piping or non-conducting type connections for jointing dissimilar metals.
- 3.1.13 Install piping to allow for expansion and contraction and to eliminate stress on equipment, piping, or connections.
- 3.1.14 Provide isolation valves or shutoff valves at all equipment.
- 3.1.15 Provide cleanouts as indicated on drawings and as required by code. Floor cleanouts are not approved in finished floor areas unless otherwise noted. Ensure adequate clearance to all cleanouts.
- 3.1.16 Provide sleeves for piping passing through floor slab. Caulk around piping and fill entire space between piping and floor slab with approved fire retardant material to maintain required fire rating where necessary.
- 3.1.17 Provide fire stop sealant at all pipe penetrations through fire separations.

3.2 Steel Pipe Connection

- 3.2.1 Screw joint steel piping up to and including 38mm (1½"). Screw or weld 50 mm (2") piping. Weld all piping 63mm (2½") and larger, including branch connections. Grooved piping is not acceptable.
- 3.2.2 Make screwed joints with standard NPT configuration. Use approved nontoxic joint compound or teflon tape.

3.2.3 Use full sized tees or main sized saddle type branch connections for directly connecting branch lines to mains in steel piping. Do not project branch pipes inside the main pipe.

3.2.4 Make reductions in large water pipes with eccentric reducing fittings installed to provide drainage and venting.

3.3 Grades, Routes and Installations

3.3.1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space.

3.3.2 Run exposed piping parallel to walls. Group piping wherever practical at common elevations.

3.3.3 Install concealed pipes close to the building structure to keep furrings to a minimum.

3.3.4 On closed systems, equip low points with 19mm ($\frac{3}{4}$ ") drain valves and hose connection.

3.3.5 At high points, provide collecting chambers and high capacity float operated automatic air vents.

3.4 Flashing

3.4.1 Flash all mechanical equipment passes through weather or waterproofed walls and roofs.

3.5 Sleeves

3.5.1 Provide and set sleeves required for piping.

3.5.2 Set sleeves in position in advance of other work. Provide suitable reinforcing around sleeves.

3.5.3 Extend sleeves through potentially wet floors 50mm above finished floor level. Caulk sleeves full depth and provide floor plate.

3.5.4 Where piping passes through floor, ceiling or wall, close off space between pipe and sleeve with noncombustible insulation or approved non-combustible insulation, fire rated as required to match the rating of the penetrated surface. Provide tight fitting metal caps on both sides.

3.5.5 Install chrome plated escutcheons where piping passes through finished surfaces including millwork.

3.5.6 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

3.6 Firestop Sealants and Collars

- 3.6.1 Clean all concrete, masonry and stone penetrations of all contaminants and impurities, concrete form release agents, water repellents, oils, surface dirt and rust, scale, all old sealants and other surface treatments.
- 3.6.2 Metal surfaces shall be cleaned by wiping them with an oil- free absorbent cloth saturated with solvent such as xylol or toluol. Do not use alcohols.
- 3.6.3 Do not apply to polycarbonates or to building materials that bleed oils, plasticizers or solvents, or where sealant is not exposed to atmospheric moisture, or to surfaces which have been or will be painted.
- 3.6.4 Collars are to be installed with steel fasteners or steel expansion anchors. Low melting temperature anchors of lead, plastic or aluminum are not approved.
- 3.6.5 Installation only when temperatures are between 4°C (40°F) and 37°C (98°F).

3.7 Identification

- 3.7.1 Identify all piping with type of service and arrows.
- 3.7.2 Refer to Section 23 05 53.

3.8 Testing

- 3.8.1 Test drains for tightness and grade as noted or required by code.
- 3.8.2 Refer to testing procedures in Section 23 05 92.

3.9 3.10 Cleaning and Treatment

- 3.9.1 Flush, clean and treat piping systems.

END OF SECTION

1 PART 1 – GENERAL

1.1 Work Included

- 1.1.1 Refrigeration piping
- 1.1.2 Insulation of refrigerant piping
- 1.1.3 Outdoor jacket for refrigerant piping

1.2 References

- 1.2.1 A.N.S.I./A.S.M.E. B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
- 1.2.2 A.N.S.I./A.S.M.E. B16.24, Cast Copper Pipe Flanges and Flanged Fittings.
- 1.2.3 A.N.S.I./A.S.M.E. B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
- 1.2.4 A.N.S.I./A.S.M.E. B31.5, Refrigeration Piping.
- 1.2.5 A.S.T.M. A307, Specification for Carbon Steel Bolts and Studs, 60,000psi Tensile.
- 1.2.6 A.S.T.M. B280, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- 1.2.7 C.S.A. B52, Mechanical Refrigeration Code.
- 1.2.8 E.P.S. 1/RA/1, Code of Practice for the Reduction of C.F.C.'s (Environment Canada).

2 PRODUCTS

2.1 General

- 2.1.1 All refrigerant piping and accessories shall be pressure rated for the refrigerant type and usage of the device or pipe.

2.2 Tubing

- 2.2.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to A.S.T.M. B280, type A.C.R.-B.
 - .2 Annealed copper: to A.S.T.M. B280, with minimum wall thickness as per C.S.A. B52 and A.N.S.I./A.S.M.E. B31.5.

2.3 Fittings

2.3.1 A.C.R. Copper

2.3.2 Brazed:

- .1 Fittings: wrought copper to A.N.S.I./A.S.M.E. B16.22.
- .2 Joints: silver solder, 45 percent A.g.-15 percent Cu or copper-phosphorous, 95 percent Cu-5 percent P. and non-corrosive flux.

2.4 Pipe Sleeves

- 2.4.1 Hard copper or steel, sized to provide 6 millimeter (1/4 inch) clearance all around between sleeve and un-insulated pipe or between sleeve and insulation.

2.5 Valves

- 2.5.1 Welded refrigerant ball valve, rated for the refrigerant and application. Full flow design, Bi-directional and shall be complete with valve stem cap. Min pressure rating 650 P.S.I.G.

2.6 Filter Drie

- .1 On lines 20 millimeters (3/4 inches) outside diameter and larger: replaceable core type. Provide isolation valves and Schrader fittings to allow filter drier to be isolated and refrigerant recovered during filter change.
- .2 On lines smaller than 20 millimeters (3/4 inches) outside diameter: sealed type, with Schrader valves on inlet and outlet of drier.
- .3 Filter drier shall be selected for the refrigerant and oil type. Working pressure shall be 680 P.S.I.G.
- .4 Size shall be full line size.

2.7 Sight Glass

- .1 Combination moisture and liquid indicator with protection cap.
- .2 Sight glass shall be full line size.
- .3 Sight glass connections shall be solid copper or brass, no copper-coated steel sight glasses allowed.

2.8 Suction Line Trap

- 2.8.1 Manufactured standard one-piece traps.

2.9 Expansion Valves

- 2.9.1 For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
- 2.9.2 Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.
- 2.9.3 T.X. valves shall be adjustable.

2.10 Roof Flashing

- 2.10.1 Thaler or equal spun aluminum complete with insulation, cap, and rubber gasket.

2.11 Piping Support Assembly

- 2.11.1 All channel members shall be fabricated from structural grade steel conforming to one of the following A.S.T.M. specifications: A. 570 G.R. 33, A .653 G.R. 33.
- 2.11.2 All fittings shall be fabricated from steel conforming to one of the following A.S.T.M. specifications: A. 575, A. 576, A. 36 or A. 635.
- 2.11.3 Electro galvanized cush clamps with shoulder bolt and molded thermoplastic cushion, size to suit pipe.
- 2.11.4 Acceptable materials:
 - .1 Unistrut
 - .2 Or equal

2.12 Insulation

- 2.12.1 T.I.A.C. Code A-6: Flexible unicellular tubular elastomer.
- 2.12.2 1" (25mm) thick.
- 2.12.3 Insulation shall be U.V. resistant. (Armaflex H.T.).

2.13 Insulation Jacket (Outdoor Piping only)

- 2.13.1 Aluminum:
 - .1 To ASTM B209
 - .2 Thickness: 0.5mm sheet.
 - .3 Finish: Corrugated.
 - .4 Joining: Longitudinal and circumferential slip joints with 50mm laps.

- .5 Fittings: 0.5mm thick die-shaped fitting covers with factory-attached protective liner.

2.13.2 Metal jacket banding and mechanical seals: Stainless steel, 19mm wide, 0.5mm thick at 300mm spacing.

2.13.3 3M Venture Clad Insulation Jacketing (or equal) is acceptable.

3 EXECUTION

3.1 General

3.1.1 Install in accordance with C.S.A. B52, E.P.S.1/R.A./1 and A.N.S.I./A.S.M.E. B31.5.

3.1.2 All refrigerant piping shall be reviewed by the equipment manufacturer it serves before installation.

3.1.3 Connect to equipment with isolating valves and unions.

3.1.4 Provide space for servicing, disassembly and removal of equipment and components all as recommended by manufacturer.

3.1.5 Protect all openings in piping against entry of foreign material.

3.1.6 Provide all necessary equipment including thermal expansion valve, sight glass, solenoid valve, filter drier, and etcetera for a complete installed system. Pipe system as per manufacturer's recommendations and requirements.

3.1.7 Provide number of refrigerant circuits and appropriate corresponding piping as per manufacturer's recommendations and requirements.

3.1.8 All refrigerant piping installations shall be in accordance with T.S.S.A. regulations. Contractor shall supply a T.S.S.A. certificate on completion of installation.

3.1.9 Contractor shall use only T.S.S.A. certified installers.

3.2 Brazing Procedure

3.2.1 Bleed inert gas into pipe during brazing.

3.2.2 Remove valve internal parts, solenoid valve coils, sight glass.

3.2.3 Do not apply heat near expansion valve and bulb.

3.3 Piping Installation

3.3.1 General:

- .1 Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
- .3 Provide trap at base of risers greater than 2.4 meters (8 feet) high and at each 7.6 meters (25 feet) thereafter.
- .4 Provide inverted deep trap at top of each riser
- .5 Provide double risers for compressors having capacity modulation.
- .1 Large riser: install traps as specified above.
- .2 Small riser: size for 5.1 m./s. (1000 f.p.m.) at minimum load. Connect upstream of traps on large riser.

3.4 Pressure and Leak Testing

- 3.4.1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- 3.4.2 Test in conformance with C.S.A. B52. The high and low sides of each system shall be tested and proved tight at not less than the lesser of the design pressure or the setting of the pressure-relief device protecting the high and low sides of the system. The system shall sustain the test pressure for a minimum test period of two (2) hours or as specified by the regulatory authority having jurisdiction.
- 3.4.3 Minimum Design Pressure for R410A as per CSA B52:
 - .1 Low Side = 236 psig (1626 kPa)
 - .2 High Side (water or evaporator-cooled) = 340 psig (2343 kPa)
 - .3 High Side (air-cooled) = 444 psig (3064 kPa)
- 3.4.4 Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.5 Dehydration and Charging

- 3.5.1 Close service valves on factory charged equipment.
- 3.5.2 Ambient temperatures to be at least 13 degrees Celsius (55 degrees Fahrenheit) for at least twelve (12) hours before and during dehydration.
- 3.5.3 Use copper lines of largest practical size to reduce evacuation time.
- 3.5.4 Use two-stage vacuum pump with gas ballast on second stage capable of pulling 5 Pa. (0.02 inches w.c.) absolute and filled with dehydrated oil.

3.5.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

3.5.6 Triple evacuate all system components containing gases other than correct refrigerant or having lost holding charge as follows:

- .1 Twice to 14 Pa. (0.056 inches w.c.) absolute and hold for four hours.
- .2 Break vacuum with refrigerant to 14 k.Pa. (0.056 inches w.c.).
- .3 Final to 5 Pa. (0.02 inches w.c.) absolute and hold for at least twelve hours.
- .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
- .5 Submit all test results to Consultant.

3.5.7 Charging:

- .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
- .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
- .3 Re-purge charging line if refrigerant container is changed during charging process.

3.5.8 Checks:

- .1 Make all checks and measurements as per manufacturer's operation and maintenance instructions.
- .2 Record and report all measurements to Consultant.

3.6 Postings on Site

3.6.1 Post instructions in frame with glass cover in accordance with C.S.A. B52.

3.7 Insulation

3.7.1 Install insulation to manufacturer's instructions.

3.7.2 Provide insulation on **all suction, liquid and hot gas** piping systems.

3.7.3 Install aluminum jacket with mechanical banding over all insulation installed exterior to building including roof. Provide mitered corners and bands to suit.

3.8 TSSA

3.8.1 Arrange for TSSA submission, certifications and inspections.

3.8.2 Provide a T.S.S.A. certificate to Consultant on completion of installation.

END OF SECTION

1 GENERAL**1.1 Reference Standards**

- 1.1.1 Ontario Building Code
- 1.1.2 ASHRAE
- 1.1.3 SMACNA
- 1.1.4 NFPA 80 – Installation, Testing and Maintenance of Fire Dampers
- 1.1.5 NFPA 90A – Air Conditioning and Ventilation Systems
- 1.1.6 /ULC S112 – Standard Method of Fire Test of Fire Damper Assemblies
- 1.1.7 CAN/ULC S112.1 – Standard for Leakage Rated Dampers for Use in Smoke Control Systems
- 1.1.8 CAN/ULC S505 – Standard for Fusible Links for Fire Protection Service
- 1.1.9 CSA
- 1.1.10 Local Codes and Requirements

1.2 Submittals

- 1.2.1 Submit shop drawings showing location, ratings, sizes of all fire dampers and combination fire-smoke dampers.
- 1.2.2 One copy of all stamped reviewed shop drawings plus operation and maintenance data shall be included in the maintenance manual.

1.3 Delivery, Storage and Handling

- 1.3.1 Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- 1.3.2 Storage: Store materials in a dry area indoor, protected from damage and in accordance with manufacturer's instructions.
- 1.3.3 Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

2 PRODUCTS

2.1 General

- 2.1.1 All required accessories shall conform to ASHRAE and SMACNA standards and recommendations.

2.2 Fire Dampers

- 2.2.1 Provide fire dampers in ducts penetrating fire rated walls, floors, or ceiling as indicated on the drawings.
- 2.2.2 Fire dampers shall be UL STD 555 to 1-1/2 hour fire ratings.
- 2.2.3 Fire dampers shall be equipped for vertical or horizontal suitable for application.
- 2.2.4 Dampers to be “dynamic” unless otherwise specified. “Static” dampers are restricted to un-ducted transfer openings.
- 2.2.5 Frame: 4-7/8”, 20 gauge galvanized steel channel.
- 2.2.6 Blades: 24 gauge galvanized steel blades, curtain type, recessed out of air stream.
- 2.2.7 Fusible link: 165°F.
- 2.2.8 Provide duct access doors of adequate size to service fire dampers. Provide Pull Tab for horizontal dampers where access door is located below the fire damper. Refer to Duct Access Doors within this section.
- 2.2.9 Acceptable Manufacturers
 - .1 Ruskin – Series IBD2 Style B
 - .2 Nailor Industries – 0120 Type B
 - .3 National Controlled Air (NCA) – FD – 80 Type B
 - .4 Tamco

2.3 Combination Fire Smoke Dampers

- 2.3.1 Combination fire/smoke dampers meeting or exceeding the following specifications shall be furnished and installed at locations shown on plans or as described in schedules.
- 2.3.2 Combination fire smoke dampers shall be triple-V groove blades.

2.3.3 Dampers shall meet the requirements of NFPA90A, 92A and 92B and shall be classified for use for fire resistance ratings of less than 3 hours, in accordance with UL555, and classified as Smoke Dampers in accordance with the latest version of UL555S.

2.3.4 Quality Assurance

- .1 Dampers shall be warranted against manufacturing defects for a period of 5 years.
- .2 Dampers shall be tested, rated and labeled in accordance with the latest ULC requirements.
- .3 Damper pressure drop ratings shall be based on tests and procedures performed in accordance with AMCA 500 and certified by AMCA (if applicable).
- .4 Factory Tests: Factory cycle damper and actuator assembly to assure proper operation.

2.3.5 Ratings:

- .1 Fire Resistance: 1-1/2 hours in accordance with ULC555.
- .2 Smoke Rating: Leakage Class II Smoke Damper in accordance with UL555S. A Class II smoke damper leaks no more than 20 cubic feet per minute (.57 m³/min) at 4 in. wg. (1 kPa) differential pressure.
- .3 Elevated Temperature Rating: 165°F.
- .4 Air Flow Rating: 2000 fpm.
- .5 Differential Pressure Rating: 4 in. wg.

2.3.6 Construction:

- .1 Frame: 5 inches x minimum 16 gage (127 x minimum 1.6 mm) roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gage (2.3 mm) U-channel type frame.
- .2 Blades:
 - .1 Style: Single skin with 3 longitudinal grooves (flat blades are not acceptable).
 - .2 Action: Opposed.
 - .3 Material: Minimum 16 gage (1.6 mm) galvanized steel.
 - .4 Width: Maximum 6 inches (152 mm).

- .3 Bearings: Self-lubricating stainless steel sleeve type, turning in extruded hole in frame.
 - .4 Seals:
 - .1 Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450°F (232°C) and galvanized steel for flame seal to 1,900°F (1,038°C). Mechanically attached to blade edge (glue-on or grip type seals are not acceptable).
 - .2 Jamb: Stainless steel, flexible metal compression type.
 - .5 Linkage: Concealed in frame.
 - .6 Axles: Minimum ½ inch (13) diameter plated steel, hex-shaped, mechanically attached to blade.
 - .7 Mounting: Vertical and/or Horizontal.
 - .8 Temperature Release Device: Heat-Actuated, Quick Detect.
 - .1 Close (in a controlled manner) and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades.
 - .2 Allow damper to be automatically and remotely reset after test or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.
 - .3 Controlled closing and locking of damper in 7 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.
 - .9 Release Temperature:
 - .10 Actuator:
 - .1 Type: Electric 120V, 60 Hz, two-position, fail close, complete with end switches.
 - .2 Mounting: External
 - .11 Finish: Mill galvanized.
- 2.3.7 Accessories
- .1 Sleeves, sized to suit wall or floor thickness.
- 2.3.8 Acceptable Manufacturers:
- .1 Ruskin - FSD36 or equal

.2 National Controlled Air (NCA) – FSD-3V

.3 Nailor - 1271

.4 Tamco

2.4 Balancing Dampers

2.4.1 Single blade damper: Galvanized steel minimum 18 gauge, provide with quadrants and lock screw.

2.4.2 Multi-blade damper: Galvanized steel minimum 16 gauge, provide with quadrants or adjustment rods and lock screw.

2.4.3 Fabricate splitter dampers of double thickness sheet metal to streamline shape, properly stiffened to avoid vibration. Size on basis of straight air volume proportioning.

2.4.4 Fabricate single blade dampers for duct sizes to a maximum of 300mm (12") tall and a maximum of 1200mm (48") wide.

2.4.5 Fabricate multi-blade dampers of opposed blade pattern with maximum blade sizes 300mm (12") to 1.8m (6'). Assemble centre and edge crimped blades in prime coated or galvanized channel frame with approved type hardware.

2.4.6 Include for the supply and installation of four (4) extra balance dampers in installed ductwork pending balance results and comments.

2.5 Turning Vanes

2.5.1 Factory or shop fabricated double thickness to SMACNA standards.

2.5.2 Acceptable Manufacturers:

.1 Duro Dyne

.2 Ductmate

2.6 Automatic Dampers

2.6.1 Damper frames and blades shall not be less than 12 gauge, 0.081" (2.1mm) extruded aluminium. Channel frame to be 4" (101.6mm) deep.

2.6.2 Blades to be single unit, internally reinforced and connected to frame with a 7/16" hexagon rod. Internal hollows to be insulated with 7/8" thick polyurethane foam with T factor of 5.0 per inch. Blades shall be thermally broken. All fresh air intake dampers to be complete with insulated frame and blade.

2.6.3 Blade and frame seals to be extruded synthetic rubber secured in an integral slot within the blade extrusion.

- 2.6.4 Frame shall be insulated with polystyrene, R factor of 5.0 per inch.
- 2.6.5 Bearings to be comprised of Celcon inner bearing fixed onto a hexagon rod rotating within a Polycarbonate outer bearing inserted into frame, resulting in no metal to metal contact.
- 2.6.6 Linkage hardware to be out of air stream and constructed of aluminium and corrosion resistant zinc plated steel, equipped with cup-point trunnion screw for slip-proof grip.
- 2.6.7 Dampers shall be suitable for operating in temperatures ranging between -40°F (-40°C) and 165°F (731°C).
- 2.6.8 Leakage shall not exceed 0.6% of the rated air flow at 10" WG differential static pressure across the damper.
- 2.6.9 Acceptable Manufacturers:

- .1 Tamco 9000

2.7 Damper Actuators

- 2.7.1 Damper actuators shall be supplied with the unit by the unit manufacturer or by mechanical Contractor as indicated in the equipment schedules and equipment specifications

2.8 Duct Access Doors

- 2.8.1 Provide access doors in ductwork of adequate size in the following locations:
 - .1 at each fire damper
 - .2 before and after each reheat coil
 - .3 bottom of all duct risers part of or next to outside air intakes and outlets
 - .4 in plenum and equipment casings to facilitate maintenance and cleaning of all components.
- 2.8.2 Construct access doors from double thickness 22 gauge galvanized steel sheets or aluminium in equal strength where required, 25mm apart, with necessary reinforcing inside for rigidity. Fill the 25mm space with glass fibre insulation.
- 2.8.3 Access doors to be ultra-low leakage with positive seal polyethylene gasket.
- 2.8.4 Access doors shall be square, rectangular or flat oval. Square and rectangular access doors shall be equal to Nailor 085CL. Flat oval access doors shall be equal to Nailor 0800.
- 2.8.5 Access Doors shall have minimum two plated steel camlock fasteners for sizes up to 350mm (14"), and four camlock compression latches for sizes over 350mm (14").

.1 Sizes

.1 Fire dampers and reheat coils

.1 Square/rectangle: minimum 16x16" or 2" less duct size

.2 Flat Oval: minimum 18x10" or 2" less duct size

.2 Duct Risers

.1 Square/rectangle: minimum 24x24" or 2" less duct size

.2 Acceptable Manufacturers

.1 Nailor

.2 Price

.3 Ruskin

2.9 Flexible Connections

2.9.1 Flexible Connections shall be Duro Dyne heavy glass, ULC listed, non-combustible, waterproof fabric, double coated with neoprene and shall be 150 mm minimum width, 0.81mm thick, density of 1.3 kg/m². Temperature rating shall be -40C (-40F) to +90C (+194F).

2.9.2 Flexible connectors shall be attached to 24 gauge metal strips minimum 75mm (3") wide.

2.9.3 Acceptable Manufacturers:

.1 Duro Dyne

.2 Mercer Rubber Co.

2.10 Test Ports

2.10.1 Test ports shall be equal to Duro Dyne TH-1, IP-2, IP-4 to suit application complete with screw in cap, neoprene gasket, insulating plug, and extensions for insulated ductwork.

2.10.2 Acceptable Manufacturers:

.1 Duro Dyne

.2 Ductmate

3 EXECUTION

3.1 Installation

- 3.1.1 Provide access doors of adequate size to service, maintain, or inspect within duct stream where required. Locations include but are not limited to automatic dampers, fire dampers, and filters. Coordinate installation with General Contractor.
- 3.1.2 Install flexible connections where rigid duct connects to equipment that is susceptible to vibration and as indicated on drawings.
- 3.1.3 Install instrument test ports to allow Pitot tube insertion with cam-action handle.

3.2 Fire Dampers

- 3.2.1 Confirm rating of devices with ratings of surfaces or separations.
- 3.2.2 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction.
- 3.2.3 Fire dampers shall be complete with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- 3.2.4 For curtain-type fire dampers in vertical ducts, the preferred access location is from the floor above the damper. Where access door is located below horizontal fire damper, damper shall be equipped with pull tab release.
- 3.2.5 Provide duct access doors to service fire dampers for those air transfer openings mounted with ducts.
- 3.2.6 Provide fire stop flaps on air outlets penetrating fire rated membranes or surfaces.

3.3 Combination Fire Smoke Dampers

- 3.3.1 Inspect areas to receive dampers. Notify the Engineer of conditions that would adversely affect the installation or subsequent utilization of the dampers. Do not proceed with installation until unsatisfactory conditions are corrected.
- 3.3.2 Install dampers at locations indicated on the drawings and in accordance with manufacturer's ULC approved installation instructions.
- 3.3.3 Install dampers square and free from racking with blades running horizontally.
- 3.3.4 Do not compress or stretch damper frame into duct or opening.
- 3.3.5 Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jackshaft.
- 3.3.6 Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

- 3.3.7 Provide duct access door at each smoke damper and combination smoke/fire damper, to permit visual inspection and service of fire detection/actuation mechanism. Provide such access doors even where dampers are provided with electrically supervised damper position indication.
- 3.3.8 Coordinate power supply for dampers with Division 26.
- 3.3.9 Provide supplemental monitoring points for dampers through building automation system.
- 3.3.10 Refer to section 23 05 92 for testing requirements.

3.4 Balancing Dampers

- 3.4.1 Provide balancing dampers, whether shown or required, at points on supply, return and exhaust systems, where branches are taken from larger ducts, for proper air balancing.
- 3.4.2 Review balance damper locations with the Balancing Contractor prior to installation. Additional costs to add balance dampers for proper balancing after installation will not be accepted.
- 3.4.3 Include for the supply and installation of four (4) extra balance dampers in the already installed ductwork pending balance results and comments.

3.5 Turning Vanes

- 3.5.1 Install in conformance with SMACNA standards.
- 3.5.2 Install in all square elbows and short radius elbows for supply and return air ductwork.

3.6 Automatic Dampers

- 3.6.1 Install opposed blade automatic control dampers as indicated on drawings.
- 3.6.2 Opposed Blade Dampers: Use for shut off service, modulating service without companion dampers, throttling services.
- 3.6.3 Parallel Blade Dampers: Use for mixing or relief service, variable position service with companion dampers.
- 3.6.4 Coordinate installation of operator and controls with Controls Contractor where applicable.
- 3.6.5 Damper actuators shall be supplied by mechanical contractors as indicated in the equipment schedules and equipment specifications.

3.7 Access Doors

- 3.7.1 Provide access doors in ductwork of adequate size in the following locations:
 - .1 at each fire damper

- .2 before and after each reheat coil
- .3 bottom of all duct risers – part of, or next to, outside air intakes and outlets
- .4 in plenum and equipment casings to facilitate maintenance and cleaning of all components.

3.7.2 Sizes

- .1 Fire dampers and reheat coils
 - .1 Square/rectangle: minimum 16x16" or 2" less duct size
 - .2 Flat Oval: minimum 18x10" or 2" less duct size
- .2 Duct Risers
 - .1 Square/rectangle: minimum 24x24" or 2" less duct size

3.8 Flexible Connections

- 3.8.1 Provide flexible connections on inlet and outlet duct connections of air handling units or other equipment likely to be affected by, or to cause vibration or noise to be transmitted through ductwork.
- 3.8.2 Install in accordance with SMACNA.

END OF SECTION

1 GENERAL

1.1 Requirements

1.1.1 Air outlets shall meet the following standards and requirements:

- .1 ASHRAE
- .2 AMCA
- .3 Local Codes and Requirements

1.1.2 Air flow tests and sound levels shall be made in accordance with ASHRAE standards.

1.1.3 Manufacturers shall certify performance and application.

1.2 Submittals

1.2.1 Shop Drawings:

- .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .2 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards. Louver shop drawings shall include free area, pressure drop and water carry over data.
- .3 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.2.2 .2 Operation and Maintenance Data:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.

2 PRODUCTS

2.1 General

2.1.1 Air flow tests and sound levels shall be made in accordance with ASHRAE standards.

2.1.2 Manufacturers shall certify performance and application.

2.1.3 All supply grilles shall be adjustable with double deflection.

2.2 Grilles and Diffusers

2.2.1 Provide grilles, registers and diffusers of the types as shown on the drawings.

Provide vertical throw type as noted based on ceiling heights.

2.2.2 Construction shall be heavy duty, with 14 gauge steel blades and heavy duty steel support bars and frame unless otherwise noted.

2.2.3 Grilles shall be complete with steel volume damper of the opposed blade type for balancing purposes as noted.

2.2.4 Supply diffusers mounted in t-bar shall not contain integral balance dampers. Balance dampers must be installed in branch duct runs to diffusers.

2.2.5 Provide fire stop flaps and blankets as noted or scheduled.

2.2.6 Acceptable Manufacturers:

.1 Price

.2 Nailor

.3 Titus

.4 Metal Aire

.5 Kreuger

2.3 Louvers (where supplied by Mechanical)

2.3.1 Louvers supplied by mechanical shall be licensed to bear the AMCA seal and certified by the manufacturer for outdoor use.

2.3.2 Louvers shall be sized as noted on drawings and model selected to prevent moisture carry-over (896 fpm for base specified Ventex 2435).

2.3.3 Frame shall be 0.081" (2.06 mm) extruded aluminium, alloy 6063-T5.

2.3.4 Blades shall be 0.081" (2.06 mm) extruded aluminium, alloy 6063-T5, at an angle of 35° on 3.5" (89mm) centres. Louver assembly shall have blades contained within a single frame.

2.3.5 Louver components including heads, jambs, sills and mullions shall be factory assembled.

2.3.6 All materials shall be factory finished after assembly with Polyester Powder Coat, standard mill finish unless otherwise indicated.

- 2.3.7 Louvers shall be complete with 19 gauge galvanized birdscreen with ½" x ½" openings.
- 2.3.8 Submit all performance data with shop drawings for free area, pressure drop and water carry over.
- 2.3.9 Acceptable Manufacturers:
 - .1 Tamco

3 EXECUTION

3.1 Grilles and Diffusers

- 3.1.1 Confirm location, type of mounting and size of all outlets with site conditions prior to ordering and installing.
- 3.1.2 Provide flanged connection off ductwork for mounting of grilles.
- 3.1.3 Paint inside of ductwork flat black behind supply and return wall grilles.
- 3.1.4 Position vertical throw diffusers and deflection of grilles to achieve best air flow in area. Adjust to suit Balancing Contractor and Engineer's requirements.
- 3.1.5 Provide birdscreen on all open ended return air ducts unless otherwise noted.

3.2 Louvers

- 3.2.1 Confirm location and size of all louvers with General Contractor prior to ordering and installing.
- 3.2.2 Provide 16 gauge galvanized sheet metal sleeve through wall opening where required.
- 3.2.3 All louvers shall be equipped with birdscreen.
- 3.2.4 Provide caulking at all louvers using non-shrink Mono caulking to match building colour.

END OF SECTION

1 GENERAL**1.1 General Requirements**

- 1.1.1 The requirements of this section shall apply to all sections in Division 26 – Electrical.
- 1.1.2 All material, labour, equipment, and services required under this section shall be the full responsibility of the Contractor including any material, labour, equipment, and services provided by their sub-contractors.
- 1.1.3 Complete and submit the Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of the tender documents.

1.2 Definitions

- 1.2.1 “Supply” shall mean supply only.
- 1.2.2 “Install” shall mean install and connect.
- 1.2.3 “Provide” shall mean supply, install, connect and test.
- 1.2.4 “Drawings and Specifications” shall mean Contract Documents.
- 1.2.5 “Authorities” or “Authorities having jurisdiction” shall mean all agencies that enforce the applicable laws, ordinances, rules, regulations, or codes of the Place of Work.
- 1.2.6 “Work” shall mean all equipment, materials, labour, and permits to provide a complete and operational electrical system as detailed in the drawings and specifications.
- 1.2.7 “Owner” or “PRP” shall mean The Regional Municipality of Peel.

1.3 Related Work

- 1.3.1 Division 1 – General
- 1.3.2 Division 22 and 23 – Mechanical
 - .1 Division 26 specifications form a part of the Contract Documents and shall be read, interpreted, and coordinated with all other Divisions. The Instructions to Bidders, General Conditions, General Requirements, Supplementary General Conditions and Amendments and Supplements thereto form a part of this Division and contain items related to the electrical work.
 - .2 Division 27 – Communications

1.4 Intent

- 1.4.1 The drawings and specifications are not a detailed set of installation instructions. Drawings and specifications are complementary to one another and that which is shown on one is as binding as that which is shown on both.
- 1.4.2 The Consultant shall be immediately informed of any discrepancies between drawings and specifications leaving in doubt the true intent of the work.
- 1.4.3 Supply all labour, equipment, and materials necessary to install a complete and operational electrical system described herein and shown on the drawings.
- 1.4.4 It is the intent of these drawings and specifications to provide for an electrical installation complete and in operating condition. The responsibility for supplying and installing all material necessary to accomplish this, except where specifically noted that such work or materials is not included, shall be part of this section.
- 1.4.5 Assess and be familiar with existing site conditions prior to pricing and construction and allow for same in tender price.
- 1.4.6 All work must be done by qualified and certified persons in such line of work. Trade certificates must be available on demand.
- 1.4.7 All work shall be in accordance with standard industry practice accepted and recognized by the Consultant and the Trade.
- 1.4.8 The Contractor shall coordinate with and cooperate with all other trades prior to installation. Where work interferes with other trades due to failure to coordinate or cooperate, the work shall be removed and relocated as approved by the Consultant at no extra cost to the Owner.
- 1.4.9 The Consultant shall have the right to reject any work that does not conform to the Contract Documents and accepted standards of practice including but not limited to performance, quietness of operation, and finish.
- 1.4.10 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.

1.5 Codes, Bylaws, Standards, and Regulations

- 1.5.1 The electrical system shall comply with the latest editions and revisions of applicable codes, bylaws, bulletins, standards, and regulations including but not limited to:
 - .1 Ontario Building Code
 - .2 Ontario Electrical Safety Code

- .3 Canadian Standards Association
- .4 Local Municipal Codes
- .5 Local Building Bylaws
- .6 Ontario Occupational Health and Safety Act
- .7 IEEE

1.5.2 Provide work in accordance with the requirements of all applicable government codes, local by-laws, underwriter's regulations base building standards, contract documents, and all authorities having jurisdiction.

1.5.3 Where discrepancies occur between contract drawings and specifications and above codes and standards referred to herein, the Contractor is to notify the Consultant in writing and obtain clarification prior to proceeding with the work.

1.5.4 Contractors shall not reduce the requirements on the contract drawings and specifications by applying any codes and standards referred to herein.

1.6 Permits and Fees

1.6.1 Apply for, obtain, and pay for all permits, fees, connections, inspections, licenses, certificates or charges necessary including all provincial and federal taxes including HST.

1.6.2 Coordinate all required inspections and give necessary notice to all authorities.

1.6.3 Upon completion of project, provide inspection certificates confirming acceptance by all authorities having jurisdiction.

1.7 Contract Breakdown

1.7.1 After the tenders close, submit a breakdown of the price into scope and trades to the satisfaction of the Consultant based on the sections of the specifications.

1.7.2 Breakdown shall include but not be limited to:

- .1 Mobilization and shop drawing submission (minimum \$2,000)
- .2 Permits and Fees
- .3 Primary Duct Bank
- .4 Secondary Duct Bank
- .5 Secondary service and cables
- .6 Switchboard and motor control centers

- .7 Panelboards and other miscellaneous distribution equipment
- .8 Starters, contactors and control devices
- .9 Feeder conduits
- .10 Branch conduits
- .11 Feeder cables
- .12 Branch wiring
- .13 Wiring for mechanical equipment
- .14 Luminaires and poles (exterior)
- .15 Luminaires (interior)
- .16 Emergency Luminaires
- .17 Fire Alarm System
- .18 Voice & Data system rough-in
- .19 Public Address (PA) System rough-in
- .20 Security and CCTV System rough-in
- .21 Close-out Submittals – Manuals & As-builts (minimum \$5,000)

1.7.3 Progress claims shall be based on the breakdown. Submit in table format showing contract amount, work complete to date as percentage, previous draw, amount this draw and balance for each line item.

1.8 Shop Drawings

1.8.1 Within fifteen (15) days of award, the Contractor shall submit shop drawings of all equipment for the project.

1.8.2 Prior to ordering of products or delivery of any products to job site, submit shop drawings electronically in PDF format to the Consultant for review and comments. Submit sufficiently in advance of construction to allow ample time for review. Size of shop drawings shall be 8.5x11. 11x17 will be acceptable where appropriate for content and scale.

1.8.3 Submittals shall contain but not be limited to details, dimensions, construction, size, arrangement, operating clearances, performance characteristics and capacities of products and parts of the work. Include wiring drawings and schematics showing interconnection with work of other Divisions.

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- .1 Clearly mark each sheet of printed submittal material, using arrow, underlining or circling, to show particular sizes, dimensions, wiring diagrams, operating clearances, control diagrams, project identification, types, model numbers, ratings, capacities and options actually being proposed. Cross out non applicable material. Note on the submittal specified features such as special tank linings, pump seals, materials or painting.
 - 1.8.4 Prior to submission to the Consultant, the Contractor shall review all shop drawings. By this review the Contractor represents that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so and that he has checked and coordinated each shop drawing with the requirements of the Work and of the Contract Documents.
 - 1.8.5 The Contractor's review of each shop drawing shall be indicated by his approval stamp, date and signature on the front of each page. Drawings will not be considered if not previously checked by the Contractor.
 - 1.8.6 Review comments from Consultant. If shop drawings are modified, confirm changes before proceeding. If shop drawings are not approved, revise and resubmit changes for approval.
 - 1.8.7 Review of the shop drawings by the Consultant does not relieve the contractor or his supplier of the responsibility to provide the correct and complete equipment, material or installation.
 - 1.8.8 Keep one complete set of shop drawings at job site during construction.
 - 1.8.9 Include stamped reviewed shop drawings in the Maintenance Manuals.
 - 1.9 Product Delivery Schedule**
 - 1.9.1 Within two (2) weeks from shop drawing review, a schedule must be submitted by the Contractor showing projected delivery dates of all products to meet required construction schedule.
 - 1.10 Construction Meetings**
 - 1.10.1 The Electrical Contractor shall attend all site meetings unless otherwise pre-approved.
 - 1.10.2 Sub-trades shall attend site meetings as requested or as required.
 - 1.11 As-built Drawings**
 - 1.11.1 Refer to Section 26-05-02.
 - 1.11.2 Maintain accurate, neat, and clean As-built Drawings on an **on-going basis** during construction to be reviewed periodically by the Consultant during construction.
 - 1.11.3 As-built drawing mark-ups shall be made available at every site meeting or inspection.

1.11.4 As-built drawings shall include but not be limited to final location of all **component locations and conduit runs.**

1.11.5 Prior to Substantial Performance submit a complete set of As-built drawings in PDF format. The Contractor is responsible for providing red-line drawings indicating all As-built conditions.

1.12 ESA Certificates

1.12.1 Furnish an unconditional Certificate of Acceptance from Electrical Safety Authority on completion of work. Arrange for interim and rough-in inspections. Arrange and pay for Occupancy Inspections if required for partial occupancies.

1.12.2 Incorporate a copy of the final ESA Certificate in the operating and maintenance manual.

1.13 Maintenance Manuals

1.13.1 Refer to Section 26 05 02.

1.13.2 Provide the Owner with two (2) **indexed**, hard cover maintenance manuals plus one (1) electronic copy on labeled on memory stick. Manuals shall contain and be tabbed in the following order:

- .1 Table of Contents
- .2 Contractor's, Manufacturer's and Supplier's Contact Information
- .3 Warranty Letter
- .4 Colour coding charts for access areas
- .5 Final ESA Certificate
- .6 Fire Alarm Verification Report, Fire Alarm Certificate and Audibility Results
- .7 Emergency Lighting Test Report
- .8 ALL stamped approved shop drawings – Include a tab and blank section for any Owner supplied equipment
- .9 Maintenance instructions, requirements, and schedule
- .10 As-built drawings

1.13.3 Submit one (1) complete copy to the Consultant for review and approval. Revise based on any comments and resubmit all copies and electronic copy to Consultant.

1.14 Testing

- 1.14.1 The installation shall be free of open circuits and grounds.
- 1.14.2 On completion, measure insulation resistances and comply with Table 24 of Ontario Electrical Safety Code.
- 1.14.3 Test all wiring and connections for continuity and grounds before equipment is energized.
- 1.14.4 Before energizing system, check all connections and set and calibrate all relays and instruments for proper operation, obtain necessary clearances, approval and instructions from utility company.
- 1.14.5 Carry out all tests and furnish all equipment required to demonstrate safe and proper completion of the work, without cost to the Owner.
- 1.14.6 Check load balance on all feeders and make necessary adjustments to provide a "balanced" load.
- 1.14.7 Check voltage drop on all feeders/branch circuits and make necessary adjustments to provide a 2% voltage drop in all feeders and branch circuits and a 4% drop from supply side to point of utilization .
- 1.14.8 Fully coordinate all testing and commissioning with all trades, the Consultant, and authorities having jurisdiction.
- 1.14.9 Provide a minimum of forty-eight (48) hours written notice to all parties.

1.15 Demonstration and Training

- 1.15.1 Demonstrate and train the Owner on proper operation of the Electrical and Auxiliary systems.
- 1.15.2 Work with and assist Division 21, 22, and 23 during training as required. Allow a minimum of four (4) separate two-hour sessions.
- 1.15.3 The Contractor shall arrange for all necessary personnel and equipment specialists to be in attendance for purposes of demonstration and training.
- 1.15.4 Provide instruction by a manufacturer's representatives as required too fully demonstrate the systems.
- 1.15.5 Demonstration and Training shall include but not be limited to:
 - .1 . Training in the normal, abnormal and emergency operating condition of all systems provided under this Division.
 - .2 Review of all necessary maintenance procedures of all systems provided under this Division.

.3 Provision of a documented maintenance program covering all systems provided or modified under this contract.

.4 Review of all close-out documentation including complete maintenance manuals and As-built drawings.

1.15.6 Prepare a Training Agenda and Log for signature by all Participants. Submit to Consultant and include in Manuals.

1.16 Substantial Completion and Performance

1.16.1 Substantial completion and performance shall be determined and awarded by the Consultant.

1.16.2 Complete the following to the satisfaction of the Consultant prior to request for substantial performance:

.1 Submit Electrical Safety Authority Certificate

.2 Submit reports as specified herein – fire alarm, emergency lighting

.3 Fire stopping

.4 Communication Test Report

.5 Security/CCTV Test Report

.6 As-built drawings

.7 Demonstration and Training

1.17 Warranty

1.17.1 Provide a one (1) year full parts and labour warranty for the new system from date of substantial completion.

1.17.2 Submit warranty letter on Company letterhead signed by Company representative stating warranty terms including warranty period from date of substantial completion.

2 PRODUCTS

2.1 General

2.1.1 All material used shall be new, free from defects, of quality specified, and installed in accordance with manufacturer's instructions.

- 2.1.2 Major components shall have nameplates on the exterior of the equipment in a visible location containing manufacturer's name, model number, serial number, performance data, and electrical characteristics.
- 2.1.3 The same manufacturer shall be used for types of components used in similar applications.
- 2.1.4 It is the responsibility of the Contractor to store and protect materials supplied by this scope.
- 2.1.5 Materials must be stored in original containers.
- 2.1.6 Remove and dispose of all redundant materials and garbage from site.

2.2 Selected Products and Equivalents

- 2.2.1 Sections within Division 26 list "Acceptable Manufacturers" which must meet characteristics of the specified equipment and products for each section.
- 2.2.2 Base specified products are specified and/or shown on the drawings, and identified by manufacturer's name, type and catalogue number.
- 2.2.3 Any alternate manufacturers from base specified products and equipment must equal or exceed the quality, finish and performance of those base specified and/or shown, and not exceed the space requirements allotted on the drawings. Include costs for any associated work to accommodate such substitutions, including the Consultant's time and revisions to the work of other divisions.
- 2.2.4 If item or material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after the Contract has been awarded.
- 2.2.5 If item of size indicated is unobtainable, supply next larger size without additional charge.

2.3 Quality Of Product

- 2.3.1 All products provided shall be CSA approved, approved by other relevant authorities.
- 2.3.2 If supplied products are not CSA approved, obtain approval of provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- 2.3.3 All products provided shall be new including those not specified and shall be of a quality best suited to the purpose required and their use subject to approval by the Consultant.

2.4 Voltage Ratings

- 2.4.1 Operating Voltages: to CAN3-C235.

- 2.4.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

2.5 Electric Motors, Equipment and Controls

- 2.5.1 Refer to Drawings for Contractor's equipment wiring responsibility.
- 2.5.2 Control wiring and conduit shall be covered under this Division except connections below 50V which are related to control systems specified under Division 23.

2.6 Product Finishes

- 2.6.1 Shop drawings shall include finishes.
- 2.6.2 All cabinets, panelboards, switchboards, cable trays, etc. shall be finished in ANSI 61 grey enamel unless otherwise specified.
- 2.6.3 Apply primer on all items which are to be finished on the job.
- 2.6.4 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

2.7 Access Doors

- 2.7.1 Provide access doors/panels as required for access, adjustment, operation, service, and maintenance.
- 2.7.2 Access doors shall be flush mounted 600mmx600mm (24"x24") for body entry and 300mmx300mm (12"x12") for hand entry. Doors to open 180 degrees, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

2.7.3 ACCESS DOORS/COVERS - FLUSH ACCESS DOOR – DRYWALL AREA

- .1 Acudor #DW-5040 Series flush to surface for drywall, satin coat steel with white baked enamel finish, formed door panel, flanged on four sides, 20 gauge. Galvanized frame with multiple bends and integral taping bead, 26 gauge. Concealed hinge, stainless steel screwdriver operated cam latch.

2.7.4 ACCESS DOORS/COVERS - FLUSH ACCESS DOOR - UNIVERSAL

- .1 **Acudor #UF-5000** Universal Access Doors, 14 GA. (1.7mm) steel, baked enamel prime coat, continuous concealed hinge, with positive and self-opening screwdriver operated lock.

2.7.5 Acceptable Manufacturers:

- .1 Acudor
- .2 Zurn
- .3 Nailor Industries
- .4 Le Hage

2.8 Floor Mounted Equipment

- 2.8.1 Mount Switchboards, Motor Control Centres and all other floor mounted electrical equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around.

2.9 Sleeves

- 2.9.1 Provide sleeves for all cables passing through masonry, concrete or fire rated assemblies unless run in conduit.
- 2.9.2 Sleeves shall be EMT conduit complete with bushing.

2.10 Fire Stopping

- 2.10.1 This Contractor shall work with all other Contractors on the project in providing one common method of fire stopping all penetrations made in the fire rated assemblies.
- 2.10.2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.
- 2.10.3 Do not use cementitious or rigid seals around penetrations for pipe, ductwork, or other mechanical items.
- 2.10.4 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.
- 2.10.5 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.
- 2.10.6 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide "fire wrap" blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.
- 2.10.7 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.
- 2.10.8 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.

- 2.10.9 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.
- 2.10.10 Firestopping shall be inspected and approved by local authority prior to concealment of enclosure.
- 2.10.11 Install material and components in accordance with ULC certification, manufacturer's instructions and local authority.
- 2.10.12 Submit product literature and insulation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and Consultant.
- 2.10.13 Acceptable Manufacturers:
- .1 Fryesleeve Industries Inc.
 - .2 General Electric Pensiil Firestop Systems
 - .3 International Protective Coatings Corp.
 - .4 Rectorseal Corporation (Metacaulk)
 - .5 Proset Systems
 - .6 3M
 - .7 AD Systems
 - .8 Hilti

3 EXECUTION

3.1 Site Examination

- 3.1.1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.
- 3.1.2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.
- 3.1.3 Report to the Consultant any unsatisfactory conditions which may adversely affect the proper completion of this work.

3.2 Interference and Coordination Drawings

- 3.2.1 Examine the drawings and all divisions of the specifications.
- 3.2.2 Prepare interference and equipment layout drawings to ensure all components will be properly accommodated within the spaces provided.
- 3.2.3 Lay out the work and equipment with due regard to architectural, structural and mechanical features, and service requirements.
- 3.2.4 Submit interference drawings to the Consultant.
- 3.2.5 Before commencing any work, obtain a ruling from the Consultant if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.

3.3 Separation of Services

- 3.3.1 Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.
- 3.3.2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.
- 3.3.3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from ceiling installer, and approved clips or hangers are used.

3.4 Workplace Safety

- 3.4.1 The workplace must be kept safe at all times.
- 3.4.2 Conform to all ministries of labour, and health and safety regulations at all times.
- 3.4.3 Use ladders and proper techniques as approved by the ministry of labour to perform all work.
- 3.4.4 Cover all holes/openings and provide barriers around hazards, etc. to ensure occupants and workers are not at risk.
- 3.4.5 Where work does not conform to such regulations, stop work immediately and report the situation to the Owner's representative or Consultant or rectify the situation immediately.
- 3.4.6 Report any hazards or concerns to the Owner's representative immediately.
- 3.4.7 Conform to the Owner's safety requirements and construction regulations.

3.5 Temporary Requirements

- 3.5.1 Provide grounded extension cords and temporary lights required for work.
- 3.5.2 Any specific task lighting required on site is the responsibility of this Division.

3.6 Location Of Luminaires

- 3.6.1 Locations may have to be revised to suit construction and equipment arrangements and it is expected that such changes will not result in additional cost to the Owner, provided that no additional labour or material is required and installation has not been completed.

3.7 Mounting Heights

- 3.7.1 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise. Coordinate with block coursing (if applicable).
- 3.7.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- 3.7.3 Install electrical equipment at following heights unless indicated otherwise (measurement to the centre of device unless specified):
 - .1 Local switches: 900mm (36") - 1100mm (43")
 - .2 Wall receptacles:
 - .1 General: 400mm (16")
 - .2 Above top of continuous baseboard heater: 200mm (8")
 - .3 Above top of counters or counter splash backs: 100 mm (4")
 - .4 In mechanical rooms: 1200mm (48")
 - .3 Panelboards: as required by Code or 1400mm (56")
 - .4 Voice/Data outlets: At height of adjacent outlet or at 400mm (16")
 - .5 Voice outlet for phone: 900mm (36") - 1100mm (43")
 - .6 Fire alarm pull stations: 1200mm (47")
 - .7 Fire alarm horns: 150mm (6") below ceiling and maximum 2300mm (90") above finished floor (measured to top of device)
 - .8 Fire alarm visual signal device: entire lens is 2000-2400mm (78"-94")

.9 Fire alarm combination visual and signal devices: Conform to 3.7.3.7 and 3.7.3.8.

.10 Thermostat: 1200mm (47")

.11 Space Sensors: 1400mm (55")

.12 Clocks: 2100mm (84")

3.8 Repairs, Cutting and Restoration

3.8.1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match finishes of same materials.

3.8.2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.

3.8.3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

3.8.4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

3.9 Painting

3.9.1 Refer to other Divisions for Painting unless otherwise specified herein.

3.9.2 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

3.9.3 Prime and touch up marred finished paintwork to match original.

3.9.4 Restore to new condition, or replace equipment at discretion of Consultant, finishes which have been damaged too extensively to be merely primed, painted and touched up.

3.10 Concealment

3.10.1 All equipment, components, piping, and conduit shall be concealed in ceiling spaces, bulkheads or walls where possible unless otherwise noted on the drawings or approved by the Owner or Consultant.

3.10.2 Exposed equipment, components, piping, and conduit installed in unfinished areas, shall be installed as high as possible. Run piping and conduit tight to roof deck and down columns.

3.11 Clearances and Accessibility

3.11.1 Install all work for easy access for adjustment, operation, and maintenance.

3.11.2 Maintain clearances for all components as per code and manufacturer's instructions.

- .1 Provide access panels of adequate size as required to access components in concealed areas. Do not install access doors in specialty walls or ceilings.
- .2 Provide fire rated access doors shall be installed in fire separations and match rating of separation.

3.12 Equipment and System Protection

3.12.1 Protect components and materials from damage in storage and on site before, during, and after installation until final acceptance.

3.12.2 Protect inside and outside of components from dust and debris with appropriate covers that will withstand through the construction.

3.12.3 Where equipment and system components become dirty or damaged, clean and repair to new condition to the satisfaction of the Consultant at the expense of this Contractor.

3.13 Supports

3.13.1 Provide all miscellaneous metals and materials as required for support, hanging, anchoring, and guiding of all components.

3.13.2 All supports must be securely mounted to structures.

3.14 Concrete Pads

- .1 Provide 100mm (4") high concrete pads under all floor mounted electrical equipment including but not limited to MCCs, switchboards and transformers. Concrete pad shall extend 100mm (4") beyond footprint of equipment.
- .2 Paint top and all sides of pad with two (2) coats of yellow paint.

3.15 Location of Outlets

3.15.1 Do not install outlets back-to-back in wall. Allow minimum 150mm (6") horizontal clearance between boxes.

3.15.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3m (10') and information is given before installation.

3.15.3 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

3.16 Fire Stopping

3.16.1 .1 Refer to Part 2 herein.

3.17 Cleaning

3.17.1 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

3.18 Owner Supplied Equipment

3.18.1 Connect to equipment supplied by the Owner and make operable.

3.19 Equipment Identification

3.19.1 Identify electrical equipment with nameplates as follows:

3.19.2 Nameplates:

- .1 Lamacoid 3mm (1/8") thick plastic engraving sheet, black face, white core, mechanically attached with self-tapping screws.

Nameplate Sizes

Size 1	9mm x 50mm (3/8" x 2")	1 line	3mm (1/8") high letters
Size 2	12mm x 70mm (1/2" x 2-1/2")	1 line	5mm (3/16") high letters
Size 3	12mm x 70mm (1/2" x 2-1/2")	2 lines	3mm (1/8") high letters
Size 4	20mm x 90mm (3/4" x 3-1/2")	1 line	9mm (3/8") high letters
Size 5	20mm x 90mm (3/4" x 3-1/2")	2 lines	5mm (3/16") high letters
Size 6	25mm x 100mm (1" x 4")	1 line	12mm (1/2") high letters
Size 7	25mm x 100mm (1" x 4")	2 lines	6mm (1/4") high letters

- .2 Wording on nameplates labels to be approved by Consultant prior to manufacture.
- .3 Allow for average of twenty-five (25) letters per nameplate.
- .4 Identification to be English.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

- .6 Nameplates for disconnects, starters and contactors must indicate equipment being controlled and voltage.
- .7 Nameplates for transformers must indicate transformer label as indicated and capacity, primary, and secondary voltages.

3.20 Wiring Identification

- 3.20.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- 3.20.2 Maintain phase sequence and colour coding throughout.
- 3.20.3 Colour code: to CSA C22.1.
- 3.20.4 Use colour coded wires in communication cables, matched throughout system.

3.21 Conduit and Cable Identification

- 3.21.1 Colour code conduits, boxes and metallic sheathed cables.
- 3.21.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15m (45') intervals.
- 3.21.3 Colour bands must be 25mm (1") wide.

<u>Prime</u>	
Up to 240V	yellow
Voice system	green
Data system	orange
Security	brown
Public address	black
Fire alarm	red

- 3.21.4 This Contractor must paint all system junction boxes and covers in conformance with the above schedule.

3.22 Wiring Terminations

- 3.22.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

3.23 Warning Signs

- 3.23.1 Meet requirements of Electrical Safety Authority and Consultant.
- 3.23.2 Provide porcelain enamel signs, with a minimum size of 175mm x 250mm (7" x 10").

3.24 Load Balance

- 3.24.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- 3.24.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage equipment.
- 3.24.3 Submit at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

3.25 Field Quality Control

- 3.25.1 Conduct and pay for following tests:
 - .1 Power distribution system including phasing, voltage, grounding, and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operating systems where applicable.
 - .5 Systems: fire alarm system.
- 3.25.2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- 3.25.3 Insulation resistance testing.
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- 3.25.4 Carry out tests in presence of Consultant.
- 3.25.5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

3.25.6 Submit test results for Consultant's review.

3.26 Coordination of Protective Devices

3.26.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as indicated on drawings or as determined from coordination study.

3.27 Field Review and Deficiencies

3.27.1 The Contractor shall notify the Consultant when the job is ready for field review at various stages including rough-in stages.

3.27.2 During the course of construction, the Consultants will monitor construction and provide written reports of work progress, discussions and deficiencies.

3.27.3 The Contractor shall correct all deficiencies within the work period prior to the next review.

3.27.4 The Contractor shall not conceal any work until inspected. Where work was concealed, the Contractor shall remove and replace tiles, coverings or other obstructions to allow proper inspection at the Contractor's expense.

3.27.5 Upon completion of the project the Consultant will do a final review. Upon receiving the final inspection report, the Contractor must correct and sign back the inspection report indicated all deficiencies are completed. A re-inspection will only be done once the Consultant receives this in writing. Where the Consultant performs the re-inspection and the work is not complete, the Contractor is responsible for reimbursing the Consultant for the field review. The fee for additional reviews will be at the Consultant's hourly rates plus mileage and applicable taxes to be paid directly to the Consultant prior to performing the next field review.

END OF SECTION

1 GENERAL**1.1 Work Included**

- 1.1.1 Operating and Maintenance Manuals
- 1.1.2 Assembly of certificates and tests reports
- 1.1.3 Assembly of shop drawings
- 1.1.4 Assembly of equipment and systems operating and maintenance instructions
- 1.1.5 Assembly of identification schedule
- 1.1.6 As Built Drawings

1.2 Related Work

- 1.2.1 Division 1
- 1.2.2 General Electrical Requirements – Section 26 05 01

2 PRODUCTS**2.1 2.1 Operation and Maintenance Materials**

- 2.1.1 Provide two (2) 8½" x 11", 3 ring type catalogue binders, labeled front and spine, with plastic tab dividers and Table of Contents. Also provide one (1) complete manual in electronic PDF format on labeled memory stick.
- 2.1.2 Manufacturer's data section is to be indexed and ordered to exactly match the sections of the specifications. Each section of the manufacturer's data section is to include an up to date copy of the equipment schedule for that section. The schedule is to be revised to suit all addenda, change orders and field changes, as well as manufacturers and model numbers matching the equipment supplied.
- 2.1.3 Assemble or develop complete and correct documentation for the operation and preventative maintenance of equipment and systems provided.
- 2.1.4 Assemble or develop copies of all certified shop drawings and material required to complete the documentation. This generally includes but is not limited to the following:
 - .1 Table of Contents
 - .2 Contractor's, Manufacturer's and Supplier's Contact Information
 - .3 Warranty Letter

- .4 Colour coding charts for access areas
- .5 Final ESA Certificate
- .6 Fire Alarm Verification Report, Fire Alarm Certificate and Audibility Results
- .7 Emergency Lighting Test Report
- .8 ALL stamped approved shop drawings – Include a tab and blank section for any Owner supplied equipment
- .9 Maintenance instructions, requirements, and schedule
- .10 As Built drawings

2.2 As Built Drawings

- 2.2.1 As Built drawings shall be kept up to date on an ongoing basis during construction for periodic review by the Consultant. As Built drawings shall always be kept in the same location on site known to the Consultant.
- 2.2.2 Contractors shall certify that final reproducible As Built drawings to be correct by notation and signature on the drawings.
- 2.2.3 As Built drawings shall precisely identify the configuration, size and location of all systems and equipment installed under this Division.
- 2.2.4 As Built drawings must be submitted in AutoCAD as specified herein.

2.3 Test Reports

- 2.3.1 Include a copy of all test reports for inclusion in Operating and Maintenance Manuals.

2.4 Demonstration and Training Reports

- 2.4.1 Refer to Section 26 05 01 – General Electrical Requirements
- 2.4.2 Include a copy of all Training literature in the Operating and Maintenance Manuals.
- 2.4.3 Include a copy of the signed and dated Training Log.

3 EXECUTION**3.1 General**

- 3.1.1 Substantial Performance will not be granted until the hard copies and electronic copy of the complete manual have been submitted by the Contractor and reviewed and accepted by the Consultant.

- 3.1.2 Submit a draft copy of the manual to the Consultant for review prior to final submission of all copies.
- 3.1.3 Provide two (2) final hard copies and one (1) electronic copy in PDF format to the Consultant for final acceptance.

3.2 As Built Drawings

- 3.2.1 Prior to Substantial Performance submit a complete set of As Built drawings in PDF format. The Contractor is responsible for providing red-line drawings indicating all As Built conditions. Make any changes as requested by the Consultant after review.
- 3.2.2 Substantial performance will not be granted until the As Built drawings have been submitted to the Consultant.

END OF SECTION

1 GENERAL**1.1 General**

- 1.1.1 The following specification represents the minimum standard required for installation of basic electrical components.

1.2 Work Included

- 1.2.1 Refer to Section 26 05 01.
- 1.2.2 Work to be done under this Section includes labour, materials, and equipment required to install, test and operate Electrical and Communication Systems.
- 1.2.3 Removal of all redundant wiring and conduit including where specifically requested by the Owner.

1.3 Codes and Standards

- 1.3.1 Ontario Electrical Safety Code – Current Edition.
- 1.3.2 CSA
- 1.3.3 ULC
- 1.3.4 American Electronic/Telecommunication Industry Association
- 1.3.5 Commercial Building for Telecommunications Pathways and Spaces
- 1.3.6 Local Telephone Company requirements
- 1.3.7 Local Codes and Requirements

1.4 Submittals

- 1.4.1 Shop Drawings:
- .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.
 - .3 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
 - .4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.4.2 Operation and Maintenance Data:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.

1.5 Standard of Materials

- 1.5.1 Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.
- 1.5.2 Materials required for performance of work shall be new and the best of their respective kinds and of uniform pattern throughout work.
- 1.5.3 Equipment items shall be standard products of approved manufacture. Identical units of equipment shall be of same manufacture.
- 1.5.4 Chemical and physical properties of materials and design performance characteristics and methods of construction and installation of items of equipment, specified herein, shall be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.
- 1.5.5 Materials shall bear approval labels as required by Code and/or Inspection Authorities.
- 1.5.6 Install materials in strict accordance with manufacturer's recommendations.
- 1.5.7 Include items of material and equipment not specifically noted on Drawings or mentioned in Specification but which are necessary to make a complete and operating installation.
- 1.5.8 Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.
- 1.5.9 Where a specific manufacturer is noted herein, other manufacturers may be considered where approved by the owner.

2 PRODUCTS**2.1 General**

- 2.1.1 Provide all equipment as per the following description to complete the entire works as shown on drawings and as indicated in the specifications to provide a complete and operational system.
- 2.1.2 Coordinate with other trades to provide the components required to make all systems operational – see mechanical schedules for details of equipment provided to make sure the works are complete.

2.2 Outlet Boxes

- 2.2.1 Outlet boxes shall conform to C.S.A. Standard C22.2 No. 18-1972.
- 2.2.2 Ceiling boxes shall be 103 mm octagon or square, complete with fittings, where required to support fixtures.
- 2.2.3 Switch and receptacle boxes shall be:
 - .1 103 mm square with plaster ring, where flush mounted in plaster walls.
 - .2 No. 1104, where flush mounted in wood or drywall, with stud fasteners as required.
 - .3 Masonry boxes in masonry walls.
- 2.2.4 Where boxes are surface mounted in unfinished areas they shall be FS conduits.
- 2.2.5 Standard outlet boxes shall be manufactured from code gauge galvanized steel.
- 2.2.6 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.
- 2.2.7 Boxes shall be of a size suitable for the number and size of conductors and the space requirements for the wiring device.

2.3 Conduit Accessories, Condulets and Fittings

- 2.3.1 Conduit accessories, condulets and fittings shall conform to C.S.A. Standard C22.2 No. 18-1972.
- 2.3.2 Rigid conduit bushings shall be as manufactured by:
 - .1 Thomas & Betts Ltd. – Series 5031
 - .2 Efcor of Canada Ltd. – Series 720B
 - .3 Commander / Iberville
- 2.3.3 EMT Connectors shall be steel set screw type as manufactured by:
 - .1 Thomas & Betts Ltd. – Steel City TC 121E Series
 - .2 Efcor of Canada Ltd. – Series 720B
 - .3 Commander / Iberville
- 2.3.4 Ground Bushing shall be as manufactured by:
 - .1 Thomas & Betts – Blackjack or 1220 Series

.2 Efcor of Canada Ltd.

.3 Commander / Iberville

2.3.5 Flexible conduit connectors shall be as manufactured by:

.1 Thomas & Betts Ltd. – Series 3110

.2 Efcor of Canada Ltd. – Series 1001B

.3 Commander / Iberville

2.3.6 Conduit fittings shall be as manufactured by:

.1 Crouse-Hinds of Canada Ltd.

.2 Kondu Mfg. Co. Limited

.3 Thomas & Betts Ltd.

.4 Killark of Canada

.5 Efcor of Canada Ltd.

.6 Commander / Iberville

2.3.7 Steel conduit shall be as manufactured by:

.1 Conduits National Co. Ltd.

.2 MBF Industries

2.3.8 Aluminum conduits shall be as manufactured by:

.1 Alcan Canada Products Ltd.

2.3.9 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.

.1 Thomas & Betts – 8125 Series

2.3.10 Terminate EMT entering boxes or enclosures with nylon insulated steel threaded bushings.

2.3.11 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.

.1 Thomas & Betts – 5332 Series

2.3.12 Install wall entrance seals where conduits pass through exterior walls below grade.

2.3.13 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.

2.3.14 All cabling shall be run in EMT conduit unless otherwise approved.

2.3.15 BX cable is acceptable for short drops to light fixtures to a **MAXIMUM LENGTH OF 1500 mm**. Any installations exceeding 1500 mm **WILL BE REMOVED AND REPLACED AT THE CONTRACTORS EXPENSE**. All installations of BX cable shall be complete with anti-short bushings at all stripped ends as per OEC #12-608(1)(a). Connectors for BX cable shall be Crouse Hinds #L16ST.

2.3.16 Rigid PVC (unplasticized) conduit shall be CSA approved according to CSA Standard C22.2 No. 136.

2.3.17 Pull Cords/Strings

- .1 Nylon twine

2.4 Conductors, Wires and Cables

2.4.1 Wiring installed in conduit, unless otherwise noted, shall be copper 600 volt RW75XLPE, RWU75XLPE or T-75 nylon jacket as per the requirements on the plans. It is the responsibility of the contractor to verify all equipment termination temperature and adjust wire size/rating to suit.

2.4.2 Lighting and power wiring shall be copper, minimum No. 12 gauge. Size wires for 2% maximum voltage drop to farthest outlet on a maximum 80% loaded circuit.

2.4.3 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.

2.4.4 Colour Coding shall be as follows:

- .1 Phase "A" – Red
- .2 Phase "B" – Black
- .3 Phase "C" – Blue
- .4 Control – Orange
- .5 Ground – Green
- .6 Neutral – White

2.4.5 Wire shall be as manufactured by:

.1 Nexans

.2 Industrial Wire and Cable (1970) Ltd.

.3 Southwire Canada

.4 Prysmian Cables & Systems Ltd (formerly Pirelli Cables Ltd.)

2.4.6 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

2.4.7 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.

.1 Thomas & Betts – Marr Max Series

2.4.8 Splice large conductors using compression type connections insulated with heat shrink sleeves.

.1 Thomas & Betts – 5400 Series lugs and heat shrink type #s series

2.4.9 Where colour coding tape is utilized, it shall be applied for a minimum of 2" at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition. Colour coding shall also apply to bussing in panels and, switchgear, disconnects, and metering cabinets.

2.5 Splitters

2.5.1 Splitters must conform to CSA C22.2 No. 76 (latest edition).

2.5.2 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

2.5.3 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

2.5.4 At least three spare terminals on each set of lugs in splitters less than 400A.

2.5.5 Splitter length must match arrangement of equipment unless indicated otherwise.

2.6 Junction Boxes and Pull Boxes

2.6.1 Junction and pull boxes must conform to CSA C22.2 No. 40 (latest edition).

2.6.2 Welded steel construction with screw-on flat covers for surface mounting.

2.6.3 Covers with 25 mm (1") minimum extension all around, for flush-mounted pull and junction boxes.

2.7 Switches

2.7.1 Local switches shall be 15A or 20A, single pole, double pole, three-way, four-way, keyed, or motor rated complete with pilot light. Switches to be silent, A.C. type and C.S.A. listed, specification grade. Provide switches rated to suit system voltage.

2.7.2 Manually operated general purpose with the following features:

- .1 Terminal holes approved for No. 10 AWG wire.
- .2 Silver alloy contacts
- .3 Urea or melamine molding for parts subject to carbon tracking
- .4 Suitable for back and side wiring
- .5 Toggle style

2.7.3 Toggle operated fully rated for tungsten filament and LED lamps

2.7.4 Up to 80% of rated capacity of motor loads.

2.7.5 Switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.

2.7.6 Provide white colour (to be confirmed at shop drawing review).

2.7.7 Catalogue numbers listed below have been used to indicate quality standards.

- .1 Single Pole Hubbell 1221/18221 Series
- .2 Double Pole Hubbell 1222/18222 Series
- .3 Three-Way Hubbell 1223/18223 Series
- .4 Four-WayHubbell 1224/18224 Series
- .5 Keyed Hubbell HBL1221L + 2 matching keys Hubbell HBL1209
- .6 Motor rated Hubbell HBL1221PL c/w pilot light (min 20A)

2.7.8 Acceptable Manufacturers:

- .1 Hubbell of Canada Ltd.
- .2 Leviton
- .3 Legrand

2.8 Dimmer Control

2.8.1 Dimmers to be provided with following features:

- .1 Rating of 20A 120V
- .2 Wattage to suit load as indicated. Minimum wattage to be 1000W.
- .3 Linear slide control.
- .4 Dimmer must be rated for LED control and provide full range control from zero to full intensity.
- .5 On/Off switch
- .6 Mountable in a single gang or multi-ganged box as required.
- .7 Cover plate to match other wiring devices

2.9 Occupancy Sensors

- 2.9.1 Ceiling mounted sensors shall be Dual Technology capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
- 2.9.2 Wall mounted sensors shall be Single Technology capable of detecting presence in the control area by detecting passive infrared heat changes
- 2.9.3 Ceiling sensors shall use patent pending ultrasonic diffusion technology that spreads coverage to a wider area.
- 2.9.4 Ceiling sensors shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either shall hold lighting on.
- 2.9.5 Ceiling sensors shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
- 2.9.6 Ceiling sensors shall be ceiling mounted with a flat, unobtrusive appearance and provide 360° coverage.
- 2.9.7 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall utilize Advanced Signal Processing that automatically adjusts the detection threshold dynamically to compensate for changing levels of activity and airflow throughout controlled space.
- 2.9.8 To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.

- 2.9.9 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
- 2.9.10 Sensors shall have a time delay that is adjusted automatically (with the SmartSet setting) or shall have a fixed time delay of 5 to 30 minutes, set by DIP switch.
- 2.9.11 Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
- 2.9.12 Ceiling sensors shall have a built-in light level sensor that works from 10 to 300 foot candles.
- 2.9.13 Sensors shall have a manual on function that is facilitated by installing a momentary switch.
- 2.9.14 Sensors shall have eight occupancy logic options that give the ability to customize control to meet application needs.
- 2.9.15 The sensors shall feature terminal style wiring, which makes installation easier.
- 2.9.16 Sensors shall have an additional single-pole, double throw isolated relay with normally open, normally closed and common outputs. The isolated relay is for use with HVAC control, data logging, and other control options.
- 2.9.17 Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less sensor visibility.
- 2.9.18 To ensure quality and reliability, sensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
- 2.9.19 Sensors shall have standard 5 year warranty and shall be UL and CUL listed.
- 2.9.20 Sensorworx is an acceptable alternate for occupancy sensor lighting control.

2.10 Receptacles

- 2.10.1 Receptacles shall conform to CSA 22.2 No. 42 (latest edition).
- 2.10.2 Receptacles shall be specification grade of amperage and voltage indicated on the drawings.
- 2.10.3 Manually operated general purpose with the following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Break-off links for use as split receptacles

- .3 Urea or melamine molding for parts subject to carbon tracking
 - .4 Suitable for back and side wiring (eight back wired entrances, four side wiring screws)
 - .5 Triple wipe contacts and riveted grounding contacts
 - .6 Tamper resistant
- 2.10.4 Switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.
- 2.10.5 Provide white colour, receptacles fed from UPS power shall be blue (to be confirmed at shop drawing review).
- 2.10.6 Receptacles shall be as listed below:
- .1 15 ampere, 120V, single phase grounded duplex tamper resistant receptacle shall be NEMA-U-ground type CSA Configuration 5-15R.
 - .2 20 ampere, 120V, single phase grounded duplex tamper resistant receptacle shall be NEMA-U-ground type CSA Configuration 5-20RA.
 - .3 15 ampere, 120V, weatherproof receptacles shall be equal to those above but complete with gasketed cast plate and hinged covers.
- 2.10.7 Other types of receptacles shall be provided as shown on Drawings.
- 2.10.8 Catalogue numbers listed below have been used to indicate quality standards.
- .1 Standard Duplex Hubbell BR15WHITR
 - .2 T-Slot Hubbell BR20WHITR
 - .3 Controlled Hubbell BR15C2GNTR
 - .4 Controlled T-Slot Hubbell BR20C2GNTR
 - .5 GFI Hubbell GFTRST15W
 - .6 GFI T-Slot Hubbell GFTRST20W
 - .7 USB Duplex Hubbell USB15C5W
 - .8 USB Only Hubbell USB4W
 - .9 Twist Lock Hubbell HBL23XX
 - .10 Dryer Hubbell HBL9430A

- .11 Range Hubbell HBL9450A

2.10.9 Acceptable Manufacturers:

- | | |
|----|---------|
| .1 | Hubbell |
| .2 | Legrand |
| .3 | Leviton |
| .4 | Cooper |

2.11 Boiler Shut-Off Switches

- 2.11.1 Boiler shut-off switches shall be red illuminated mushroom type, Siemens Model 35B1801.

2.12 Cover Plates

- 2.12.1 Switch, receptacle, telephone and other plates shall be stainless steel 18-8 chrome metal alloy, Type 302, non-metallic in finished areas and pressed steel in unfinished areas. Finish brush marks shall be run in a vertical direction.
- 2.12.2 Cover plates shall be of the same manufacturer throughout.
- 2.12.3 Cover plates shall be as manufactured by:
- .1 Leviton
 - .2 Hubbell
 - .3 Legrand

2.13 Disconnect Switches

- 2.13.1 Fused or Un-fused disconnect or safety switches shall be Type "A", quick-make, quick-break construction with provision for padlocking switches in either "ON" or "OFF" position.
- 2.13.2 Switches throughout job shall be of same manufacture.
- 2.13.3 Fused switches shall have fuse clips designed for Class "J" fuses and designed to reject standard N.E.C. fuses.
- 2.13.4 Switches shall be as manufactured by:
 - .1 Eaton
 - .2 Siemens
 - .3 Schneider Electric

2.13.5 Provide fused or un-fused safety or disconnect switches as shown and as required by Code.

2.13.6 Disconnects feeding elevator controllers must be equipped with two auxiliary contacts approved by the elevator supplier.

2.14 Motor Starters

2.14.1 Starts shall conform to CSA C22.2 No. 14 (latest edition) and EEMAC E14-1.

2.14.2 Manual motor starters shall be/have:

- .1 .1 Used for motors ½ hp or less
- .2 .2 Equal to Allen Bradley type 600 and 609
- .3 .3 Toggle operated
- .4 .4 Locking
- .5 .5 Plug-in heaters sized to suit the full load current of the motors installed
- .6 .6 Red neon pilot light

2.14.3 Magnetic motor starters shall be/have:

- .1 Used for motors over ½ hp
- .2 Equal to Allen Bradley IEC type
- .3 Contactor solenoid operated, rapid action type
- .4 Motor overload protective device in each phase, manually reset from outside enclosure
- .5 Hand/off/auto push button selector switches
- .6 Indicating lights: standard duty, 1 red pilot light for “stop” or “off” and 1 green light for “start” or “on”.
- .7 1-N/O and 1-N/C spare auxiliary contacts
- .8 24V auxiliary contacts
- .9 Wiring and schematic diagram inside starter enclosure in visible location

2.15 Combination starters shall be/have:

2.15.1 .1 Used where fused switch and magnetic starter are in same location

- 2.15.2 Equal to Allen Bradley IEC
- 2.15.3 Include fused disconnect switch with operating lever on outside of enclosure to control disconnect
- 2.15.4 Locking in "OFF" position
- 2.15.5 Independent locking of enclosure door
- 2.15.6 Provision for preventing switching to "ON" position while enclosure door is opened.
- 2.15.7 Magnetic starter features as per above.
- 2.15.8 Provide control transformers and auxiliary contacts as required for control connections.
- 2.15.9 Provide push to test lights throughout.
- 2.15.10 Half size and IEC starters will not be accepted.
- 2.15.11 Acceptable Manufacturers:
 - .1 .1 Allen Bradley
 - .2 .2 Eaton
 - .3 .4 Siemens
 - .4 .5 Schneider Electric

2.16 Control Transformers

- 2.16.1 Control transformers shall conform to CSA C22.2 No. 66 (latest edition).
- 2.16.2 Auto-transformers shall conform to CSA C22.2 No. 47 (latest edition).
- 2.16.3 Single phase, dry type, control transformer with primary voltage as indicated and secondary voltage to suit remote control device, complete with secondary fuse, installed in with starter as indicated.
- 2.16.4 Size control transformer for control circuit load plus 20% spare capacity.

2.17 Contactors

- 2.17.1 Contactors shall conform to CSA C22.2 No. 14 (latest edition).
- 2.17.2 Electrically held and controlled by pilot devices as indicated and rated for type of load controlled. (Mechanically held style for exterior lighting control).
- 2.17.3 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.

2.17.4 Mount in CSA Enclosure 1 unless otherwise indicated.

2.17.5 Include following options in cover:

- .1 Red indicating lamp.
- .2 Hand – Off – Auto selector switch.

2.17.6 24V Control transformer: mounted in contactor enclosure.

2.17.7 Acceptable Manufacturers:

- .1 .1 Allen-Bradley
- .2 .2 Eaton
- .3 .3 Siemens
- .4 .4 Schneider Electric

2.18 Control Relays

2.18.1 Control relays shall be equal to Allen Bradley type P, electrically held. Confirm coil voltages for relays controlling mechanical equipment with controls contractor.

2.19 Surface Raceway Systems

2.19.1 All surface mounted raceways shall be two cell compartment for power and data/voice with full separation between compartments where required.

2.19.2 Surface raceway is to be utilized in dry interior locations only as covered in Article 352 Part B of the National Electrical Code, as adopted by the National Fire Protection Association and as approved by the American National Standards Institute.

2.19.3 The surface raceway system specified herein for branch circuit wiring and/or data network, voice, video and other low-voltage wiring shall be steel system as manufactured by the Panduit, T70 Series for multiple devices in same location as noted on drawings.

2.19.4 The raceway and all system components must be UL Listed.

2.19.5 The raceway shall be a one-piece design with base and cover factory assembled.

2.19.6 Manufacturer shall provide tools to cut, bend and install raceway.

2.19.7 A full compliment of fittings must be available including, but not limited to flat, internal and external elbows, tees entrance fittings, cover clips and end caps. The fittings shall have a matte texture, in ivory or white colours to match the base and cover. They shall overlap the cover and base to hide uneven cuts. All fittings shall be supplied with a base where applicable to eliminate mitreing. A transition fitting shall be available to adapt to other Wiremold series raceways.

2.19.8 Device brackets shall be available for mounting standard devices in-line with the raceway. Faceplates shall match and fit flush in the device plate.

2.19.9 The raceway manufacturer will provide a complete line of connectivity outlets and modular inserts for UTP (including Category 5), STP (150 ohm) Fibre Optic, Coaxial and other cabling types with face plates and bezels to facilitate mounting. This contractor is to provide brackets for faceplates to be provided by others.

2.19.10 Acceptable Manufacturers:

.1 Wiremold Company

.2 Hubbell

.3 Panduit

2.20 Hangers and Supports

2.20.1 Provide and correctly locate all hangers and inserts required for the installation of all work under this Contract.

2.20.2 Hangers for electrical conduit shall be galvanized after fabrication.

2.20.3 Conduit hangers shall be as manufactured by:

.1 Burndy Canada Ltd.

.2 Canadian Strut Products Ltd.

.3 E. Myatt & Co. Ltd.

.4 Steel City Electric Co.

.5 Pilgrim

.6 Thomas & Betts

.7 B-line

2.20.4 Do not use perforated strapping (grappler bars).

2.21 Finishes and Painting

2.21.1 All factory supplied equipment shall have finish coating factory applied whether finish be painted, galvanized or other, as required and as specified.

2.21.2 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

3 EXECUTION**3.1 General**

- 3.1.1 All wiring to meet Ontario Electrical Safety Code and local authorities.
- 3.1.2 All power, interlock and control wiring over 50V, and disconnects shall be supplied and installed by the Electrical Contractor. Coordinate with Division 22 and 23.
- 3.1.3 Division 22 and 23 shall install all control and low voltage interlock wiring less 50V or less for mechanical equipment unless specified.
- 3.1.4 All outdoor wiring to be run in liquidtight. All indoor wiring to be run in conduit. Last 1.5m (5') at final connection to equipment shall be run in flexible conduit only (not liquidtight).
- 3.1.5 Where wire size is not indicated, ampacity must match or exceed rating of protective device.
- 3.1.6 Panels are specified as sequence bussed and all branch circuit wiring from these panels shall be such that where a common neutral is used for two or three circuits, these circuits shall be fed from adjacent breakers, so that single-pole breakers may be replaced with 2 or 3 pole breakers should this be required in the future. All circuits shall be balanced. All neutrals shall be sized to meet the requirements of Section 4-018 of the Ontario Electrical Safety code and in no case smaller than 12 AWG.
- 3.1.7 Feeders, sub-feeders, circuit wiring and ancillary items shall be colour coded for phase identification. Neutral conductors shall be full capacity with white covering and be continuous throughout the system without fuses, switches or breakers of any kind.
- 3.1.8 Install wiring continuously within raceways, splices will be permitted only at outlets and junction boxes. Sufficient slack wire shall be left at these points to permit proper connection of fixtures, devices, equipment, etc.
- 3.1.9 Any exposed conduits or cables shall be run parallel to or at right angles to building lines and in a neat manner. Conduits shall be thoroughly reamed and each threaded termination shall be provided with two lock nuts. Running threads for rigid conduit will not be accepted.
- 3.1.10 Internal raceways in the building
 - .1 Securely cap or plug all openings in conduit and ducts during the execution of the Work to prevent dust and debris from entering the openings.
 - .2 At completion of the installation, the service entry ducts and the conduit system in the building shall be fished to clear all blocks.
- 3.1.11 Outlet and pull boxes shall be cleaned out and the system left free from water and moisture.

- 3.1.12 Provide all conduit, wire, fittings, disconnect switches, line voltage, starters, disconnects, controls and auxiliary materials as previously defined to wire into service all 3 phase motors, single phase motors and equipment included in other Sections unless specified otherwise.
- 3.1.13 Install pull boxes in conduit run where required to facilitate the pulling in of cable and locate in inconspicuous accessible spaces.
- 3.1.14 Provide flexible connections to mechanical equipment for vibration isolation. Connections to equipment roof mounted or in other damp or wet locations shall be liquid tight.
- 3.1.15 Conduits and cables shall not be attached to mechanical units for support.
- 3.1.16 All devices in General Purpose rooms, Mechanical and/or Electrical rooms and all exterior mounted devices shall have wire guards for protection from mechanical damage. Provide wire guards elsewhere as noted on drawings.

3.2 Wiring Methods

- 3.2.1 Install wiring in conduit unless otherwise specified.
- 3.2.2 Flexible conduit and armoured cable will be accepted for a maximum length of 1500 mm for final connection to lighting fixtures. Do not connect from fixture to fixture.
- 3.2.3 Use thin wall conduit (EMT), up to and including 53 mm conduit size, for branch circuit and feeder wiring in ceilings, furred spaces, concrete block walls, hollow walls and partitions. Use rigid galvanized steel conduit for wiring in poured concrete, where exposed, and for conduit 65 mm or larger. Use rigid PVC conduit for wiring in slabs on grade and wiring below grade.
- 3.2.4 Aluminum conduit may be used, in lieu of rigid steel conduit, in clean and dry locations, but shall not be used in poured concrete, or for signal and intercommunication systems wiring.
- 3.2.5 Conduit manufacturer's touch-up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

3.3 Outlet Boxes

- 3.3.1 Where 103 mm square outlet boxes are installed in exposed concrete or cinder block finished areas, blocks will be cut under Masonry Division as instructed under this Section. Opening shall be cut to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Mortar shall not be used to patch up openings that are cut too large or to patch ragged edges.
- 3.3.2 Ceiling boxes shall be 103 mm octagon or square, complete with fittings, where required to support fixtures.
- 3.3.3 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.

- 3.3.4 Support outlet boxes independently of conduit and cable.
- 3.3.5 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.
- 3.3.6 Offset outlet boxes, shown back to back in partitions, horizontally a min. 150mm to minimize noise transmission between adjacent rooms.
- 3.3.7 Use gang boxes at locations where more than one device, of the same system only, is to be mounted. Each system shall utilize separate boxes.
- 3.3.8 Use tile wall covers where 103 mm square outlet boxes are installed in exposed concrete or cinder block in finished areas.
- 3.3.9 Flush mount boxes, panels, cabinets and electrical devices, which are installed in finished areas, shall be provided with suitable flush trims and doors or covers, unless specifically noted otherwise.
- 3.3.10 Provide pre-formed polyethylene vapour barriers for all boxes located in walls with internal vapour barriers.

3.4 Conduit Accessories, Condulets and Fittings

- 3.4.1 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.
 - .1 Thomas & Betts – 8125 Series
- 3.4.2 Terminate EMT entering boxes or enclosures with nylon insulated steel threaded bushings.
- 3.4.3 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.
 - .1 Thomas & Betts – 5332 Series
- 3.4.4 Install wall entrance seals where conduits pass through exterior walls below grade.
- 3.4.5 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.

3.5 Conductors, Wires and Cables

- 3.5.1 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.
- 3.5.2 Colour Coding shall be as follows:

- .1 Phase "A" – Red
- .2 Phase "B" – Black
- .3 Phase "C" – Blue
- .4 Control – Orange
- .5 Ground – Green
- .6 Neutral – White

3.5.3 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

3.5.4 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.

- .1 Thomas & Betts – Marr Max Series

3.5.5 Splice large conductors using compression type connections insulated with heat shrink sleeves.

- .1 Thomas & Betts – 5400 Series lugs and heat shrink type #s series

3.5.6 Where colour coding tape is utilized, it shall be applied for a minimum of 2" at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition. Colour coding shall also apply to bussing in panels and, switchgear, disconnects, and metering cabinets.

3.6 Splitters

3.6.1 Install splitters and mount plumb, true and square to the building lines on 19mm (3/4") painted plywood backboards.

3.6.2 Provide equipment identification in conformance with Section 260501.

3.7 Junction Boxes and Pull Boxes

3.7.1 Install pull boxes in inconspicuous but accessible locations. Provide access doors in all drywall areas.

3.7.2 Install junction boxes and pull boxes so as not to exceed 30m (100') of conduit run between pull boxes and in conformance with the Electrical Safety Authority.

3.7.3 Provide equipment identification in conformance with Section 260501.

3.7.4 Label all junction boxes with panel and circuit number.

3.8 Switches

- 3.8.1 Install single throw switches with handle in the “up” position when switch is closed.
- 3.8.2 Install switches in gang type outlet box when more than one switch is required in one location.
- 3.8.3 Confirm colour prior to ordering.
- 3.8.4 Refer to Section 26 05 01 for mounting heights.

3.9 Receptacle

- 3.9.1 Mount receptacles so long dimension is in the vertical.
- 3.9.2 Exact locations shall be verified to suit furniture layout.
- 3.9.3 Connect receptacle grounding terminal to the outlet box with a copper wire.
- 3.9.4 Install receptacles in gang type outlet box when more than one switch is required in one location.
- 3.9.5 Where split receptacle has one portion switched mount vertically and switch upper portion.
- 3.9.6 Weatherproof receptacles shall be equal to 20A GFI and mounted in weatherproof enclosure complete. Enclosure shall be equivalent to Hubbell RW58300.
- 3.9.7 Confirm colour prior to ordering.
- 3.9.8 Refer to Section 26 05 01 for mounting heights.

3.10 Cover Plates

- 3.10.1 Do not install plates until final painting of room or area is completed. Remove protective covering.

3.11 Destratification Fans and Controls

- 3.11.1 Ensure fans and controls are installed in conformance with manufacturer recommendations.
- 3.11.2 Suspend/free hang ceiling fans from roof structure from eye hook / eyebolt on fan. Use minimum ¼ carabineer. Provide chain for back-up support.
- 3.11.3 Provide junction box for power connection directly above the fan and run flexible conduit to fan.
- 3.11.4 Fans shall be mounted level with surrounding structure to ensure air flow is not impeded.

3.11.5 Electrical Contractor shall supply and install switch or speed controller to suit fan. Install wire guards to be level. Fasten wireguards to structure NOT roof deck. Provide intermediate unistrut supports to suit. Demonstrate fan operation at the time of final inspection. Surface Raceway Systems

3.11.6 Raceway is to be supplied and installed with all necessary fittings, hardware and device brackets for a complete functional system

3.11.7 Install conduit system, wiring and devices as indicated.

3.11.8 Install raceway as per manufacturer recommendations.

3.11.9 Provide end caps where raceway ends.

3.12 Hangers and Supports

3.12.1 Provide and correctly locate all hangers and inserts required for the installation of all work under this Contract.

3.12.2 Support outlet boxes, junction boxes, conduit and all electrical equipment independently with hangers and fastenings to building structural members.

3.12.3 Hangers in general shall be supported from inserts in concrete construction or from building structure using beam clamps for steel structures. Provide all additional angle or channel steel members required between beams for support of conduits, cables, luminaires, etc.

3.12.4 Use coach screws, lag screws or wood screws as appropriate in any wood construction.

3.12.5 Feeders, conduits and power ducts running vertically in a building shall be supported at each floor and between each floor if necessary.

3.13 Mounting Heights

3.13.1 .1 Refer to Section 26 05 01.

3.14 Conduit Sleeves and Curbs

3.14.1 Provide conduit sleeves of galvanized steel for conduit and cable runs passing through concrete walls, beams, slabs and floor. Include for all power, communications and control wiring. All conduit sleeves shall be de-burred and have plastic bushings installed to protect wiring.

3.14.2 Extend galvanized conduit sleeves for conduit rising through slabs 4" minimum above finished floors. Provide sleeves, passing through floors having a waterproof membrane, with an integral flashing clamp.

3.15 Hand Dryers

- 3.15.1 Install and connect hand dryers in conformance with manufacturer's recommendations.
- 3.15.2 Provide GFI breaker for circuit feeding hand dryer. Hand dryers are to be mounted at a height to suit age of expected users. Unless otherwise noted confirm height with Architectural drawings prior to rough in.
- 3.15.3 Once installed this Contractor is to caulk the joint between dryer and wall surface with a bead of white silicone. Coordinate installation with General Contractor.

3.16 Supports and Bases

- 3.16.1 Mount Switchboards, Motor Control Centres and all other floor mounted electrical equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around.
- 3.16.2 Supply and erect special structural work required for installation of electrical equipment. Provide anchor bolts and other fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.
- 3.16.3 Switches or other electrical equipment shall be complete with suitable bases or mounting brackets.
- 3.16.4 Provide channel or other metal supports where necessary, to adequately support lighting fixtures. Do not use wood unless wood forms part of the building structure.
- 3.16.5 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members, required between beams for supporting conduits and cables.
- 3.16.6 Provide any additional supports required from existing concrete construction for any piping or equipment, by drilling same and installing expansion bolt cinch anchors.
- 3.16.7 Do not use explosive drive pins in any section of work without obtaining prior approval.

3.17 Finishes and Painting

- 3.17.1 Primary and final painting for work, other than items specified as factory primed or finished, shall be performed by trades specializing in this type of work.
- 3.17.2 Repair and finish factory finished equipment, damaged or scratched during installation, in an approved manner.
- 3.17.3 Leave bare metal surfaces ready for painting by removing dirt, rust, grease or millscale to Consultant's approval.

- 3.17.4 All structural steel including hangers, brackets, supports and other ferrous metals shall be shop or factory prime painted wherever practicable. Wherever structural steel including hangers, brackets, supports, and other ferrous metals cannot be shop or factory prime painted, wire brush to remove all traces of rust, clean of all traces of dirt, oil, and grease, and apply one coat of an approved rust inhibiting primer in accordance with CGSB-GB-40d and leave ready to receive finish paint.

3.18 Electrical Connections for Mechanical Equipment

- 3.18.1 Provide all required electrical connections to apparatus provided and/or supplied by Division 21, 22 and 23, the Owner and as part of the work of other Divisions of the Specifications.
- 3.18.2 All power and control wiring over 50V and disconnects shall be installed by the Electrical Contractor.
- 3.18.3 All control and low voltage wiring 50V and under shall be installed by the Mechanical Contractor and/or Controls Contractor. Coordinate all low voltage wiring with the Mechanical Contractor.
- 3.18.4 All connections to roof mounted mechanical equipment shall be installed through a gooseneck style pitch pocket equal to Thaler Metal MEF-2A/2A1/2A2. Pitch pocket supplied and installed by Electrical Contractor. Coordinate installation with General Contractor and/or Roofing Contractor.

3.19 Motors and Starters

- 3.19.1 Division 26 shall supply and install all starters unless otherwise indicated.
- 3.19.2 Coordinate with Division 22 and 23 as required.
- 3.19.3 Install line voltage disconnect switches at each motor not within the required distance from its starter to meet code requirements.
- 3.19.4 All motors shall be wired and connected under this Division. The drawings do not necessarily show the exact location of wiring to motors and it shall be the responsibility of this Division to fully coordinate this work with Division 22 and 23.
- 3.19.5 Temperature Controls: Be responsible for the "line" side power connections to all control apparatus where detailed or required to make the system operational.

3.20 Equipment Identification

- 3.20.1 Refer to Section 26 05 01.

3.21 Testing

- 3.21.1 Make tests of equipment and wiring at times requested.

- 3.21.2 Tests shall include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load, and operation of each piece of equipment for correct operation.
- 3.21.3 Supply meters, materials and personnel as required to carry out these tests.
- 3.21.4 Test electrical work to standards and function of Specification and applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.
- 3.21.5 Before energizing system, check all connections and set and calibrate all relays and instruments for proper operation, obtain necessary clearances, approval and instructions from utility company.
- 3.21.6 Connect single phase loads so that there is the least possible unbalance of the supply phases.
- 3.21.7 Submit all test results in report format.

END OF SECTION

1 GENERAL**1.1 Shop Drawings**

1.1.1 Submit shop drawings for each system in Conformance with Section 26 05 01.

1.2 Product/Maintenance Data

1.2.1 Submit product/maintenance data for each system for inclusion in maintenance manual conforming to Section 26 05 01.

1.3 Scope

1.3.1 The scope of this Section will include the following systems.

- .1 Cable management system
- .2 Telephone system rough-in
- .3 Communications rough-in
- .4 Fire Assembly

2 PRODUCTS**2.1 Cable Management System**

2.1.1 The system where noted shall be a continuous, rigid, welded steel wire mesh cable management system with the following features:
Permits continuous ventilation of cable and maximum dissipation of heat.

- .1 Continuous safety edge T-welded wire lip.
- .2 Welded at all intersections.
- .3 Straight sections 4"x 12" (100 mm x 300 mm) in configurations noted on the drawings.
- .4 Constructed of carbon steel wire, ASTM A 510, grade 1008. Wire welded, bent, and surface treated after manufacture.
- .5 Post fabrication finish of electro-plated zinc galvanizing: ASTM B 633, Type III, SC-1.
- .6 Fittings: Field fabrication in accordance with manufacturer's instructions from straight sections.

- .7 The support system shall be threaded rods as per manufacturer recommendations for specified system
- .8 The necessary hardware, including splice connectors and support components furnished by manufacturer.
- .9 The product shall be WBT tray. #WBT4x8 complete with support brackets and hangers at intervals as recommended by the manufacturer.
- .10 The manufacturer shall be:
 - .1 WBT
 - .2 Panduit

2.2 Telephone System Rough-In

- 2.2.1 Provide a #6 insulated green ground conductor from main service ground to telephone equipment backboard located on drawings.
- 2.2.2 Outlets where noted shall be single gang flush mounted in wall.
- 2.2.3 Recess empty conduit
- 2.2.4 Outlets if unwired are to be provided with blank cover plates

2.3 Communications Rough-In

- 2.3.1 Concealed empty conduit with pull strings and junction boxes maximum 50' spacing.
- 2.3.2 Outlets where noted shall be single gang flush mounted in wall.
- 2.3.3 Recess empty conduit
- 2.3.4 Outlets if unwired are to be provided with blank cover plates.

2.4 Fire Assembly

- 2.4.1 Provide fire rated assembly for communication cables entering any data rooms as noted on drawings.
- 2.4.2 Fire Assembly shall be Specified Technologies Inc. model #EZDP433GK.

3 EXECUTION**3.1 Cable Management System**

- 3.1.1 Install cable management system at locations indicated on the drawings and in accordance with manufacturer's instructions.
- 3.1.2 Support system every 2.4 m (8'-0") unless system is used within a telecommunication room. In that situation support every 1.5 m (5'-0").
- 3.1.3 Cut wires in accordance with manufacturer's instructions.
- 3.1.4 Cut wires with side action bolt cutters to ensure integrity of galvanic protective layer. Cut using side action bolt cutters.
- 3.1.5 Cut each wire with 1 clean cut to eliminate grinding or touch-up.
- 3.1.6 Install cable management system using hardware, splice connectors, support components, and accessories furnished by manufacturer.
- 3.1.7 Suspend from structure or intermediate unistrut channel spanning across the corridor where access to structure is not available due to the concentration of mechanical ductwork and/or piping.
- 3.1.8 Ground cable tray with continuous ground per O.E.S.C. and manufacturer instructions. Test to ensure minimum 5 ohms resistance.
- 3.1.9 Locate cable management system minimum 9" EMI source including but not limited to fluorescent lights, transformers, motors, and power cables.
- 3.1.10 Coordinate installation with communications contractor prior to ordering final system to ensure communication requirements are met.

3.2 Telephone System Rough-In

- 3.2.1 Installed incoming service duct and terminated as noted.
- 3.2.2 Provide background as noted complete with ground connection to main service ground.
- 3.2.3 A 21 mm ($\frac{3}{4}$ ") conduit as to be installed from elevator machine room to service backboard.

3.3 Communications Rough-In

- 3.3.1 Outlets are to be installed complete with 21 mm ($\frac{3}{4}$ ") conduit to ceiling space or nearest zone conduit (if applicable). Provide insulated bushings on all conduits terminated in ceiling space.

END OF SECTION

1 GENERAL

1.1 General Requirements

- 1.1.1 The studies must be submitted to the Consultant prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Consultant may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device rating and characteristics will be satisfactory.
- 1.1.2 The studies shall include all portions off the electrical distribution system from the normal power source or source down to and including the smallest adjustable trip circuit breaker in the distribution system. Normal system connections and those, which result in maximum fault conditions, shall be adequately covered in the study.
- 1.1.3 The firm should be currently involved in high- and low- voltage power system evaluation. The study must be performed, stamped and signed by a registered professional engineer in the Province of Ontario. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the Consultant for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.
- 1.1.4 The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

1.2 Data Collection For The Study

- 1.2.1 The Contractor shall provide the required data for preparation of the studies. The Consultant performing the system studies shall furnish the Contractor with a listing of the required data immediately after awards of the contract.
- 1.2.2 The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacturing.

2 PRODUCTS

2.1 Short Circuit And Protective Device Evaluation And Coordination Study

- 2.1.1 The short-circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standard.
- 2.1.2 In the short-circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculation, tabulations of calculation quantities

and results, conclusions, and recommendations. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low-voltage switchgear lineup, switchboard, motor control centre, distribution panelboard, pertinent branch circuit panelboard, and other significant overcurrent protective device locations throughout the system. Provide a ground fault current study for the same system area, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor fault contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.

- 2.1.3 In the protective devices coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time, dial, pickup, instantaneous, and time delay settings.
- 2.1.4 Include on the curve sheets power company relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. In addition, include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control centre, and main breaker in branch panelboards.
- 2.1.5 Include all adjustable setting for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical fault currents. Terminate device characteristics curves at a point reflecting the maximum symmetrical fault current to which the device is exposed.
- 2.1.6 Select each primary protective device required for a delta-wye connected transformer so that it's characteristic or operating band is within the transformer characteristic, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Separate transformer primary protective by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristics curves from curves for other devices by least a 0.4- second time margin.
- 2.1.7 Include complete fault calculations as specified herein based on contract documents.
- 2.1.8 Submit qualifications of individuals(s) who will perform the work for approval prior to commencement of the studies. Provide studies in conjunction with equipment submittals to verify equipment ratings required. Submit the study to Consultant for review prior to delivery of the study to the Owner. Make all additions or changes as required by the reviewer.
- 2.1.9 Utilize equipment load data for the study obtained by the Contractors form contract document, including contract addendum's issued prior to bid openings.

- 2.1.10 Include fault contribution of all motors in the study. Notify the consultant in writing of circuit protective devices not properly rated for fault conditions
- 2.1.11 When emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristics of the protective devices. Contractor shall obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not typical values for the generator.
- 2.1.12 Evaluate proper operations of the ground relays in 4-wire distributions with more than one main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.
- 2.1.13 For motor controls circuits, show the MCC full-load current plus symmetrical and asymmetrical of the largest motor starting current and time to ensure protective devices will no trip during major or ground start operation.

2.2 Arc Flash Hazard Analysis

- 2.2.1 The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E- Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D and CSA Z462-2018.
- 2.2.2 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D.
- 2.2.3 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study room. Alternative methods shall be presented in proposal.
- 2.2.4 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboard, busway and splitters) where work could be performed on energized parts.
- 2.2.5 The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.
- 2.2.6 Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- 2.2.7 The Arc Flash Hazard analysis shall include calculation for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

2.2.8 Arc flash computation shall include both line and load side of main breaker calculations, where necessary.

2.2.9 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped based on IEEE 1584 latest edition.

2.3 Study Report

2.3.1 The result of the power system study shall be summarized in a final report. Three (3) bound copies of the copies of the final report must be submitted.

2.3.2 The report shall include the following sections:

- .1 Descriptions, purpose, basis, and scope of the study.
- .2 Tabulation of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
- .3 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
- .4 Fault current calculations including a definition of terms and guide for interpretation of computer printout.
- .5 Incident energy and flash protective boundary calculations
 - .1 Arcing fault magnitude
 - .2 Device clearing time
 - .3 Duration of arc
 - .4 Arc flash boundary
 - .5 Working distance
 - .6 Incident energy
 - .7 Hazard Risk Category
 - .8 Recommendations for flash energy reduction

3 EXECUTION

3.1 Field Settings

3.1.1 The Contractor shall perform field adjustment of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study, and protective device coordination study.

3.1.2 Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Owner.

3.2 Arc Flash Warning Labels

3.2.1 The vendor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

3.2.2 The label shall have an orange header with the wording, "WARNING , ARC FLASH HAZARD" and shall include the following information:

- .1 Location designation
- .2 Nominal voltage
- .3 Flash protection boundary
- .4 Hazard risk category
- .5 Incident energy
- .6 Working distance
- .7 Engineering report number, revision number and issue date.

3.2.3 Labels shall be machine printed, with no field marking.

3.2.4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommend overcurrent device settings.

3.2.5 For each 600, 480 and applicable 208 volt panelboard, one arc flash label shall be provided.

3.2.6 For each motor control centre, one arc flash label shall be provided.

3.2.7 For each low voltage switchboard, one arc flash label shall be provided.

- 3.2.8 For each switchgear, one flash label shall be provided.
- 3.2.9 For medium voltage switches one arc flash label shall be provided.
- 3.2.10 Labels shall be field installed by the firm providing the Arc Flashing Hazard Analysis

3.3 Acceptable Testing Firms

- 3.3.1 MVA Engineering
- 3.3.2 GT Woods
- 3.3.3 Brosz & Associates
- 3.3.4 K-Tek Electro-services Ltd.
- 3.3.5 Eaton Electrical Service Group
- 3.3.6 Schneider Electrical Service Group
- 3.3.7 Siemens Service Group

END OF SECTION

1 GENERAL**1.1 Work Included**

1.1.1 Commissioning shall be carried out by a Third Party Commissioning Agent obtained by PRP.

1.1.2 The Contractor shall provide assistance throughout the commissioning process as needed.

1.2 PART 2 - PRODUCTS

1.2.1 All equipment and products necessary to assist with Commissioning shall be covered under this Division at no cost to the Owner.

1.3 PART 3 - EXECUTION**1.4 3.1 Commissioning**

1.4.1 Provide assistance during complete commissioning process. Refer to Appendix 'A' for Third Party Commissioning Plan.

1.4.2 All equipment and systems shall be started, tested, and reports submitted and accepted prior to commissioning starting.

1.4.3 System tests shall include but not be limited to:

- .1 Lighting Foot-Candle Readings
- .2 Verification Using Meter and Load Readings. (See Appendix 'A' for Test Form.)
- .3 Fire Alarm Verification. Contractor to submit test forms in conformance with ULC. Final Performance Test to be witnessed by Commissioning Agent.
- .4 Loss and Return of Utility Power.
- .5 Miscellaneous Systems
- .6 Other systems specified within this Division.

1.4.4 The Contractor shall submit all checklists included with the Commissioning Plan under Appendix 'A'.

1.5 Demonstration and Training

1.5.1 Provide assistance during Demonstration and Training. Refer to Appendix 'A' for Third Party Commissioning Plan.

- 1.5.2 Complete and accepted maintenance manuals and record drawings shall be submitted and available for use during the Demonstration and Training.

END OF SECTION

1 GENERAL

1.1 Codes and Standards

1.1.1 Ontario Electrical Safety Code-Current Edition

1.1.2 CSA

1.1.3 ULC

1.1.4 Local Codes and Requirements

1.2 Submittals

1.2.1 Shop Drawings:

- .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.
- .3 One copy of all stamped approved shop drawings shall be included in maintenance manual.
- .4 Operation and Maintenance Data:

1.2.2 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.

1.2.3 Operation and maintenance data shall be included in the maintenance manual.

2 PRODUCTS

2.1 Duct (direct buried underground cable duct)

2.1.1 PVC ducts and fittings: Rigid PVC duct to CSA C22.2 No. 211.1, type DB2 with fittings for direct burial (expanded flange ends).

2.1.2 Rigid PVC bends, reducers, bell end fittings, plugs caps, spacers, adaptors same product material as duct to make complete installation

2.1.3 Cable: CU RWU75 XLPE of size noted on drawings. Cable termination temperature to be adjusted to suit equipment to be installed.

2.2 Lighting and Receptacle Panels

- 2.2.1 Panel boards shall be as manufactured by Eaton complete with circuit breakers and labeled with a CSA short circuit rating. Panel board and circuit breaker short circuit rating shall be as indicated on panel schedules. Provide copper bus sized in accordance with the contract drawings and CSA standards.
- 2.2.2 Electrical characteristics, main sizes, quantities of breakers and quantity of branch circuits shall be as indicated on the drawings.
- 2.2.3 Where noted on the drawings, panel boards serving isolated ground circuits shall be complete with a separate ground bar isolated from the panel board box by an insulating plate. Connect this ground bar directly to the main building ground using AWG #6 copper minimum or larger as required by table 16 of the Ontario Electrical safety Code (unless otherwise noted).
- 2.2.4 Panel boards shall be supplied with doors, concealed hinges, chromed locks and hardware. All locks shall be keyed alike. Doors shall be fitted with plastic covered panel directory, with circuits and areas served typed in. Doors shall be provided with spring latches and semi flush cylinder locks and catch assemblies. Provide two (2) keys per panel board.
- 2.2.5 All panel boards to have sprinkler proof enclosures.
- 2.2.6 Branch Breakers: Shall be of the heavy duty, bolt-on type, single, two or three pole as shown on the drawings and of the ampere ratings indicated. They shall be thermal magnetic, non interchangeable, moulded, case type with toggle mechanism, and be designed for use as switches. Two and three pole breakers shall be common trip type with single handle. Handle ties will not be permitted. Each breaker to be quick-make, quick break type. Shall be approved for use with CU/AL cables.
- 2.2.7 Breakers 200 Amps and above shall have adjustable long delay pickup/time, adjustable short delay pickup/time and adjustable instantaneous pickup.
- 2.2.8 Provide lock-on devices for fire alarm, stairway, exit and night light circuits.
- 2.2.9 Ground fault circuit interrupters where required shall be C.S.A Class A with 5 mA tripping level and shall have push-to-test button on front.
- 2.2.10 Provide ground bus in each panel.
- 2.2.11 Door and trim finish: grey enamel.
- 2.2.12 Panel board depth is not to exceed 146mm.
- 2.2.13 Cover plates shall be provided for all the blank spaces in the distribution section.
- 2.2.14 Provide a nametag on the exterior of the enclosure. Nametag to indicate interrupting rating, voltage, service description, etc.

- 2.2.15 Provide sequential phase bussing with odd numbered breakers on the left and even numbered on the right complete with each breaker identified by permanent marker identification as to circuit number and place.
- 2.2.16 Main breaker, where required, to be mounted top or bottom of the panel to suit cable entry. When mounted vertically, down position shall trip the breaker.
- 2.2.17 Branch circuit panel boards (250 AMP or smaller) must be equal to Eaton POW-R-Line-C PRL-1 or PRL-2 or approved alternate.
- 2.2.18 Branch circuit panel boards shall be complete with transient voltage surge suppression filtering system integral to the panel tub and must be equal to Eaton #CPSBXCH208YSD or approved alternate.
- 2.2.19 Power distribution circuit breaker panel boards (400 AMP or larger) must be equal to Eaton POW-R-Line-C PRL-4a with bottom side entry wire way or approved alternate.
- 2.2.20 Acceptable Manufacturers:
 - .1 Eaton
 - .2 Schneider
 - .3 Siemens

2.3 Fuses

- 2.3.1 Fuses: Shall be RK5 or HRC-I, Class J or L unless otherwise specified. Fuses in combination starters shall be HRC time delay type where specified.
- 2.3.2 Motor fuses shall be sized according to the Drawings for the specified motor and starting cycle.
- 2.3.3 Fuses shall be as manufactured by Buss, Gould, Little Fuse or approved equal.
- 2.3.4 Provide three spare fuses of each type and size installed for maintenance.

3 PART 3 – EXECUTION**3.1 Grounding**

- 3.1.1 Provide ground plate or two ground rods and connect to the service with 3/0 copper bare ground wire.
- 3.1.2 Make all required ground connections from water meter and gas piping to main electrical service ground. Ground conductors shall be minimum #2/0 copper wire connected with approved fittings.

- 3.1.3 Conduit systems shall not be used for grounding. Provide separate ground conductors in all raceways. Bond the ground wire to all boxes and luminaries.
- 3.1.4 Install grounding connections to typical equipment included in but not necessarily limited to the following list. Service equipment transformers, switchgear, duct systems, frames of motors, motor control centres, starters control panels, building steel work, distribution panels, outdoor lighting.
- 3.1.5 Test the resistance of the grounding system. Add additional ground wires and ground rods if required as directed by the Engineers and retest. Repeat this process until ground resistance is 2 ohms or less. Conduct all tests using Megger Null Balance or Megger Universal ground resistance test equipment.
- 3.1.6 Test and log all ground connections at panels, switchboards and ground buses prior to and after the computer is put into operation. Trace and isolate all equipment causing current in ground wires to exceed one ampere. Replace such equipment if furnished as part of this contract.
- 3.1.7 Test all receptacles for proper connections with a neon lamp type polarity tester. Check that ground resistance is less than 0.2 ohms with an Edgecumbe Peebles Ltd., ground loop impedance tester.

3.2 Electrical Connections for Mechanical Equipment

- 3.2.1 Provide all required electrical connections to apparatus provided and/or supplied by Division 21, 22 and 23, the Owner and as part of the work of other Divisions of the Specifications.
- 3.2.2 All power and control wiring over 50V and disconnects shall be installed by the Electrical Contractor.
- 3.2.3 All control and low voltage wiring 50V and under shall be installed by the Mechanical Contractor or Controls Contractor. Coordinate all low voltage wiring with same.

END OF SECTION

1 GENERAL**1.1 Description of System and Site**

1.1.1 Provide a 100 kilowatt integrated, standby power system to supply electrical power at 120/240V Volts, 60 Hertz, 1 Phase. The system will utilize generators rated 100 kilowatts. The generator shall consist of a liquid cooled diesel engine, a synchronous A.C. alternator, and system controls with all necessary accessories for a complete operating system, including but not limited to the items as specified hereinafter.

1.1.2 The site is an O.E.S.C. ordinary location with no specific harsh environment requirements.

1.2 Requirements of Regulatory Agencies

1.2.1 An electric generating system, consisting of a prime mover, generator, governor, coupling and all controls, must have been tested, as a complete unit, on a representative engineering prototype model of the equipment to be sold.

1.2.2 The generator set must conform to applicable N.F.P.A. requirements.

1.2.3 The generator set must conform to all CSA C282 requirements.

1.2.4 The generator set must include a listing for the U.L. 2200 standard for stationary engine generator assembly.

1.2.5 The generator set must meet E.P.A. federal emission guidelines for stationary emergency power generation.

1.3 Manufacturer Qualifications

1.3.1 This system shall be supplied by an original equipment manufacturer (O.E.M.) who has been regularly engaged in the production of engine-alternator sets, automatic transfer switches, and associated controls for a minimum of 25 years, thereby identifying one source of supply and responsibility. Approved suppliers are Generac Industrial Power or an approved equal.

1.3.2 The manufacturer shall have printed literature and brochures describing the standard series specified, not a one of a kind fabrication.

1.3.3 Manufacturer's authorized service representative shall meet the following criteria:

- .1 Certified, factory trained, industrial generator technicians
- .2 Service support 24/7
- .3 Service location within 200 miles
- .4 Response time of 4 hours

- .5 Service & repair parts in-stock at performance level of 95 percent

1.4 Submittals

- 1.4.1 Engine Generator specification sheet
- 1.4.2 Controls specification sheet(s)
- 1.4.3 Installation/Layout dimensional drawing
- 1.4.4 Wiring schematic
- 1.4.5 Sound data
- 1.4.6 Emission certification
- 1.4.7 Warranty statement

1.5 Based Manufacturer

- 1.5.1 Generac

1.6 Acceptable Alternate Manufacturer

- .1 Kohler
- .2 Cummins
- .3 Toromont
- .4 Sommers
- .5 Simpson Maxwell
- .6 Alternate as approved through addenda by Consultant.
- .7 The specification must be fully complied with. Any deviation/exception must be listed in the bid as non-compliance and the installing contractor will be responsible for additional cost associated with design change/review due to non-compliance to the specification.

2 PART 2 - GENERAL**2.1 Engine**

- 2.1.1 Engine Rating and Performance

2.1.2 The prime mover shall be a liquid cooled, diesel fueled, turbocharged after-cooled engine of 4 cycle design. It will have adequate horsepower to achieve rated kilowatt output with at an operating speed of 1800 revolutions per minute.

2.1.3 The engine shall support a 100 percent load step.

2.1.4 Engine Oil System

.1 Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter(s) with internal bypass and replaceable element(s).

.2 The engine shall operate on mineral based oil. Synthetic oils shall not be required.

.3 The oil shall be cooled by an oil cooler which is integrated into the engine system.

2.1.5 Engine Cooling System

.1 The engine is to be cooled with a unit mounted radiator, fan, water pump, and closed coolant recovery system. The coolant system shall include a coolant fill box which will provide visual means to determine if the system has adequate coolant level. The radiator shall be designed for operation in 122 degrees Fahrenheit, (50 degrees Celsius) ambient temperature.

.2 The engine shall have (a) unit mounted, thermostatically controlled water jacket heater(s) to aid in quick starting. The wattage shall be as recommended by the manufacturer.

.3 Engine coolant and oil drain extensions, equipped with pipe plugs and shut-off valves, must be provided to the outside of the mounting base for cleaner and more convenient engine servicing.

.4 A radiator fan guard must be installed for personnel safety that meets U.L. and O.S.H.A. safety requirements.

2.1.6 Engine Starting System

.1 Starting shall be by a solenoid shift, D.C. starting system.

.2 The engine's cranking batteries shall be lead acid. The batteries shall be sized per the manufacturer's recommendations. Battery specifications (type, amp-hour rating, cold cranking amps) to be provided in the submittal.

.3 The genset shall have an engine driven, battery charging alternator with integrated voltage regulation.

.4 The genset shall have an automatic dual rate, float equalize, 10 amp battery charger. The charger must be protected against a reverse polarity connection. The chargers charging current shall be monitored within the generator controller to support remote monitoring and diagnostics. The battery charger is to be factory installed on the

generator set. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.

2.1.7 Engine Fuel System

- .1 The engine fuel system shall be designed for operation on 2 diesel fuel and cold weather diesel blends.
- .2 The engine shall include a primary fuel filter, water separator, manual fuel priming pump, and engine flexible fuel lines must be installed at the point of manufacture. Element shall be replaceable paper type.
- .3 The engines suction line shall be fitted with a check valve to secure prime for the engines injection pump.

2.1.8 Fuel Lines

- .1 All pipes, filter casings, adapters and valve casing to have melting point greater than 538 degrees Celsius.
- .2 All fill and vent piping shall be threaded grade B black steel pipe painted orange.
- .3 Vent, fill, supply and return pipe wall penetrations to be sleeved and sealed with firestop caulking.
- .4 Valves shall be new, certified for intended use, quarter turn ball valves with lockable handles.
- .5 Fuel tank vent piping to be installed with insect screen and rain cap. Install vent pipe 600mm clear of any building openings.
- .6 Provide ULC listed lockable spill contain box and lockable fill cap.
- .7 Fuel piping system shall be pneumatically pressure tested to a minimum of 28 kPA and the test shall be completed over a period of two hours while system is incepted for leaks.
- .8 Provide signage stating tight fill only overfill protection valve installed.

2.1.9 Engine Controls

- .1 Engines that are equipped with an electronic engine control module (E.C.M.), shall monitor and control engine functionality and seamlessly integrate with the genset controller through digital communications. E.C.M. monitored parameters shall be integrated into the genset controllers N.F.P.A. 110 alarm and warning requirements. All E.C.M. fault codes shall be displayed at the genset controller in standard language – fault code numbers are not acceptable.
- .2 For engines without E.C.M. functionality or for any additional genset controller monitoring, sensors are to be conditioned to a 4 to 20 milliamp signal level to

enhance noise immunity and all sensor connections shall be sealed to prevent corrosion.

- .3 Engine speed shall be controlled with an integrated isochronous governor function with no change in alternator frequency from no load to full load. Steady state regulation is to be 0.25 percent.

2.1.10 Engine Exhaust and Intake

- .1 The engine exhaust emissions shall meet the E.P.A. emission requirements for standby power generation and be positive leak free connection.
- .2 The manufacturer shall supply its recommended stainless steel, flexible connector to couple the engine exhaust manifold to the exhaust system. A rain cap will terminate the exhaust pipe after the silencer. All components must be properly sized to assure operation without excessive back pressure when installed.
- .3 The manufacturer shall supply a critical grade exhaust silencer as standard. For applications with site specific sound requirements (reference section 1.1), the silencer shall be selected to achieve site sound levels.
- .4 For gensets in a weather or sound attenuated enclosure, all exhaust piping from the turbo-charger discharge to the silencer shall be thermally wrapped to minimize heat dissipation inside the enclosure. Restore insulating wrap as required to suit exhaust piping integrity test.
- .5 The engine intake air is to be filtered with engine mounted, replaceable, dry element filters.
- .6 Provide documentation certifying the exhaust piping is vapour tight to the satisfaction of T.S.S.A.

2.2 Alternator

- 2.2.1 The alternator shall be the voltage and phase configuration as specified in Section 1.1.1.
- 2.2.2 The alternator shall be a 4 pole, revolving field, stationary armature, synchronous machine. The excitation system shall utilize a brushless exciter with a three phase full wave rectifier assembly protected against abnormal transient conditions by a surge protector. Photo-sensitive components will not be permitted in the rotating exciter.
- 2.2.3 The alternator shall include a permanent magnet generator (P.M.G.) for excitation support. The system shall supply a minimum short circuit support current of 300 percent of the rating (250 percent for 50 hertz operation) for 10 seconds.
- 2.2.4 The alternator shall support 200 starting kilovolt ampere with a maximum voltage dip of 15 percent.
- 2.2.5 Three phase alternators shall be 12 lead, broad range capable of supporting voltage reconnection. Single phase alternators shall be four lead and dedicated voltage designs

(600 volts) shall be six lead. All leads must be extended into a N.E.M.A. 1 connection box for easy termination. A fully rated, isolated neutral connection must be included by the generator set manufacturer.

- 2.2.6 The alternator shall use a single, sealed bearing design. The rotor shall be connected to the engine flywheel using flexible drive disks. The stator shall be direct connected to the engine to ensure permanent alignment.
- 2.2.7 The alternator shall meet temperature rise standards of U.L. 2200 (120 degrees Celsius). The insulation system material shall be class "H" capable of withstanding 150 degrees Celsius temperature rise.
- 2.2.8 The alternator shall be protected against overloads and short circuit conditions by advanced control panel protective functions. The control panel is to provide a time current algorithm that protects the alternator against short circuits. To ensure precision protection and repeatable trip characteristics, these functions must be implemented electronically in the generator control panel -- thermal magnetic breaker implementation are not acceptable.
- 2.2.9 An alternator strip heater shall be installed to prevent moisture condensation from forming on the alternator windings. A tropical coating shall also be applied to the alternator windings to provide additional protection against the entrance of moisture.

2.3 Controls

- 2.3.1 The generator control system shall be a fully integrated microprocessor based control system for standby emergency engine generators meeting all requirements of N.F.P.A. 110 level 1.
- 2.3.2 The generator control system shall be a fully integrated control system enabling remote diagnostics and easy building management integration of all generator functions. The generator controller shall provide integrated and digital control over all generator functions including: bi-fuel control, engine protection, alternator protection, speed governing, voltage regulation and all related generator operations. The generator controller must also provide seamless digital integration with the engine's electronic engine control module (E.C.M.) if so equipped. Generator controller's that utilize separate voltage regulators and speed governors or do not provide seamless integration with the engine management system are considered less desirable.
- 2.3.3 Communications shall be supported with building automation via the Modbus protocol without network cards. Optional internet and intranet connectivity shall be available.
- 2.3.4 The control system shall provide an environmentally sealed design including encapsulated circuit boards and sealed automotive style plugs for all sensors and circuit board connections. The use of non-encapsulated boards, edge cards, and pc ribbon cable connections are considered unacceptable.
- 2.3.5 Circuit boards shall utilize surface mount technology to provide vibration durability. Circuit boards that utilize large capacitors or heat sinks must utilize encapsulation methods to securely support these components.

- 2.3.6 A predictive maintenance algorithm that alarms when maintenance is required. The controller shall have the capability to call out to the local servicing dealer when maintenance is required.
- 2.3.7 Diagnostic capabilities should include time-stamped event and alarm logs, ability to capture operational parameters during events, simultaneous monitoring of all input or output parameters, callout capabilities, support for multi-channel digital strip chart functionality and .2 millisecond data logging capabilities.
- 2.3.8 In addition to standard N.F.P.A. 110 alarms, the application loads should also be protected through instantaneous and steady state protective settings on system voltage, frequency, and power levels.
- 2.3.9 The control system shall provide pre-wired customer use I/O: 4 relay outputs (user definable functions), communications support via RS232 and RS485. Additional I/O must be an available option.
- 2.3.10 Customer I/O shall be software configurable providing full access to all alarm, event, data logging, and shutdown functionality. In addition, custom ladder logic functionality inside the generator controller shall be supported to provide application support flexibility. The ladder logic function shall have access to all the controller inputs and customer assignable outputs.
- 2.3.11 The control panel will display all user pertinent unit parameters including: engine and alternator operating conditions; oil pressure and optional oil temperature; coolant temperature and level alarm; fuel level (where applicable); engine speed; D.C. battery voltage; run time hours; generator voltages, amps, frequency, kilowatts, and power factor; alarm status and current alarm(s) condition per N.F.P.A. 110 level 1.

2.4 Engine/Alternator Packaging

- 2.4.1 The engine/alternator shall be isolated from the generator frame with rubber isolators. The packaging shall not require the addition of external spring isolators.
- 2.4.2 A mainline, thermal magnetic circuit breaker carrying the UL mark shall be factory installed. The breaker shall be rated between 100 to 125 percent of the rated ampacity of the genset. The line side connections are to be made at the factory. Output lugs shall be provided for load side connections.
- 2.4.3 A second mainline, thermal magnetic circuit breaker carrying the UL mark shall be factory installed. The breaker shall be rated 200 amps. The line side connections are to be made at the factory. Output lugs shall be provided for load side connections.
- 2.4.4 The generator shall include a unit mounted auxiliary power load center. All ancillary A.C. devices (block heater, battery charger, alternator strip heater, etcetera) shall have a dedicated breaker within the load center.

2.5 Enclosure

- 2.5.1 The genset shall be packaged with a sound attenuating enclosure.

- 2.5.2 The enclosure shall be completely lined with sound deadening material. This material must be of a self extinguishing design with a reflective surface for enhanced serviceability.
- 2.5.3 The enclosure shall be made of steel with a minimum thickness of 16 gauge. The enclosure is to have hinged, removable doors to allow access to the engine, alternator and control panel. The hinges shall allow for door fit adjustment. Hinges and all exposed fasteners will be stainless steel or Sermagard coated. The use of pop-rivets weakens the paint system and not allowed on external painted surfaces. Each door will have lockable hardware with identical keys.
- 2.5.4 The enclosure shall be coated with electrostatic applied powder paint, baked and finished to manufacturer's specifications. The color will be manufacturer's standard.
- 2.5.5 The enclosure shall utilize an upward discharging radiator hood. Due to concerns relative to radiator damage, circulating exhaust, and prevailing winds, equipment without a radiator discharge hood will not be acceptable.
- 2.5.6 The genset silencer shall be mounted on the discharge hood of the enclosure. Due to architectural concerns, silencers mounted on the top of the generator enclosure are not acceptable. Gensets with silencers mounted inside the main generator compartment are acceptable only if the silencer is thermally wrapped to minimize heat stress on the surrounding components.

2.6 Sub-base fuel tank

- 2.6.1 The packaging shall include a double wall, sub-base mounted, U.L.142 listed fuel tank. The tank shall be sized to provide 48 hours of run time.
- 2.6.2 The tank shall include fuel suction and return connections, normal and emergency vents, secondary containment emergency vent and rupture basin sensor, mechanical fuel level indication and a stub-up area convenient for electrical conduit entry.
- 2.6.3 The fuel tank shall use an electric fuel sensor to provide an analog indication of fuel level. The controller shall have a warning indication on low fuel level and provide optional shutdown functionality for low, low fuel level.
- 2.6.4 The fuel tank shall be equipped with a vacuum alarm which is to be tied into the generator control panel.
- 2.6.5 The fuel tank must be supplied by the engine-generator set manufacturer and be installed before shipment

Loose Items

- 2.7.1 Supplier to itemize loose parts that require site mounting and installation. Preference will be shown for gensets that factory mount items like mufflers, battery chargers, etcetera.
- 2.7.2 Spare Parts:
 - .1 Fuses: One spare set
 - .2 Filters One spare set (air, fuel, oil)

3 ADDITIONAL PROJECT REQUIREMENTS

3.1 Factory testing

3.1.1 Before shipment of the equipment, the engine-generator set shall be tested under rated load for performance and proper functioning of control and interfacing circuits. Tests shall include:

- .1 Verify voltage and frequency stability.
- .2 Verify transient voltage and frequency dip response.
- .3 Load test the generator for 2 hours.

3.2 Manuals

3.2.1 Three (3) sets of owner's manuals specific to the product supplied must accompany delivery of the equipment. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included.

3.3 Installation

3.3.1 Contractor shall install the complete electrical generating system including all external fuel connections in accordance with requirements of N.E.C., N.F.P.A., CSA and the manufacturer's recommendations as reviewed by the Engineer.

3.3.2 Contractor shall include first fill of diesel tank including top up after load bank testing.

3.4 Service

3.4.1 Supplier of the genset and associated items shall have permanent service facilities in this trade area. These facilities shall comprise a permanent force of factory trained service personnel on 24 hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the owner maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Service contracts shall also be available.

3.5 Warranty

3.5.1 The standby electric generating system components, complete genset and instrumentation panel shall be warranted by the manufacturer against defective materials and factory workmanship for a period of ten (10) years. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for parts, labor and travel.

3.5.2 The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etcetera.) will not be acceptable. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty

for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

3.6 CSA C282 Maintenance

- 3.6.1 Provide services to perform all required CSA C282 maintenance requirements during the first year of service. Maintenance tasks shall include items required for monthly, semi-annual and annual tasks as dictated by the standard including the annual load bank test.

3.7 Startup and Commissioning

- 3.7.1 The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to validate the completed installation and to perform an initial startup inspection to include:

- .1 Ensuring the engine starts (both hot and cold) within the specified time.
- .2 Verification of engine parameters within specification.
- .3 Verify no load frequency and voltage, adjusting if required.
- .4 Test all automatic shutdowns of the engine-generator.
- .5 Perform a load test of the electric plant, ensuring full load frequency and voltage are within specification by using building load.

3.8 Training

- 3.8.1 Training is to be supplied by the start-up technician for the end-user during commissioning. The training should cover basic generator operation and common generator issues that can be managed by the end-user.
- 3.8.2 Training is to include manual operation of system.
- 3.8.3 Allow for two (2) 3 hour training sessions. Session date and times to be coordinated with owner.

END OF SECTION

1 GENERAL

1.1 Scope

- 1.1.1 Provide complete factory assembled power transfer equipment with field programmable digital electronic controls designed for fully automatic operation and including: surge voltage isolation, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.
- 1.1.2 The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for all the products provided. Technicians specifically trained to support the product and employed by the generator set supplier shall service the transfer switches. The generator set and transfer switch shall be warranted for one year.

1.2 Codes and Standards

- 1.2.1 The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
 - .1 C.S.A. 282-15, Emergency Electrical Power Supply for Buildings
 - .2 N.F.P.A.70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
 - .3 N.F.P.A.110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems.
 - .4 I.E.E.E. 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
 - .5 N.E.M.A. I.C.S. 10-1993 – A.C. Automatic Transfer Switches.
- 1.2.2 The transfer switch assembly shall comply with the following standards:
 - .1 C.S.A. C22.2, No. 14 – M91 Industrial Control Equipment.
 - .2 E.N. 55011, Class B Radiated Emissions
 - .3 E.N. 55011, Class B Conducted Emissions
 - .4 I.E.C. 1000-4-5 (E.N. 61000-4-5) AC Surge Immunity.
 - .5 I.E.C. 1000-4-4 (E.N. 61000-4-4) Fast Transients Immunity
 - .6 I.E.C. 1000-4-2 (E.N. 61000-4-2) Electrostatic Discharge Immunity

- .7 I.E.C. 1000-4-3 (E.N. 61000-4-3) Radiated Field Immunity
- .8 I.E.C. 1000-4-6 Conducted Field Immunity
- .9 I.E.C. 1000-4-11 Voltage Dip Immunity.
- .10 I.E.E.E. 62.41, A.C. Voltage Surge Immunity.
- .11 I.E.E.E. 62.45, A.C. Voltage Surge.
- .12 U.L. 1008 – Transfer Switches. Transfer switches shall be U.L. 1008 listed. U.L. 1008 transfer switches shall be supplied in U.L. 891 enclosures if necessary to meet the physical requirements of the project.

1.2.3 The transfer switch manufacturer shall be certified to I.S.O. 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with I.S.O. 9001.

1.3 Acceptable Manufacturers

1.3.1 Generator set manufacturers shall supply the transfer switch. Equipment specifications for this project are based on microprocessor-based transfer switches.

2 PART 2 - PRODUCTS

2.1 Power Transfer Switch

2.1.1 Ratings

- .1 The transfer switch shall be 400 ampere, 3-pole, 60 cycle, 1-phase, 120/240 V.A.C. with solid neutral sized for the new 100 kilowatt standby power generator. Transfer switch shall be double sided bypass.
- .2 Main contacts shall be rated for 240 volts A.C. minimum.
- .3 Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of minus 40 to plus 60 degrees Celcius, relative humidity up to 95 percent (non-condensing), and altitudes up to 10,000 feet (3000 meters).
- .4 Transfer switch equipment shall have withstand and closing ratings (W.C.R.) in R.M.S. symmetrical amperes greater than the available fault currents shown on the drawings and at the specified voltage. The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third party listed and labeled for use with the specific protective device(s) installed in the application.

2.1.2 Construction

- .1 Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source one and source two positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.
- .2 Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms.
- .3 Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
- .4 Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.
- .5 Power transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
- .6 Transfer switches designated on the drawings as 4-pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.
- .7 Transfer switches that are designated on the drawings as 3-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100 percent of the current designated on the switch rating.
- .8 The transfer switch shall be factory mounted in a custom cabinet designed to interface with the existing Commander switchgear. The cabinet will include space for buss extensions and terminal lugs to extend cable to the transfer switch terminals. Include for all required buss, barriers and cable supports.

2.1.3 Connections

- .1 Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
- .2 Transfer switch shall be provided with A.L./C.U. mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

2.2 Transfer Switch Control

2.2.1 Operator Panel: Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated N.E.M.A. 3R/I.P.53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities:

- .1 High intensity L.E.D. lamps to indicate the source that the load is connected to (source one or source two); and which source(s) are available. Source available L.E.D. indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.
- .2 High intensity L.E.D. lamps to indicate that the transfer switch is "not in auto" (due to control being disabled or due to bypass switch (when used) enabled or in operation) and "Test/Exercise Active" to indicate that the control system is testing or exercising the generator set.
- .3 "OVERRIDE" pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.
- .4 "TEST" pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.
- .5 "RESET/LAMP TEST" pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.
- .6 The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via a P.C. based service tool and an operator display panel.
- .7 Security Key Switch to allow the user to inhibit adjustments, manual operation or testing of the transfer switch unless key is in place and operated.
- .8 Analog A.C. meter display panel, to display 1-phase A.C. amperes, 1-phase A.C. volts, hertz, kilowatt load level, and load power factor. The display shall be color-coded, with green scale indicating normal or acceptable operating level, yellow indicating conditions nearing a fault, and red indicating operation in excess of rated conditions for the transfer switch.
- .9 Vacuum fluorescent alphanumeric display panel with push-button navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The alphanumeric display panel shall be capable of providing the following functions and capabilities:

- .1 Display source condition information, including A.C. voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance. Line to neutral voltages shall be displayed for 3 wire systems.
- .2 Display source status, to indicate source is connected or not connected.
- .3 Display load data, including 1-phase A.C. voltage, 1-phase A.C. current, frequency, kilowatt, kilovolt-ampere, and power factor. Voltage and current data for all phases shall be displayed on a single screen.
- .4 The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:
 - .1 Set nominal voltage and frequency for the transfer switch.
 - .2 Adjust voltage and frequency sensor operation set points.
 - .3 Set up time clock functions.
 - .4 Set up load sequence functions.
 - .5 Enable or disable control functions in the transfer switch, including program transition.
 - .6 Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.
- .5 Display Real time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
- .6 Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.
- .7 Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller D.C. voltage, A.T.S. fail to close on transfer, A.T.S. fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.

2.2.2 Internal Controls

- .1 The transfer switch control system shall be configurable in the field for any operating voltage level up to 240 V.A.C. Provide R.M.S. voltage sensing and metering that is accurate to within plus or minus 1 percent of nominal voltage level. Frequency

sensing shall be accurate to within plus or minus 0.2 percent. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.

- .2 Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:
 - .1 Monitoring all phases of the normal service (source one) for under voltage conditions (adjustable for pickup in a range of 85 to 98 percent of the normal voltage level and dropout in a range of 75 to 98 percent of normal voltage level).
 - .2 Monitoring all phases of the emergency service (source two) for under voltage conditions (adjustable for pickup in a range of 85 to 98 percent of the normal voltage level and dropout in a range of 75 to 98 percent of pickup voltage level).
 - .3 Monitoring all phases of the normal service (source one) and emergency service (source two) for voltage imbalance.
 - .4 Monitoring all phases of the normal service (source one) and emergency service (source two) for loss of a single phase.
 - .5 Monitoring all phases of the normal service (source one) and emergency service (source two) for phase rotation.
 - .6 Monitoring all phases of the normal service (source one) and emergency service (source two) for over voltage conditions (adjustable for dropout over a range of 105 to 135 percent of normal voltage, and pickup at 95 to 99 percent of dropout voltage level).
 - .7 Monitoring all phases of the normal service (source one) and emergency service (source two) for over or under frequency conditions.
 - .8 Monitoring the neutral current flow in the load side of the transfer switch. The control shall initiate an alarm when the neutral current exceeds a preset adjustable value in the range of 100 to 150 percent of rated phase current for more than an adjustable time period of 10 to 60 seconds.
- .3 All transfer switch sensing shall be configurable from a Windows P.C. based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing D.I.P. switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic L.E.D. lamps.
- .4 The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.

- .5 The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0 to 15 seconds); transfer (adjustable in a range from 0 to 120 seconds); retransfer (adjustable in a range from 0 to 30 minutes); and generator stop (cooldown) (adjustable in a range of 0 to 30 minutes).
- .6 The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device for load shedding purposes. On receipt of this signal, the transfer switch shall switch to a neutral position when connected to source two. If source one is available when the load-shed signal is received, the transfer switch shall connect to source one.
- .7 The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.
- .8 The transfer switch shall provide a relay contact signal prior to transfer or retransfer. The time period before and after transfer shall be adjustable in a range of 0 to 50 seconds.
- .9 The control system shall be designed and prototype tested for operation in ambient temperatures from minus 40 degrees Celcius to plus 70 degrees Celcius. It shall be designed and tested to comply with the requirements of the noted voltage and R.F.I./E.M.I. standards.
- .10 The control shall have optically isolated logic inputs, high isolation transformers for A.C. inputs, and relays on all outputs, to provide optimum protection from line voltage surges, R.F.I. and E.M.I.

2.2.3 Control Interface

- .1 The transfer switch will provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C., for compatibility with any generator set.
- .2 Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amperes 250 V.A.C.
- .3 The transfer switch shall provide relay contacts to indicate the following conditions: source one available, load connected to source one, source two available, source two connected to load.
- .4 The transfer switch shall provide auxiliary contacts for annunciation at the security alarm control panel for generator running status and for a common alarm to annunciate upon any conditions noted on drawings.

2.3 Enclosure

- 2.3.1 Enclosures shall be U.L. listed. The enclosure shall provide wire bend space in compliance to the latest version of N.F.P.A.70. The cabinet door shall include permanently mounted key type latches.

- 2.3.2 Transfer switch equipment shall be provided in a N.E.M.A. 3R or better enclosure.
- 2.3.3 The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

3 EXECUTION

3.1 Operation

3.1.1 Open Transition Sequence of Operation

- .1 Transfer switch normally connects an energized utility power source (source one) to loads and a generator set (source two) to the loads when normal source fails. The normal position of the transfer switch is source one (connected to the utility), and no start signal is supplied to the genset.
- .2 Generator Set Exercise (Test) With Load Mode. The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:
 - .1 Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
 - .2 The transfer switch shall issue a compatible start command to the generator when the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
 - .3 The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period, the transfer switch shall automatically reconnect the generator set to the normal service.
 - .4 On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
 - .5 The transfer switch shall operate the generator set unloaded for a cooldown period, and then remove the start signal from the generator set. If the normal

power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

- .3 Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:
 - .1 Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
 - .2 When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.
 - .3 At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

3.2 Factory Testing

- 3.2.1 The transfer switch manufacturer shall perform a complete operational test on the transfer switch prior to shipping from the factory. A certified test report shall be available on request. Test process shall include calibration of voltage sensors.

3.3 Service and Support

- 3.3.1 The manufacturer of the transfer switch shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.
- 3.3.2 The transfer switch shall be serviced by a local service organization that is trained and factory certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
- 3.3.3 The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.
- 3.3.4 After generator set installation, the generator set supplier shall conduct complete operation, basic maintenance, and emergency service training for up to 10 persons employed by the facility owner. The training shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the P.C. based service and maintenance tools provided under this contract, and emergency operation procedures. The training shall include practical operation with the installed equipment. Refer to Generator Specifications for training hours to be included.

END OF SECTION

1 PART 1 - GENERAL

1.1 References

- 1.1.1 CAN/ULC-S524 (latest edition), Installation of Fire Alarm Systems.
- 1.1.2 ULC-S525 (latest edition), Audible Signal Appliances for Fire Alarm Systems.
- 1.1.3 CAN/ULC-S526 (latest edition), Visual Signal Appliances, Fire Alarm.
- 1.1.4 CAN/ULC-S527 (latest edition), Control Units, Fire Alarm.
- 1.1.5 CAN/ULC-S528 (latest edition), Manual Pull Stations.
- 1.1.6 CAN/ULC-S529 (latest edition), Smoke Detectors.
- 1.1.7 CAN/ULC-S530 (latest edition), Heated Actuated Fire Detectors, Fire Alarm.
- 1.1.8 CAN/ULC-S531 (latest edition), Smoke Alarms.
- 1.1.9 CAN/ULC-S536 (latest edition), Inspection and Testing of Fire Alarm Systems.
- 1.1.10 CAN/ULC-S537 (latest edition), Verification of Fire Alarm Systems.
- 1.1.11 OBC-2024, Ontario Building Code.

1.2 Description of System

1.2.1 System includes:

- .1 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
- .2 Trouble signal devices.
- .3 Power supply facilities.
- .4 Addressable manual alarm stations.
- .5 Addressable automatic alarm initiating devices.
- .6 Audible and visual signal devices.
- .7 End-of-line devices.
- .8 Annunciators.

.9 Ancillary devices.

.10 Interface and zone modules.

1.3 Requirements of Regulatory Agencies

1.3.1 This system is subject to review by local building department officials, local fire department officials. Therefore, submission of verification certificate and field technical device verification sheets is required prior to inspection by these officials. Schedule accordingly.

1.4 Shop Drawings

1.4.1 Submit shop drawings in accordance with Section 26 05 01.

1.4.2 Include:

.1 Layout of equipment

.2 Zoning

.3 Complete wiring diagram

1.5 Operation and Maintenance Data

1.5.1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual specified in Section 26 05 01.

1.5.2 Include:

.1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data – illustrated parts list with parts catalogue numbers.

.3 Copy of approved shop drawings.

.4 List of recommended spare parts for system.

1.6 Maintenance Materials

1.6.1 10% spare glass rods for total number of manual pull box stations if applicable.

1.7 Training

1.7.1 Arrange to pay for on-site demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system. **Obtain written receipt of training session and include in maintenance manual.**

1.8 System Operation**1.8.1 Operation of any alarm initiating device to:**

- .1 Cause audible and visual signal devices to sound throughout building.
- .2 Transmit signal to fire department via monitoring station.
- .3 Cause zone of alarm device to be indicated on control panel and remote annunciator(s).
- .4 Cause air conditioning and ventilating fans to shut down and to function so as to provide required control of smoke movement.
- .5 Cause fire doors and smoke control doors of normally held open, to close automatically.
- .6 Log the alarm in the historical alarm log file.

1.8.2 System Reset

- .1 It shall be possible to reset the fire alarm system until all the alarm zones have been properly reset or cleared.

1.8.3 System Trouble Operation

- .1 A trouble initiated by the actuation of a sprinkler system supervisory trouble switch shall cause the following to occur:
 - .1 An audible and visual trouble signal shall sound at the main control panel only until acknowledge by an operator.
 - .2 Annunciate the Supervisory Trouble Alarm at the main control panel LCD Display and all remote annunciator(s).
 - .3 Log the Supervisory Trouble Alarm in the Historical Trouble Log File.
 - .4 Cause the remote trouble indicator to activate.
- .2 Any system trouble shall cause the following to occur:
 - .1 An audible and visual trouble signal shall sound at the main control panel LCD Display Only until acknowledged by an operator.
 - .2 Log the trouble condition in the separate Historical Trouble Log File.

1.9 Performance Criteria

- 1.9.1 These specifications describe the minimum functional requirements for an electronically supervised, microprocessor based, fully integrated system. The initial installation shall

include all the necessary electronic hardware, software and memory for a completely operable system in accordance with these specifications.

1.10 Quality Assurance

- 1.10.1 Each and all items of the fire alarm system shall be listed as the products of a single manufacturer under the appropriate category by the Underwriter's Laboratories of Canada and shall bear the "ULC" label.
- 1.10.2 Each and all items of the fire alarm system shall be covered by a one year parts and labour warranty covering defects resulting from faulty workmanship and materials. The warranty shall be deemed to begin on the date the system is accepted by the Project Manager on issuance of the substantial performance certificate for the project.
- 1.10.3 All control equipment must have Transient Protection Devices to comply with ULC requirements.

1.11 Approved Manufacturer

- 1.11.1 Mircom FX4000-supplied by Mircom only (base specified system).
- 1.11.2 Simplex 4100ES.
- 1.11.3 Chubb Edwards EST3-supplied by Chubb-Edwards only.
- 1.11.4 No other alternate suppliers will be accepted.

2 PRODUCTS**2.1 General**

- 2.1.1 The fire alarm system shall be an addressable, single stage, zoned, non-coded, indicating, fully integrated fire alarm.
- 2.1.2 The fire alarm control panel shall allow for loading or editing of special instructions and operating sequences as required. The system shall be capable of on-site programming to accommodate expansion, and changes required by local codes. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.
- 2.1.3 The ability to selectively program input/output control functions based on ANDing, ORing, NOTing, Timed and Special Coded Operations is also to be incorporated in the resident software programming of the system.
- 2.1.4 The system shall have the ability to manually disable and enable any device/circuit individually for maintenance or testing purposes.
- 2.1.5 It shall be possible to reprogram selected or all smoke detector initiating zones for alarm verification.

- 2.1.6 It shall be possible to program an adjustable time delay circuit for each waterflow initiating circuit to prevent false alarms that may be caused by erroneous pressure surges in the sprinkler system.
- 2.1.7 All on site programming changes to the fire alarm system shall be password protected.
- 2.1.8 Wiring to any remote annunciator shall be supervised for open and ground conditions. A separate annunciator trouble indicator must be provided at the control panel, which shall illuminate and an audible trouble signal shall sound at the control panel upon the detection of an open or ground condition.
- 2.1.9 All Control Panels and Remote Annunciator Cabinets are to be properly grounded to building ground. Conduit ground will not be acceptable. The green coloured grounding loop shall be a minimum #14 AWG insulated copper conductor run in conduit. The ground loop shall be connected to building water supply to the line side of the water meter. Ground wire must not be run in same conduit as the Fire Alarm wiring.

2.2 Power Requirements

- 2.2.1 The control panels shall receive 120 VAC power via a dedicated overcurrent protected circuit. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator. A green "Power On" LED shall be displayed continuously while incoming power is present.
- 2.2.2 Control Panel output power supply shall have the following operating characteristics:
 - .1 Rated for five Amps continuous duty
 - .2 24 VDC filtered and regulated
 - .3 Power limited with a range of 20.4 VDC to 32 VDC.
 - .4 Automatic "Brownout" transfer to standby batteries when supply voltage falls to 102 VAC.
- 2.2.3 The system shall be provided with a sufficient standby capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of twenty-four hours with two hours of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
- 2.2.4 Battery charger shall have the following operating characteristics:
- 2.2.5 Ability to charge a range up to 33 AH to 70% of their capacity within 12 hours.
- 2.2.6 Compatible with either lead acid or nicad batteries.
- 2.2.7 All circuits requiring system operating power shall be individually fused at the control panel.

- 2.2.8 The system shall be modular in design to allow future expansion with a minimum of hardware additions and system interruptions.

2.3 Fire Alarm Control Panel

- 2.3.1 The fire alarm control panel construction shall be modular in design with solid state microprocessor based electronics. An 80 character Liquid Crystal Display shall indicate alarms, supervisory service conditions and any troubles. The panel shall include but not be limited to the following:

- .1 80 character LCD display
- .2 Local Energy, Shunt Master Box, or Reverse Polarity Remote Station Connection
- .3 Form C Trouble Contact
- .4 Earth Ground Supervision Circuit
- .5 Basic 8 A power supply
- .6 Automatic Battery Charger
- .7 Standby Batteries
- .8 Resident non-volatile programmable operating system memory for all operating requirements.
- .9 Five Programmable Multi-Function keys with status LED's
- .10 Red Alarm LED and Acknowledge Button
- .11 Yellow Supervisory Service LED and Acknowledge Button
- .12 Yellow Trouble LED and Acknowledge Button
- .13 Green Power on LED
- .14 Alarm/Signal Silence Button
- .15 System Reset Button
- .16 Operator Interface Keypad for Manual Control and System Information Access
- .17 Addressable Interface Control Card
- .18 Supervised Annunciator Circuit

- 2.3.2 The control panel shall be capable of chronologically logging and storing 300 events in an alarm log and 300 events in a trouble log. The historical logs shall be stored in the CPU's memory and shall be protected by a lithium battery that is supervised for a low battery

condition. Each recorded event shall include the time and date of that event's occurrence. The alarm log file must be separate from the trouble log file. It shall be possible for the user to generate a report of both logs upon request.

- 2.3.3 All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble.
- 2.3.4 Signal Circuits shall be independently supervised and fused such that a fault on one circuit shall not affect the operation of any of the other circuits. All signal circuits shall be configured as follows:
 - .1 Class "A" wiring, current limited.
 - .2 Rated at two Amps of continuous power.
 - .3 Capable of powering polarized 24 VDC audible and visual signaling appliances.
- 2.3.5 Provide dry contact auxiliary control circuits as follows:
 - .1 Central Station alarm output.
 - .2 Central Station trouble output.
 - .3 SPDT Form C relays fused at 2 A @ 24 VDC.
- 2.3.6 System Expansion Modules connected by ribbon cables shall be supervised for module placement. Should a module become disconnected the system trouble indicator must illuminate and audible trouble signal must sound.
- 2.3.7 The Fire Alarm Control Panel shall be capable of supporting RS-232-C I/O ports. CPU data output to the I/O ports shall be in parallel ASCII format at field adjustable baud rates of 220, 300, 1200, 2400 and 4800.
- 2.3.8 A walk test feature must be provided.
- 2.3.9 All system controls shall be housed in a surface wall mounted steel cabinets. Finish shall be according to the manufacturer's standards.
- 2.3.10 All modules shall be secured behind hinged locked door with a full viewing tempered plastic window. The hinged locked doors shall give access to all the operating controls but shall not expose live connections.
- 2.3.11 All internal wiring, control circuits, connections and terminals shall only be accessible behind a removable metal retainer plate.
- 2.3.12 All Cabinets are to be properly grounded to building ground. Conduit ground will not be acceptable.

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- 2.3.13 The system must provide communication with addressable initiating devices. All of these devices will be annunciated on the control panel's main LCD display. Annunciation shall include the following conditions for each point:
- .1 40 Character Zone/Device Location
 - .2 Type of Device
 - .3 Detector Status (Normal/Alarm/Trouble)
 - .4 Device Missing/Failed
- 2.3.14 The communication format must be a completely digital poll/response protocol to allow tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol.
- 2.3.15 Each addressable device must be uniquely identified by an address code entered on each device base at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact.
- 2.3.16 It shall be possible for the owner's representative to change a smoke detector without any special tools or programming.
- 2.3.17 The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions. Systems, which cannot support 100% of their point capacity in alarm simultaneously, cannot assure appropriate system response and are not acceptable.
- 2.3.18 The appropriate quantity of isolator modules shall be installed so that a wiring fault (short, open or ground) within one floor area shall not prevent the normal operation of other addressable devices on other floor areas.
- 2.3.19 The system shall **maintain** the sensitivity level set, for each sensor, over time by automatically compensating for environmental factors such as dust and dirt accumulations in a smoke sensor's chamber. The smoke sensor shall be a smoke density measuring device having no self-contained set-point. **The control panel shall determine the alarm decision for each sensor.**
- 2.3.20 The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined value a 'Dirty Sensor' trouble condition shall be audibly and visually indicated at the control panel for the individual sensor.
- 2.3.21 All data transmissions, **including the analogue value**, between the smoke sensors and the control panel shall be digitally transmitted and incorporate parity and checksum digital data checks of each transmission.
- 2.3.22 An operator from the control panel, having a proper access level, shall have the ability to:

- .1 Manually access and print the following information for each sensor in a report format that can be easily understood by the user:
 - .1 Primary Status
 - .2 Device Type
 - .3 Present Average Value
 - .4 Present Sensitivity Selected
 - .5 Highest Peak Detection Values
 - .6 Sensor Chamber Status (Normal, Almost Dirty, Dirty, Excessively Dirty)
- .2 Manually control the following of each sensor:
 - .1
 - .2 Clear Peak Detection Values
 - .3
 - .4 Enable or Disable the Point
 - .5
 - .6 Clear Verification Tally
 - .7
 - .8 Control a Sensor's Relay Driver Output
 - .9
- .3 It shall be possible to program the control panel to **automatically** charge the sensitivity settings of each sensor based on **time-of-day** and **day-of-week**.

2.4 Addressable Manual Alarm Stations

- 2.4.1 Manual alarm stations shall be addressable, single action, non-coded, semi-flush mounted type. Pull stations shall be break-glass style. Contacts are to activate when handle is pulled down.
- 2.4.2 Addressable pull station electronics shall be mounted to the back plate of the station. The station's address will be set at the time of installation. Device addressing shall be accomplished by either an electrical or mechanical means.

- 2.4.3 Where noted on drawings, stations are to be equipped with tamperproof guard equal to Stopper II Cat. # STI-1100.

2.5 Intelligent Detectors – General Operation

- 2.5.1 Addressable devices shall use simple to install and maintain decade, numbered 0 to 9, address switches. Detectors that have expanded addressing will have decade switch numbered from 0 to 15 for the most significant digit to allow detector addressing from 1 to 250.
- 2.5.2 Device addressing shall be accomplished by either an electrical or mechanical means.
- 2.5.3 Detectors shall be in Telligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel signaling line circuits.
- 2.5.4 Addressable smoke detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alar condition has been detected, if required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
- 2.5.5 The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.
- 2.5.6 Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance.
- 2.5.7 The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.
- 2.5.8 The detectors shall provide at test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
- 2.5.9 Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
- 2.5.10 Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
- 2.5.11 Detectors shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LEDs shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.

- 2.5.12 Addressable devices shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
- 2.5.13 The sensors shall be of a low profile design and ULC listed for both ceiling and wall mount applications.
- 2.5.14 Automatic smoke sensors shall be equipped with a dust cover, which shall be removed at the time of verification to prevent dust and dirt entering the smoke chamber during construction.
- 2.5.15 A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

2.6 Intelligent Multi-Detector

- 2.6.1 The intelligent multi-detector shall be an addressable device, which is designed to monitor photoelectric, ionization, and thermal technologies in a single sensing device. This detector shall utilize advanced electronics which react to smaller products of combustion found in fast flaming fires (ionization), slow smoldering fires (photoelectric), and heat (thermal) all within a single sensing device.
- 2.6.2 The multi-detector shall include two bicolour LEDs, which flash green in normal operation and turn on steady red in alarm.
- 2.6.3 Detectors are to be provided with relay base where noted on the drawings.
- 2.6.4 Separately mounted photoelectric ionization and heat detectors in the same location are not acceptable alternatives.

2.7 Fixed Temperature Heat Detector

- 2.7.1 These heat detectors shall have a low mass thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. The heat detector shall have a nominal alarm point rating of 57°C (135°F). The heat detector shall be rated for ceiling installation at a minimum of 21.3m (70') centres and be suitable for wall mount applications.

2.8 Fixed Temperature / Rate of Rise Heat Detector

- 2.8.1 These heat detectors shall have a low mass thermistor heat sensor and operate in a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 57°C (135°F) and a rate-of-rise alarm point of 9°C (15°F) per minute.

The heat detector shall be rated for ceiling installation at a minimum of 21.3m (70') centres and be suitable for wall mount applications.

2.9 Photoelectric Smoke Detectors

2.9.1 The intelligent photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging, and humidity. The photo detector shall be rated for ceiling installation at a minimum of Soft (Olin) centres and be suitable for wall mount applications.

2.9.2 The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3%. The photo detector shall be suitable for operation in the following environment:

- .1 Temperature: 0°C to 49°C (32°F to 120°F)
- .2 Humidity: 0-93% RH, no-condensing
- .3 Elevation: no limit

2.9.3 Detectors are to be provided with relay base where noted on the drawings.

2.10 Standard Detector Mounting Bases

2.10.1 Provide standard detector mounting bases suitable for mounting on North American 1-gang, 85mm (3-1/2") or 100mm (4") square box. The base shall, contain no electronics, support all detector types and have the following minimum requirements:

2.10.2 Removal of the respective detector shall not affect communications with other detectors.

2.10.3 Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.

2.11 Audible/Visual Signal Devices

2.11.1 Mini Horns: flush mounted temporal mini horn, 24 Vdc operation, selectable HIGH/LOW setting 94.5 dBA (high) / 89.8 dBA (low) at 3 m (10'), white or red coverplate, FM and ULC listed. Suitable for mounting on a single gang box.

2.11.2 Strobe: semi-recessed, 24 Vdc operation, complete with selectable 15/30/75/110 candela output (unless otherwise noted set at 15 cd), synchronized strobe, red finish, FM and ULC listed. Suitable for mounting on a single gang box.

2.11.3 Mini Horn/Strobe: flush mounted temporal combination mini horn/strobe, 24 Vdc operation, selectable HIGH/LOW setting 94.5 dBA (high) / 89.8 dBA (low) at 3 m (10') selectable 15/30/75/110 candela output (unless otherwise noted set at 15 cd), synchronized strobe white or red coverplate, FM and ULC listed. Suitable for mounting on a single gang box.

- .1 Signal devices with integral strobe lights in high abuse areas (i.e. hangar, change rooms, etc.) must be provided with protective wireguards.
- .2 Any surface mounted signal devices must be provided with suitable backboxes supplied by the manufacturer.
- .3 Provide synchronization modules to suit signal devices (if required by manufacturer).

2.12 Graphic Display (Passive)

- 2.12.1 The colour graphic display shall be computer printed on archival film. The film must be dimensionally stable and the inks utilized shall offer UV protection with no fade characteristics. The graphic image shall be electronically stored for easy access and future alterations. Electronic version of the floor plan is available from the Consultant for an agreed fee.
- 2.12.2 The building outline and zone area designations shall be depicted by a blank border and clearly labelled with description and zone number. A "You Are Here" notation shall be shown in red at the annunciator location and proper directional orientation must be observed.
- 2.12.3 The computer-printed film shall be placed on a 3 mm (1/8") thick white matte acrylic sheet and be protected by a 1/8" thick clear acrylic outer shield. The active display shall come complete with window to view the graphic display LED's.
- 2.12.4 The annunciator must be flush mounted at the location indicated and keyed similar to control panel.
- 2.12.5 In addition to the above, the graphic display shall be provided with:
 - .1 Green power on LED.
 - .2 Yellow system trouble LED.
 - .3 Red system alarm LED.
- 2.12.6 The annunciator shall be complete with an LCD display indicating alarm, supervisory and trouble conditions complete with status of all system conditions.

2.13 Intelligent Modules – General Operation

- 2.13.1 The modules shall have a minimum of 2 diagnostic LED's mounted behind a finished coverplate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes, which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:
 - .1 Temperature: 0°C to 49°C (32°F to 120°F)
 - .2 Humidity: 0-93% RH, non-condensing

2.14 Monitor Module

- 2.14.1 The monitor modules shall have the following operating characteristics:
- 2.14.2 A flashing LED indicates that the module is in communication with the control panel. The LED latches steady on alarm (subject to current limitations on the loop).
- 2.14.3 The monitor modules shall have the following features:

Nominal operating voltage:	15 to 32 VDC
Maximum current draw:	5.1 mA (LED on)
Average operating current:	400uA (LED flashing)
EOL resistance:	47K ohms.
Temperature range:	0°C to 49°C (32°F to 120°F)
Humidity range:	10% to 93%
noncondensing	
Dimensions:	114.3mm (4.5") high x 101.6 mm (4") wide x 31.75 mm (1.25") deep. Mounts to a 101.6 mm (4") square x 53.975 mm (2-1/8") deep box.

2.15 Isolator Module

- 2.15.1 Fault isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The fault isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop. If a wire-to-wire short occurs, the fault isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the fault isolator module shall automatically reconnect the isolated section of the SLC loop.
- 2.15.2 The fault isolator module shall not require any address-setting, and its' operations shall be totally automatic. It shall not be necessary to replace or reset a fault isolator module after its normal operation. The fault isolator module shall mount in a standard 10.16 cm (4") deep electrical box, in a surface-mounted backbox, or in the fire alarm control panel. It shall provide a single LED which shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

2.16 Control Module

- 2.16.1 Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification

appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay.

- 2.16.2 The control module NACs may be wired for Style Z or Style Y (Class A/B) with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% or all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

- 2.16.3** The control module shall be suitable for pilot duty applications and rate for minimum of 0.6 Amps at 30 VDC.

2.17 Sprinkler and Supervised Valve Connections

- 2.17.1 Sprinkler and standpipe system contacts shall be provided by Division 21 but connected into the fire alarm system by this Division.

2.18 ULC Monitoring

- 2.18.1 Obtain the services of an approved Fire Alarm monitoring company to obtain a ULC certificate for monitoring of Fire Alarm system.

.1 Approved Fire Alarm monitoring company: Alarm Systems

- 2.18.2 Provide monitoring system as required by code. Enclosures to be properly labelled and to be coloured red.

- 2.18.3 Provide redundant lines of communication for monitoring (one data and one phone line)

- 2.18.4 Provide security style control panel to monitor minimum of four points from the fire alarm control panel:

- .1 Fire Alarm
- .2 Fire Alarm Trouble
- .3 Fire Alarm Supervisory
- .4 Fire Alarm Tamper (Door Open)

2.19 System Wiring

- 2.19.1 The system wiring must be FSA rated in conformance with the Electrical Safety code to suit the type of installation.

- 2.19.2 Wiring shall be minimum #18 AWG twisted shielded pair in conduit. "Securex 2" armoured cable will be permitted to be used for "drops" to devices on accessible ceilings.

- 2.19.3 As indicated on system riser diagram initiating device wiring shall be run in a loop with a home run from the last device to the control panel (Class 'A' configuration).

- 2.19.4 Signal wiring is to be cross connected in a Class 'A' configuration.
- 2.19.5 Install isolator modules in service rooms no higher than 2.4 m AFF. Provide location of these devices at the time of shop drawing submission.
- 2.19.6 These are the basic wiring requirements for system operation. Prior to tender close manufacturer and contractor are to confirm all necessary wiring specifications and requirements.

3 EXECUTION

3.1 Installation

- 3.1.1 The entire system shall be installed in accordance with CAN/ULC-S524 (latest edition) and approved manufacturers manuals and wiring diagrams. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the Electrical Safety Code, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout.
- 3.1.2 Install main control panel and connect to AC power supply.
- 3.1.3 Locate and install manual alarm stations and connect to alarm circuit wiring.
- 3.1.4 Locate and install detectors and connect to alarm circuit wiring. **Do not mount detectors within 1m (39") of air outlets.** Maintain at least 600 mm (24") radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- 3.1.5 Connect alarm circuits to main control panel.
- 3.1.6 Locate and install signal devices and connect to signalling circuits.
- 3.1.7 Connect signalling circuits to main control panel.
- 3.1.8 Install remote annunciator panels and connect to annunciator circuit wiring.
- 3.1.9 Locate and install door releasing devices.
- 3.1.10 Locate and install remote relay units to control fan shut down.
- 3.1.11 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- 3.1.12 Connect fire suppression systems to control panel.
- 3.1.13 Elevator controllers are to be connected with 4 #14 conductors in conduit from fire alarm control panel to signal elevator recall in the event of a general alarm.
- 3.1.14 The manufacturer and electrical contractor are to allow in their tender the cost of additional devices noted below to be installed and verified in locations as directed by the Consultant.

The cost of the additional devices shall include remobilization (if required), verification and labour/material based on 5000mm of conduit and wire.

3.1.15 Note: This installation and verification will be occurring after the audibility testing is complete.

- .1 Smoke Detectors – Five
- .2 Heat Detectors – Five
- .3 Pull stations – Three
- .4 Horns – Five
- .5 Strobes – Five
- .6 Combination Horn/Strobes – Five
- .7 Signal DB reducers – Ten
- .8 Relay Module – One
- .9 Isolator Module – Three

3.2 Field Quality Control

3.2.1 The system shall be installed and fully tested under the supervision of trained manufacturer's representative. The system shall be demonstrated to perform all the functions as specified.

3.3 Acceptable Installer

3.3.1 The fire alarm/life safety system specified herein shall be installed by an Authorized Electrical Contractor who is CFAA Certified.

3.4 Examination

3.4.1 Prior to the commencement of any of the work detailed herein, an examination and analysis of the area(s) where the Fire Alarm/Life Safety System and all associated components are to be installed shall be made.

3.4.2 Any of these area(s) which are found to be outside the manufacturer's recommended environments for the particular specified products shall be noted on a Site Examination Report which shall be given to the Building Owner's Representative, and the Consultant.

3.4.3 Any shorts, opens, or grounds found on existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.

3.5 Demonstration

- 3.5.1 Each of the intended operations of the installed Fire Alarm/Life Safety System shall be demonstrated to the Building Owner's Representative and the Consultant.

3.6 System Test

- 3.6.1 Perform tests in accordance with Section 26 05 01 and CAN/ULC-S537 (latest edition) Standard for the Verification of Fire Alarm Systems.

3.6.2 Fire Alarm System:

- .1 Test each device and alarm circuit to ensure noted devices transmit alarm to control panel and actuate general alarm ancillary devices.
 - .2 Check annunciator panels to ensure zones are shown correctly.
 - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.
 - .4 Class A Circuits:
 - .1 Test each conductor on all circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - .2 Test each conductor on all circuits for capability of providing alarm signals during ground-fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
- 3.6.3 The control panel shall continuously perform as automatic self-test routine on each sensor, which will functionally check the sensor electronics and ensure the accuracy of the values being transmitted to the control panel.
- 3.6.4 Automatic testing will occur at a rate of one sensor every four minutes.
- 3.6.5 The sensor's average analogue value is the average of the last 2000 recorded analogue entries of its chamber.
- 3.6.6 Any sensor that fails this test shall indicate a '**SELF-TEST ABNORMAL**' trouble condition with the sensor's address at the control panel.
- 3.6.7 The system shall automatically indicate when an individual sensor needs cleaning. When the sensor's average value reaches a predetermined value, a '**DIRTY SENSOR**' trouble condition shall be audibly and visually indicated at the local control panel for that sensor. If a '**DIRTY SENSOR**' indication is left unattended and its average value increases to a second predetermined value, an '**EXCESSIVELY DIRTY SENSOR**' trouble condition shall be indicated at the local control panel for that sensor. To prevent false alarms, these '**DIRTY**'

conditions shall in no way decrease the amount of smoke obscuration necessary to generate an alarm condition.

3.6.8 An operator having a proper access level, shall have the capability to manually access the following information from the control panel:

- .1 Primary Status
- .2 Device Type
- .3 Present Average Value
- .4 Present Sensitivity Selected*
- .5 Highest Peak Detection Values (HVP) *
- .6 Sensor Range (Normal, Dirty, Excessively Dirty)

* Values shall be in 'percent of smoke obscuration' format so that no interpretation is required by the operator.

3.7 Audibility Testing

3.7.1 Audibility Testing:

- .1 The contractor is to coordinate an two (2) audibility tests prior to occupancy of the facility. The test is to be performed by the representatives of the fire alarm manufacturer in the presence of the Consultant. The test report is to be in chart form indicating:
 - .1 Project
 - .2 Date of test
 - .3 Room name and number
 - .4 Ambient dB level
 - .5 Alarm dB level
 - .6 Name of testing technician
- .2 The test results are to be submitted to the Consultant for review prior to issuing to Owner's representatives and/or authorities having jurisdiction. Second audibility test to be conducted after initial test results have been reviewed and remediation confirmed by Consultant, if required.

END OF SECTION

1 GENERAL**1.1 Shop Drawings**

- 1.1.1 Submit 6 sets of shop drawings to the electrical contractor for submission to the consultant for review.
- 1.1.2 Submit shop drawings of materials and equipment to be supplied on the project. Submission shall include manufacturer, dimensions, appearance and specifications.
- 1.1.3 Submit shop drawings for jacks, copper cable, faceplates, patch panels, racks, cable managers, patch cords, etcetera.

1.2 Product/Maintenance Data

- 1.2.1 Submit product/maintenance data for each system for inclusion in maintenance manual conforming to Section 26 05 01.

1.3 Scope

- 1.3.1 The scope of this Section will include the following system.
 - .1 Voice/data network installations.
- 1.3.2 Provide complete data cabling system

2 PRODUCTS**2.1 Voice/Data Network Installations**

- 2.1.1 The scope of work for this system shall be as follows:
 - .1 This work includes Category 6a voice and data cabling.
 - .2 Copper services between the communication rooms and a voice outlet shall consist of the one plenum rated Category 6 compliant four-paired unshielded twisted pair cable, and one plenum rated Category 6 compliant four-paired unshielded twisted pair cables for a data outlet.
 - .3 Horizontal data cables shall be terminated in Cat. 6 jacks at the workstation end and in Cat. 6 path panels at the communications closet end.
 - .4 Patch panels shall be mounted in racks(s) and/or cabinets as specified.
 - .5 Horizontal voice cables shall be terminated in Cat. 6 jacks at the workstation end and in BIX1A4 punch down blocks in the main telecommunication room. Punch down blocks shall be mounted in BIX10A complete with designation strips and labels.

- .6 A cable management system has been provided in the corridors for all voice and data cables. Outlets boxes and conduits have been provided at each outlet location. Conduits extend from the outlet box to the corridor and terminate adjacent to the cable management system.
- .7 Additional conduits have been provided to complement the cable management system. Refer to the floor plans.
- .8 Supply and install a complete voice and data structured cabling system as outlined in the tender drawings and specifications.
- .9 The installation of patch cords at the workstation end shall be by this contractor. The length of the patch cords shall be as follows: 7ft. long, with final lengths coordinated with owner.
- .10 The local area network system must be "protocol neutral" and provide users access into a variety of resources from any location within the building. An Ethernet backbone shall be utilized for the system with intelligent switching HUBS coordinating and managing data flow. The wiring configuration is based on a "physical star" topology in which cabling runs emanate in a radial pattern from the telecom rooms in which the intelligent switching equipment is located.
- .11 The Contractor shall provide cabling from main Hub Room to each location shown on drawings for future wireless access points. Contractor shall coil 6.1 meters (20 feet) of cable in ceiling space at location to allow for relocation as required by Owner's I.T. personnel. Identify each cable in main Hub Room.
- .12 All work performed must conform to the latest version of the applicable codes, standards and regulations of authorities having jurisdiction.
 - .1 A.N.S.I./T.I.A./E.I.A.-568-B Telecommunications Cabling Standard
 - .2 A.N.S.I./T.I.A./E.I.A.- 569 Pathway and Space
 - .3 I.S.O.-11801 Generic Cabling for Customer Premises
 - .4 B.I.C.S.I. Telecommunications Distribution Methods Manuals
 - .5 C.S.A. T530 Commercial Building Standard for Telecommunication Pathways and Spaces (ANSI/T.I.A./E.I.A.-569-A)
 - .6 C.S.A. T528 Administration Standards for the Telecommunications Pathway and Spaces. (ANSI/T.I.A./E.I.A.-606)
 - .7 C.S.A. T527 Commercial Building Grounding and Bonding Requirements for Telecommunications. (ANSI/T.I.A./E.I.A.-607)
 - .8 C.S.A. C22.1 Canadian Electric Code Part 1 - Ontario Electrical Safety Code

- .9 C.S.A. C22.2 No. 214 Communications Cables.
- .10 C.S.A. C22.2 No. 232-M Fibre Optic Cables.
- .11 O.B.C. Ontario Building Code
- .13 The Owner has standardized on Panduit for the Structured Cabling System. No alternative will be accepted, except where noted. Bidders must identify alternate products with their bids, including Manufacturer part numbers. No alternates will be considered unless they are clearly identified in the tender submission.
- .14 For the installation of Panduit Communications Products, the successful Bidder must:
 - .1 Be a member in good standing of Panduit ONE Partner accredited with the Deploy competency as of the date of installation. Contractor must be able to issue Certification Plus System Warranties. Bidder qualification must be in good standing prior to submitting its bid for the Project and on all dates when any work is performed on the Project.
 - .2 Submit with its bid evidence demonstrating membership in good standing as a Panduit ONE Partner.
 - .3 Perform all work on the Project in compliance with the requirements of this specification, the Contract and the Panduit ONE program.
 - .4 Once the structured cabling system has been installed, registered, and validated by Panduit, a Certification Plus System Warranty Certificate will be issued to the end user, providing them with confidence and security in their newly installed Panduit structured cabling system.
- .15 The successful bidder will be responsible for complete storage, handling, delivery and installation of all materials.
- .16 The Telecommunications Contractor will be responsible for cleanup related to his/her scope of work. The Contractor will be expected to remove all debris related to his work on a daily basis. Failure to comply will expose the Contractor to back-charges from the General Contractor or the Owner for clean-up on the Contractor's behalf.
- .17 The Contractor will have only tradesmen who are fully qualified and experienced in the installation of a certified communications cabling system and wireless network systems.
- .18 The successful Contractor will be required to submit the following documents, prior to being awarded the contract:
 - .1 Current training and certification status by the specified manufacturer of the Cabling System.

- .2 Proof of R.C.D.D. on staff. Registration information must be submitted with the shop drawings.
- .3 Experience in construction projects for related projects.
- .4 Experience in construction projects working for General Contractors.
- .5 Experience on troubleshooting and problem solving in data communication networks.
- .19 At least one member of the Contractor's project team must hold a current R.C.D.D. accreditation. The R.C.D.D. will be responsible for quality control and certification of the project.
- .20 A Project Manager and Foreman will be assigned to the project within 3 working days of contract award. These personnel will not be removed from the project without the prior consent of the Board's Representative.
- .21 The Contractor must comply with all job-site union requirements for the duration of the project.
- .22 The contractor will not subcontract any portion of the work, unless authorized in writing by the Board's Representative.
- .23 The Contractor must comply with all requirements of the Occupational Health and Safety Act, without exception.
- .24 Outlets where noted shall be single gang flush mounted in wall or surface raceways.
- .25 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.
- .26 A single manufacturer shall manufacture the specified cable and channel components. The manufacturer shall warrant the cable, channel components, and applications for a period as specified in the Warranty section.
- .27 Category 6a Cable
 - .1 Cable shall be 4 pair, 24 A.W.G. solid bare annealed copper conductors.
 - .2 The jacket shall be printed with TRU-Mark™ 1000 feet to 0 feet marking system, C.M.P. (F.T.-.6) rated with blue outer sheath for data and white outer sheath for voice.
 - .3 Shall be suitable for use indoor, riser or plenum, and horizontal applications.
 - .4 Category marking shall be printed every one foot.

- .5 Shall be independently verified to comply with T.I.A./E.I.A. 568-B.2 or T.I.A./E.I.A. 568-A-5.
- .6 Shall be packaged in a way protecting the cable.
- .7 Cable shall be A.N.S.I./T.I.A./E.I.A.-568-B-2 and I.S.O./I.E.C. 11801 category 6 compliant.
- .8 Attenuation shall be measured in accordance with T.I.A./E.I.A. 568B.2 and shall be maximum of 22.0 d.B. at 100 M.Hz.
- .9 Cable shall be exhibit positive P.S.A.C.R. above 200 M.Hz.
- .10 Cable shall be tested & characterized to 350 MHz.
- .11 Cable shall be U.L. LISTED.
- .12 An I.S.O. 9002 Certified Manufacturer shall make the Cable.
- .13 Cable shall exhibit the following transmission characteristics:

Frequency M.Hz.	NEXT dB	ELFEXT dB	Attenuation (d.B.)	Return Loss (d.B.)
1.0	70	64	2.0	20.0
4.0	61	52	4.1	23.0
10.0	55	44	6.5	25.0
16.0	52	40	8.2	25.0
20.0	50	38	9.3	25.0
31.25	47	34	11.7	23.6
62.5	43	28	17.0	21.5
100.0	40	24	22.0	20.1

- .14 The "Structured Cabling Plan" is an end to end solution which includes the data communication outlet and patch cord at the workstation and the patch panel, patch cords and racks at the HUB room.
- .15 Approved Manufacturers:

.16 Panduit Cat. # PFP6X04BU-UG (DATA)

.28 Faceplates

- .1 Faceplates shall be U.L. Listed C.S.A. Certified
- .2 Faceplates shall be constructed of stainless steel.
- .3 Faceplates shall be 2.75 inches Wide by 4.5 inches High (69.8 millimeters by 114.3 millimeters) for single gang and 4.5 inches by 4.5 inches (114.3 by 114.3 millimeters) double gang.
- .4 Faceplates shall be available to mount one, two, three, four, or six jacks in a single gang, and six or nine jacks in double gang configuration.
- .5 Two and three-port faceplates shall be available with thermal ink transfer stenciled port indications for voice and data or voice.
- .6 Faceplates shall provide for T.I.A./E.I.A. 606 compliant station labeling.
- .7 All horizontal data cable installed in surface raceway shall be terminated with jacks as specified following in a 3-port "DECO adapter" plate on the raceway outlet location. Provide plate to match selected raceway colour and provide blanks in ports not used. Surface faceplates on top of the raceway will not be permitted.
- .8 Approved Manufacturers:
 - .1 Panduit Cat. # C.F.P. Series

.29 Category 6a Modular Jack (Horizontal Cabling)

- .1 Jacks shall be 8-position un-keyed.
- .2 Each jack shall be individually constructed unit and shall snap mount in an industry standard manufacturer's opening (.760 inches by .580 inches).
- .3 Jack housings shall be high impact 94 V.0. rated thermoplastic.
- .4 Jacks shall have an operating temperature range of minus 10 degrees Celsius (14 degrees Fahrenheit) to 60 degrees Celsius (140 degrees Fahrenheit).
- .5 Modular jack contacts shall accept a minimum of 2500 plug insertions without degradation of electrical or mechanical performance.
- .6 Contacts shall maintain a minimum vertical deflection force of 110 grams.
- .7 Modular jack contacts shall be formed flat for increases surface contact with mated plugs. These contacts shall be arranged on the PC board in 2 staggered arrays of 4 maximize contact spacing and minimize crosstalk.

- .8 Modular jack contacts shall be constructed of Beryllium copper for maximum spring force and resilience.
- .9 Contact Plating shall be a minimum of 50 micro inches of gold in the contact area over 50 micro-inches of nickel.
- .10 Jack termination shall be industry standard insulation displacement contact, integral to the jack housing, laid out in 2 arrays of 4 contacts, positioned at angles to minimize the bending of terminated cables.
- .11 Jacks shall utilize a paired punch down sequence. Cable pairs shall be maintained up to the I.D.C., terminating all conductors adjacent to its pair mate to better maintain pair characteristics designed by the cable manufacturer.
- .12 Insulation displacement contacts shall utilize tin lead plated (60 percent tin per 40 percent lead) phosphor bronze.
- .13 Jacks shall terminate 22-26 A.W.G. standard or solid conductors.
- .14 Jacks shall terminate insulated conductors with outside diameters up to .050 inches.
- .15 Jacks shall be compatible with single conductor impact termination tools (if applicable).
- .16 Jacks shall include grey translucent wire retention stuffer caps to hold terminated wires in place while allowing conductors to be viewed in the I.D.C. housing. Stuffer caps may also be used for wire termination with parallel jaw pliers.
- .17 Jacks shall be compatible with E.I.A./T.I.A. 606 color code labeling and accept snap on icons for identification or designation of applications.
- .18 Jacks shall be designed for 100 Ohm U.T.P. cable termination.
- .19 Jacks shall be U.L. VERIFIED for T.I.A./E.I.A. Component compliant Category 6e electrical performance.
- .20 Jacks shall be U.L. LISTED 1863 and C.S.A. certified.
- .21 Jacks shall be manufactured by an I.S.O. 9002 Registered Manufacturer.
- .22 Jacks shall exhibit values, which exceed the following in a Channel Performance (ga) based on worst case in a 4-connector model verified at TEL Laboratories.

Frequency M.H.z.	ATTEN d.B.	PSNEXT d.B.	NEXT d.B.	ELFEXT d.B.	PSELFEXT d.B.	Return Loss d.B.
10	6	55.6	57.7	45.5	43.6	28.7
62.5	15	41.8	44.8	33.1	29.4	20.7
100	18.3	37	40.3	27	25.4	18.5
155	23.7	33.9	36.7	22.7	22	16.6
250	31.3	30.7	33.4	21.4	17.6	16.2

.23 Jacks shall exhibit a propagation delay of less than 5 ns.

.24 Jacks shall exhibit a delay skew of less than 1.25 ns.

.25 Approved Manufacturer:

Data: Panduit Cat. #CJ6X88TGBU

.30 Category 6a Patch Panels

- .1 Panels shall be made of black anodized .090 inch aluminum in 24 and 48-port configurations.
- .2 Panels shall accommodate 24 ports for each rack mount space or "U" (1U = 44.5 millimeters [1.75 inches]).
- .3 Panels shall be manufactured with a rolled-edge at the top and bottom for stiffness.
- .4 Panels shall have modular jacks employing staggered array contacts with a flat "hairpin" design made of Beryllium copper with a minimum 50-micro-inch gold plating on contact surfaces over 50-100 micro-inch of nickel compliant with F.C.C. part 68.
- .5 Panels shall be available in both T568A and T568B wiring schemes.
- .6 Panels shall be equipped with a termination made of fire retardant U.L. 940V0 rated thermoplastic and tin lead solder plated I.D.C.

- .7 Panel circuit boards shall be fully enclosed front and rear for physical protection.
- .8 Panels shall have port identification numbers on both the front and rear of the panels. The port identification numbers on the panel front shall be located so as to minimize obstruction by patch cords.
- .9 Panels shall have optional rear cable support bar for strain relief, which shall clip to the rear of the patch panel.
- .10 The panel front shall have two raised panel identification label fields to accept ½ foot label inserts.
- .11 Panels shall have self-adhesive, clear label holders and white designation labels provided with the panel for each 8 port adapter.
- .12 Panels shall provide wiring identification and colour code and maintain a paired punch down sequence that does not required the overlapping of cable pairs.
- .13 Panels shall terminate 22-26 A.W.G. solid conductors, maximum insulated conductor outside diameter 0.050 inches.
- .14 Panels shall be A.N.S.I./T.I.A./E.I.A.- 568-A- and I.S.O./I.E.C. 11801 Category 6e compliant.
- .15 Panels shall be U.L. VERIFIED for T.I.A./E.I.A. Category 6e performance.
- .16 Panels shall be U.L. LISTED 1863 and C.S.A. certified.
- .17 Panels shall be made by an I.S.O. 9002 Certified Manufacturer.
- .18 Panels shall exhibit a Component NEXT loss of at least the following:

Frequency M.H.z.	NEXT d.B.	FEXT d.B.	Attenuation d.B.
1.0	81.7	82.0	.01
4.0	70.9	69.6	.01
8.0	68.8	64.1	.01
10.0	67.3	62.1	.01
16.0	63.4	58.1	.02

20.0	61.5	56.1	.02
25.0	59.7	54.2	.03
31.25	57.8	52.2	.03
62.5	51.9	45.1	.05
100.0	47.1	68.9	.09

.19 Approved manufacturers:

Panduit 24 PORT Cat. #DP246X88TGY
 48 PORT Cat. #DP486X88TG

.31 Voice Terminations

- .1 All voice cables shall be terminated in the main telecommunication backboard in the Hub Room in BIX1A4 connectors mounted in BIX10A mounts. Supply and install all necessary accessories, designation strips, labels, D-rings, etcetera, for a complete installation.

.32 Patch Cords – U.P.T. (Category6a)

- .1 Copper patch cords shall be 100% tested to Category 6 A.N.I.S./T.I.A./E.I.A.-568-A-4 specifications.
- .2 Cord wiring shall be compatible with T568a and T568B wiring standards.
- .3 Patch cords shall have yellow jacket.
- .4 Provide one (1) cord for each each data port in the project plus 10% spare. Cable length shall be 7ft, with final lengths coordinated with owner.
- .5 Acceptable manufacturers:
- .1 Panduit Cat. # UTP28X#YLY ('#' indicates length as previously specified)

.33 Labels

- .1 Labels shall be mechanically printed. Hand written labels are not acceptable.

- .2 Supply and install self laminated labels at both ends of each cable. Cables shall be labeled as follows:
- .3 "ROOM #/PATCH PANEL LETTER/PORT#"
- .4 EXAMPLE: A cable in room 201, patch panel #A, port #12 shall be designated as 201/A/12.
- .5 NOTE: Labeling must be confirmed with Owner's Representative.
- .6 Supply and install labels at each outlet location. Labels shall be affixed to the faceplate on the space provided by the Manufacturer.
- .7 Workstation faceplates shall be designated in an identical duplicate manner as cables.
- .8 Patch panel ports shall be identified in simple numeric form.
- .9 Patch cords shall be identified at both ends in simple numeric form, not necessarily corresponding to port numbers.
- .10 All cable and workstations shall be recorded in a hard copy "CABLE IDENTIFICATION LOG" which is to be handed over to Manager of Computer Services after cable testing and certification is complete.

NOTE: The faceplate identification numbers/tags MUST be added to the electronic versions of the floor plans. BOTH a digital and paper copy of this plan must be submitted. This will be considered part of the AS Built contracts closeout submittals. The electronic version of the floor plan will be provided in an acceptable ACAD format by the Consultant.

.34 Data wiring termination rack:

- .1 All racks for this project are to be complete with the following features:
 - .1 Free standing, floor mounted.
 - .2 Standard 475 millimeters (19 inches) module compatible.
 - .3 44u or rack mounting space.
 - .4 Maximum dimensions: 550 millimeters (22 inches) Wide by 300 millimeters (12 inches) Deep by 2125 millimeters (85 inches) High.
 - .5 Each rack shall come complete with vertical cable managers installed (one mounted on each side). The vertical cable managers must run the full height of the rack mounting space and provide a minimum of 125 millimeters (5 inches) by 150 millimeters (6 inches) of cable management space on the outside of ganged racks and one 125 millimeters (5 inches) by 188 millimeters (7.5 inches) (minimum) in

between each pair of racks. The vertical cable manager must have hinged front doors and back and side cut outs to allow for Patch Cords. It must also have lancets along the back of the cable manager to allow for the fastening of the horizontal cable to the outside of the manager itself.

- .6 Each rack shall come complete with a hinged overhead cable manager installed, dimensions 100 millimeters (4 inches) by 150 millimeters (6 inches); both ends of the overhead management are to be completed with end caps.
- .7 For all racks the Cabling Contractor is to supply and install horizontal cable managers (compatible with standard 475 millimeters (19 inches) equipment racks). The horizontal cable managers are to be hinged at the front with vertical access to the patch panels above and below. Each horizontal cable manager is to be 2-rack unit (2U) in height. One chimney stack per rack minimum. Supply a total of 1 horizontal cable manager per 48 port patch panel plus 1 additional horizontal cable manager per rack.
- .8 Each rack is to come complete with one vertical power bar. Each power bar is to have 10 outlets (minimum) and surge protection. The power cord must be a minimum 1.8 meters (6 feet) in length to reach up to the overhead ceiling where it will plug into a 15 Amp receptacle (supplied by others). The power bars are to be non-switched and have 15 Amp twist lock receptacles, they are to be mounted on the left side of the rack at the back.
- .9 In all cases racks and components are to be black.
- .10 Approved manufacturers:
 - .1 RF MOTE Cat. #RFM-1944-RB 19" standing rack complete with
 - .2 RFM-RVCM - vertical managers
 - .3 RFM-119 HCT- top managers
 - .4 RFM-HCTE - ends caps
 - .5 RFM-76-PBVT - power strip
 - .6 RFM-192D-HCM-TD - horizontal manager
 - .7 Approved equals:
 - .8 Middle Atlantic
 - .9 Panduit CMR Series

.35 Grounding and Bonding

- .1 The grounding and bonding requirements of this project shall meet C.S.A. T527 and it intender to work in concert with the cabling topology and installed in accordance with C.S.A. T530 (telecommunication pathways and spaces standard).
- .2 A copper ground busbar will be established in each telecommunication room provided by the selected Electrical Contractor. Establish a communications ground that is continuous and permanent through all the telecommunication rooms.
- .3 Ground all racks, cabinets and pathways to the telecommunication grounding system using green #6 A.W.G. insulated stranded copper ground wire. This grounding is to be provided by the Electrical Contractor.

3 EXECUTION

3.1 Voice/Data Network Installations

- 3.1.1 Cabling Contractor is to adhere to all Standard, regulations and documents listed following.
- 3.1.2 All products installed must meet or exceed all local, provincial and federal building, fire, health, safety and electrical codes.
- 3.1.3 The responsibility of the network sub-contractor is to include but not be limited:
 - .1 Supply and installation of computer cabling to every outlet as noted on the drawings.
 - .2 Termination of computer cabling at outlet and distribution panel.
 - .3 Supply and installation of device faceplates in surface raceways and/or flush outlet boxes.
 - .4 Supply and installation of fibre optic cable.
 - .5 Supply and installation of computer network rack and distribution panels required for a complete and operational system. Interface server computer and hubs will be supplied complete by the Owner.
 - .6 Testing in conformance with noted procedures.
- 3.1.4 Co-ordinate work with Owner's Computer Services personnel.
 - .1 Labeling of outlet faceplates and associated port on distribution panel. An "As Built" floor pan "outlets addresses" must be provided at the completion of the project.

- 3.1.5 The Owner's Network Integrator must be present on site to witness and coordinate the required system testing. The cabling contractor and the Network Integrator must together perform a job walk through upon completion of testing, together sign the cabling test report to verify that network cabling is properly installed and performs to acceptable Owner's Standard.
- 3.1.6 The Electrical Contractor is to include all costs of the network sub-contractor in his tender. The Electrical Contractor must sub-contract and coordinate all work of the network sub-contractor.
- 3.1.7 General installation practices shall be as follows:
- .1 Supply and install cabling to locations as detained on floor plan(s). The Cabling Contractor shall use the cabling support system (support by others) to distribute the cables throughout the facility. Where the cables leave the cable support system and extend to the termination point they shall use the conduit provided or cable management system. Any horizontal exposed cable must be installed in surface raceways equal to Wiremold Series 500/700.
 - .2 All Cables and components to be installed and terminated in accordance with C.S.A., A.N.S.I./E.I.A./T.I.A. -568 and its' Amendments as well as UL Guidelines. Particular attention must be given to maintaining the integrity of the pair twists, bend radius and ensuing proper distance is kept from fluorescent light fixtures, electrical cables or any other source of E.M.I.
 - .3 Ensure A.N.S.I./E.I.A./T.I.A. -568A installation practices are followed. Cables are to be combed and bundled in a neat and organized manner. The Owner's Representative and/or Consultant will determine neatness of the installation. Cables that have not been properly combed and dressed will have to be re-dressed at the Cabling Contractor's expense. The Cabling Contractor shall coordinate with the Communications Consultant prior to termination in any communications room.
 - .4 The maximum horizontal run length is not to exceed 90 meters (300 feet). If the 90 meters (300 feet) constraint cannot be met, the Cabling Contractor is to notify the Consultant of any cables that exceed 90 meters (300 feet), prior to their installation.
 - .5 Any deviation from the cable routing, outlet and equipment locations shown on drawings must be approved by the Owner/Consultant and documented on as-built drawings.
 - .6 Avoid scraping, denting, or otherwise damaging cables, before, during or after installation. The Cabling Contractor without any additional compensation shall replace damaged cables.
 - .7 Ensure that all cable lengths are sufficient to allow for slack, vertical runs, wastage, connectorization and future moves.

- .8 Bush, ream, and remove any sharp projections on all conduits prior to installation of communications cables.
- .9 When terminating copper cables remove only enough cable jacket to perform termination, untwist pairs a maximum of 13 millimeters (1/2 inch) for Category 6, Enhanced Category 6 and proposed Category 6 cable.

3.1.8 Faceplates

- .1 Jacks and/or connectors shall be terminated to the appropriate cable and inserted in the correct orientation into the faceplate prior to the mounting of the faceplate.
- .2 Cable slack shall be stored behind the faceplate in such a way that allows the minimum bend radius of the cable to be maintained as per the following: Fibre Optic Cable, a minimum of 3 feet (1 meter) slack with a minimum bend radius of 1.18 inches (30 millimeters). U.T.P. cable, a minimum of 1 foot slack with a minimum bend radius of 4 times the cable diameter. Care shall be taken when mounting the faceplate to avoid crimping or kinking the cables.
- .3 Faceplates shall be securely mounted to a surface mounted housing, a recessed box, or box eliminator bracket.
- .4 Faceplates shall be labeled with the appropriate port designations as per the E.I.A./T.I.A. 606 standard.

3.1.9 Category 6 Jacks – U.T.P.

- .1 Jacks shall be installed to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair as a result of termination to the jack I.D.C. shall be no greater 0.5 inches (13 millimeters).
- .2 Jacks shall be installed according to manufacturer's instructions and properly mounted in plates, frames, housings or other appropriate mounting device.
- .3 Jacks shall be installed such that cables terminated to the jacks maintain minimum bend radius of at least 4 times the cable diameter into the I.D.C. contacts. Cables shall be terminated on jacks such that there is no tension on the conductors in the termination contacts.

3.1.10 Horizontal Cabling

- .1 Cable shall be installed to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair as a result of termination shall be no greater than 0.5 inches (13 millimeters).
- .2 Shall be installed according to manufacturer's instructions.

- .3 Shall be installed such that cables can maintain minimum bend radius of at least 4 times the cable diameter. Cables shall be terminated in such a way that there is no tension on the conductors in the termination contacts.
- .4 Shall be properly labeled on front and back with the cable number and port connections for each port.
- .5 Shall be installed in one continuous length unless specified in the contract document.
- .6 Adhere to T.I.A. standard requirements regarding pulling tension and allowable lubricants.
- .7 The Contractor shall assume the responsibility for any difficulties or damage to the cable during placement.
- .8 Contractor shall provide Owner with all installed cable measurements.
- .9 Firestop all openings where cable is installed through a fire barrier.
- .10 All cables shall have sufficient slack for retermination five times at both ends. Strain relief shall be provided sufficiently to secure cables to terminal panels. All cables are to be neatly tie-wrapped (plenum rated tie wraps) through wiring trays.
- .11 All data communication cables shall be separated from sources of electromagnetic radiation in accordance with T.I.A. Standard proposal SP-2072 and the following:
 - .1 If both data and small power cable (2 k.V.A. power circuits) are installed in grounded, ferrous metal conduit throughout the run, then no separation is required. (i.e. E.M.T. conduit).
 - .2 C.M.P. (FT-6) rated data cabling with no metallic raceway and power conductors (2 K.V.A. power circuits) in grounded raceway requires 5" (125 millimeters) clearance.
 - .3 For fluorescent luminaires the required clearance is 12 inches (300 millimeters).
 - .4 Clearance increased up to 24 inches (600 millimeters) for power circuits over 5 K.V.A.
 - .5 For large motor, transformer, power panels, etcetera, the required clearance is 40 inches (1 meter).
 - .6 Cables must be routed to avoid direct contact with steam piping, hot water piping or other heat sources to avoid thermal degradation.

3.1.11 Testing

- .1 The communications Contractor shall perform a full Category 6e test for every data drop installed in order to verify for a 100/1000 megabits per second solution. Testers to be used shall be Microtest Omniscanner or Fluke D.S.P. 4000.
- .2 Upon completion of the testing, the Consultant may ask the Contractor to perform random tests of up to 30% of the cables. A penalty of \$50.00 will be deducted from the contract amount for each cable that fails the test.
- .3 All tests shall be in accordance with A.N.S.I./E.I.A./T.I.A. =568B.1, Section 11, Cabling Transmission Performance and Test Requirements.
- .4 Category 6e field test parameters shall be:
 - .1 Wiremap
 - .2 Insertion loss
 - .3 Equal-level far end cross-talk (ELFEXT)
 - .4 Power sum Equal-level far end cross talk (PSELFEXT)
 - .5 Propagation Delay
 - .6 Length
 - .7 Near end cross talk (NEXT)
 - .8 Power sum near end cross talk (PSNEXT)
 - .9 Return loss
 - .10 Delay skew
- .5 Voice cables shall also be tested for continuity, shorts, opens, grounds, correct polarity and length.
- .6 Jacks shall be tested as part of the installed horizontal cabling system.
- .7 Category 6e Jacks shall be tested as part of the channel for Length, DC continuity, NEXT, PSNEXT, Attenuation, Return Loss, ELFEXT, and PSELFEXT using a level IIe tester for Category 6e channel compliance.
- .8 Test patch cords to portable tester must be designed for testing by the manufacturer. Field assembled patch cords are not acceptable. Field testers must use the appropriate jack/tester adapter specified for use with the cabling jack(s) specified within this document.
- .9 The nominal velocity of propagation (N.V.P.) must be set specify to each cable manufacturer before testing. Portable tester to be calibrated on a minimum annual basis.

- .10 Testing of horizontal cables is to be completed in accordance with the following test criteria. The testing must be completed on the Channel Level. Testing is to be completed from both ends of the installed cable. Testing of the cabling must confirm to the following Standards: Category 6e: E.I.A./T.I.A. -568-A-5 'Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 E.
- .11 Cabling Contractor to produce a test report based on the cable schedules. The report should indicate for each cable, when it was tested successfully and the signature of the technician that performed the test, location, cable type, cable number and tester make and model. A copy of the test report must be submitted to the Consultants for approval. The entire report must be signed by an authorized person for the Cabling Contractor at the end of the project.
- .12 Correct all cable faults. Splicing of any cables will not be permitted, for any reason, unless prior authorization is received in writing from the Consultant.
- .13 A "PASS" indication shall be obtained for all link or channel tests when tested using the appropriate level tester for the appropriate category.
- .14 Testers shall be correctly set to test the type and manufacturer of the horizontal cable used in the link or channel being tested, including the correct N.V.P.
- .15 Link attenuation shall be calculated as: *Link attenuation = cable attenuation + connector insertion loss + splice insertion loss.*
- .16 The Owner's Computer Services personnel will conduct a random audit of the newly installed wiring (time frame 9- days from completion) and if the failure rate is greater than 10%, the Contractor will assume the cost of hiring a third party to complete a full audit of all the new network drops.

3.1.12 Test Results

- .1 Test results shall be submitted in hard and electronic format. Electronic reports shall be submitted on C.D. format in a Windows based database (Microsoft Excel is acceptable). All electronic reports must be accompanied by a certificate signed by an authorized representative of the company warranting the truth and accuracy of the electronic report. Hard copy of the report is to be submitted triplicate in three individual binders.
- .2 The test result documentation shall be submitted to the Electrical Contractor no later than 10 working days following the completion of the installation.

3.1.13 As Built Drawings

- .1 This Contractor shall maintain an updated copy of as-built drawings on site at all times.
- .2 At the end of the project, the Contractor shall obtain AutoCAD files from the Consultant and update them with the work performed by the Contractor. This Contractor shall provide one (1) electronic copy of updated as-built drawings.

- .3 As-built drawings shall be submitted to the Consultant no later than 10 working days following the completion of the installation.

3.1.14 Warranty

- .1 The Contractor shall provide a system warranty covering the installed cabling system against defects in workmanship, components, and performance, and follow-up support after project completion for a period of one year.
- .2 The Contractor shall warrant the cabling system against defects in workmanship for a period of one year from the date of system acceptance by the Board. The warranty shall cover all labour and materials necessary to correct a failed portion of the system and to demonstrate performance within the original installation specifications after repairs are accomplished. This warranty shall be provided at no cost to the Owner.
- .3 The performance warranty shall warrant properly installed 100 M.H.Z. horizontal copper portion of the cabling system. Copper links shall be warranted against the link performance minimum expected results defined in the T.I.A./E.I.A. 568A, and TSB-67.
- .4 The Contractor shall provide a guaranteed twenty four (24) hour response time to any warranty claims.
- .5 The Communications Cabling Contractor will be required to provide a 25 year manufacturer's Extended Component Warranty and an Application Assurance Warranty for the entire communications cabling system. Warranty shall be in effect from the date of substantial completion as certified by the Architect.
- .6 The Communications Cabling Contractor shall provide certification number within two weeks of award of the project.
- .7 The Communications Cabling Contractor shall provide a letter of Certification within two weeks of substantial completion. This document will include the following:
 - .1 Verification of the performance of the installed system.
 - .2 Manufacturer's certification number.
 - .3 Identification of the installation by location and project number.
- .8 The system manufacturer shall provide in writing to the Owner that in the event of the demise or failure of the installing certified system installer, the manufacturer shall be responsible for providing another certified system installer/vendor to fulfill the remainder of the warranty conditions.
- .9 Contractors must ensure that the selected network cabling components manufacturer and the wiring manufacturer have contractual relationships to ensure that the system warranty is a true "end to end" structured cabling system warranty.

.10 All costs for these warranties must be included in the tender amount.

END OF SECTION

1 GENERAL

1.1 Work Included

- 1.1.1 This specification covers the requirements of the supply and installation of welded wired fences at the fence line locations shown in the Contract Drawings and Bi-folding gate locations.

1.2 Related Sections

- 1.2.1 Attached Security Contract Drawings Package ("Contract Drawings")

1.3 References

1.3.1 Reference Standards

- .1 Canadian Electrical Code (CEC)
- .2 Ontario Electrical Safety Code
- .3 Ontario Building Code (OBC)

1.4 Quality Assurance

- .1 The fencing installer must have a minimum of two (2) years experience performing work specific to this specification.
- .2 The fencing installer must be serviced by field technicians trained on the product.

1.5 Submittals

1.5.1 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit:
 - .1 Functional description of equipment
 - .2 Technical data for all devices
 - .3 Typical device location plans
 - .4 Typical device connection plans and detail drawings

1.5.2 Shop Drawings:

- .1 Shop drawings to indicate project layout, including the following details:
 - .1 Submit layout drawings indicating location of all components.

.2 Submit complete equipment list and schedules

1.5.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.5.4 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.6 Delivery, Storage and Handling

1.6.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.6.2 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect equipment from any damages.

.3 Replace defective or damaged materials with new.

1.7 Warranty

1.7.1 For the components and associated materials within this specification, the five (5) year warranty period.

1.7.2 Extended warranty period shall include warranty against components and associated materials within this specification against specified performance requirements, for specified time period.

1.7.3 Manufacturer's Warranty: submit to the Owner's Representative for acceptance, manufacturer's standard warranty document executed by authorized company official.

2 PRODUCTS

2.1 General

2.1.1 Welded wire fences shall be a fence type that provides anti-climbing properties to the fence perimeter of the designated buildings. All components of the welded wire fence are to be constructed in accordance with Contract Drawing details to prevent climbing of hands / fingers.

2.1.2 All welded wire fences shall be of the color powdered black using anti-rusting painting or equivalent.

2.2 Galvanized Steel Fence

2.2.1 Fence framework shall consist of 38mm [1.5-in] diameter galvanized pipe guardrail and posts with 25mm [1-in] diameter pickets at 100mm [4-in] on center.

2.2.2 Posts shall be installed through retaining wall modular blocks.

2.3 Approved Anti-Scale Welded Wire Fence System Manufacturers

2.3.1 Install only anti-scale welded wire fencing systems supplied by two (2) manufacturers listed below:

- .1 Cochrane Global
- .2 Omega Two; or
- .3 An approved anti-scale welded wire fencing system alternative, approved by the Consultant and Owner.

2.4 Anti-Scale Welded Wire Fence

2.4.1 The contractor shall submit products meeting the projects specification for review and approval by the Consultant and Owner.

2.4.2 Welded wire apertures shall be spaced to prevent any fingers to be fitted within gaps for climbing. The same narrow spacing is to prevent any wire cutters to fit within the aperture gaps.

2.4.3 Welded wire aperture sizes centre to centre of 12.7mm vertically with horizontal segments of 76mm.

2.4.4 All welded wires shall be of 4mm diameter steel.

2.4.5 Wire mesh coatings shall be galvanized.

2.4.6 Wire mesh shall be finished in a protective black polyester powder coat.

2.4.7 The brackets utilized to secure fence mesh to the post shall be vandal resistant and tamper proof.

2.4.8 Reinforcing rib welded wire mesh with pressed high-density paneling between fence posts shall be consistent with the fence line.

2.4.9 Fence post foundations shall be 915mm deep spaced at a maximum of 2500mm.

2.5 Anti-Scale Welded Wire Fence with Privacy Slats

2.5.1 The Privacy slats shall prevent climbing as well as direct view into the secured side of the building perimeter.

2.5.2 Privacy slats shall be constructed in conjunction with the welded wire anti-climbing fences to provide a full perimeter line of fencing using similar fence posts.

2.5.3 All privacy slats are to be mountable from the ground to the top of the adjacent fence post to form a wall within the fence in accordance with Contract Drawing details.

2.5.4 Perforations to reduce wind loading shall be embedded within the privacy slats in accordance with the maximum local wind speed experienced within the last 25 years.

2.6 Bi-Folding Gate Integration

- 2.6.1 The anti-climb welded wire fence shall be able to be constructed with a framing to be mounted on the bi-folding gates to prevent climbing at the gate operator locations shown in the Contract Drawings.
- 2.6.2 Framing and anti-climb mesh panel shall not exceed the weight of 25 lb per square feet and shall be securely welded onto the bi- folding gate.
- 2.6.3 All accessories from the anti-climb welded wire fence shall be consistent with the anti-climb frame mounting onto the bi-folding gates.

2.7 Man / Pedestrian Gate

- 2.7.1 Gate material type shall be a 4mm diameter welded wire mesh.
- 2.7.2 Top rails shall incorporate matching anti-climb spikes to the bi- folding gate.
- 2.7.3 Gate panel shall be 1950mm in height from the ground to the top of the gate panel.
- 2.7.4 Space between the pales (connected throughout by railing) shall not exceed 83mm.
- 2.7.5 A minimum of 2 railings (top and bottom) shall be welded onto, as part of the hinge assembly.
- 2.7.6 Concrete foundation of the posts shall be a minimum of 915mm deep in accordance with the manufacturer's specifications of post mounting and diameter.
- 2.7.7 Posts shall be hollow with capacity to route conduit pathways within to gate security devices. Any modifications to the post shall be provided to secure faster electric strikes, door / gate contact and card reader onto gate.
- 2.7.8 Post spans shall be in accordance with the measured spacing shown in Contract Drawings.
- 2.7.9 Post (latch and hinge sides) shall be provided to suit the man gate width. Hinge clearance between the post and the man gate shall not exceed 52mm. Latch clearance between the post and the man gate shall not exceed 78mm.

2.8 Double swing gate (manual)

- 2.8.1 Gate material type shall be a 4mm diameter welded wire mesh consistent with material type in section 32 31 16-2.3.
- 2.8.2 Top rails shall incorporate matching anti-climb spikes to the bi- folding gate.
- 2.8.3 Post spans shall be in accordance with the measured spacing shown in Contract Drawings.
- 2.8.4 Post (hinge) shall be provided to suit the man gate width. Hinge clearance between the post and the man gate shall not exceed 52mm.
- 2.8.5 Gate panel shall be 1950mm in height from the ground to the top of the gate panel.
- 2.8.6 A minimum of 2 railings (top and bottom) shall be welded onto, as part of the hinge assembly.

2.8.7 Latching of the double man gates be attached between the 2 gate leafs. Latching hardware shall designate one of the two (2) leafs as the latch fixed side and the other the latching side. The Contractor shall confirm with the Owner or its representative the latching sides and mechanism prior to installation.

2.8.8 Concrete foundation of the posts shall be a minimum of 915mm deep in accordance with the manufacturer's specifications of post mounting and diameter.

2.9 Sliding Gate

2.9.1 Gate material type shall be a 4mm diameter welded wire mesh.

2.9.2 Gate mounting posts shall enclose the sliding gate in front and behind the sliding gate. Adjacent anti-scale welded wire fencing shall mend and transition into the sliding gate posts at one of the sides.

2.9.3 Sliding gate shall be a cantilevered without rolling casters on the ground as a support for the weight of the sliding gate.

2.9.4 Sliding gate post spans shall be in accordance with the measured spacing shown in Contract Drawings.

2.9.5 Gate panel shall be 1950mm in height from the ground to the top of the gate panel. The contractor shall measure out either side of the sliding gate fence to ensure adjacent fence heights are consistent with the height of the gate panel.

2.9.6 A minimum of 2 railings (top and bottom) and diagonal sliding gate supports between the railings shall be included as part of the fence fabric.

2.9.7 Sliding gate mounting posts shall be at a dimension and gauge strength suitable for the sliding gate length and weight. Manufacturer's guidelines shall be followed.

2.9.8 Concrete foundation of the posts shall be a minimum of 1220mm deep in accordance with the manufacturer's specifications of post mounting and diameter.

2.9.9 Concrete foundation shall suit the post size in accordance with manufacturer's guidelines.

3 EXECUTION

3.1 Examination

3.1.1 Verification of Conditions: verify conditions are acceptable for system installation in accordance with manufacturer's written instructions.

.1 Visually inspect conditions.

.2 Inform the Owner's Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Owner's Representative.

3.2 Installation – General Requirements

- 3.2.1 The installation and connection of all power requirements shall be completed by a licensed electrical contractor under permit.
- 3.2.2 Ensure that any fencing is installed seamlessly and fits any posts and foundations used by the gate operator and its associated specification components.
- 3.2.3 The Contractor shall comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheet.
- 3.2.4 The Contractor shall coordinate with the fencing contractor to ensure that any trenching required and associated with the specified conduit provisions is completed in accordance with the project specifications. Before any trenching, the Contractor shall contact a local underground utility locating company to identify any existing buried services.
- 3.2.5 The Contractor shall install the gate controller in strict accordance with the product specifications, project specifications, and best industry installation standards.
- 3.2.6 The Contractor shall ensure that any electronic components attached to the fence is grounded in accordance with the electronic component's product manufacturers specifications and all applicable codes.
- 3.2.7 Locations of equipment as shown on the provided Security Drawings are approximated. Exact locations shall be determined on site, with the approval of Owner's designated authority having due regard to the function of the equipment and best practical placement.
- 3.2.8 Install ULC labels where required.

3.3 Cleaning

- 3.3.1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- 3.3.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
 - .1 Remove protective coverings from accessories and components.
 - .2 Clean housings and system components, free from marks, packing tape, and fingerprints, in accordance with manufacturer's written cleaning recommendations.
 - .3 Clean components free from dirt and fingerprints.
- 3.3.3 Waste Management: separate waste materials for reuse/recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION