



**Request for Tender # T-1023-2018
for
New Materials Storage Facility
at the Orono Depot**

Appendix D, D-1 and D-2

The Deliverables and Material Disclosures

Document 4 of 4

Electronic submission required

1 Appendix D, D-1 The Deliverables

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Not Used

1 General

1.1 Section includes

- .1 This Section specifies requirements for the bonds, insurance and warranty security holdback.

1.2 Reference standards

- .1 Appendix B – Supplementary Conditions to CCDC 2 General Conditions
- .2 CCDC 2 General Conditions

1.3 Surety bonds

- .1 Provide a performance bond in an amount equal to fifty per cent (50%) of the tendered price for the faithful performance of the Contract, including all obligations during the warranty period. The warranty period will be extended if known deficiencies are incomplete upon expiration of the 2 year period. In any case, the performance bond shall continue until the final acceptance certificate has been issued by the Owner in accordance with General Conditions.
- .2 Provide a labour and material payment bond in an amount equal to fifty per cent (50%) of the tendered price for the faithful payment of all labour and materials related to this Contract.
- .3 **Bonds shall not be extended to cover any work beyond the original scope of the Work unless explicitly requested by the Owner.** The Contractor shall not be entitled to claim for bonding on such additional work unless such additional bonding is requested by the Owner. The Owner accepts that all additional work performed by Change Order is not covered by the bonds. The Owner shall not be entitled to a credit related to the bonds if a change in the Work results in a reduction of the Contract Price.
- .4 Any contract progress reports issued by the Contractor's surety company must be issued directly to the Owner or Consultant at the address provided.

1.4 Insurance

- .1 Provide insurance as required by GC 11.1 of the CCDC 2 General Conditions, as amended by Appendix B – Supplementary Conditions.

1.5 Warranty security holdback

- .1 A warranty security holdback will be retained progressively, commencing on the first payment certificate, from monies that would otherwise be payable to the Contractor, up to a maximum value of \$21,000.00
- .2 The maximum warranty security holdback will be held commencing on the Substantial Performance Payment Certificate. The amount withheld on payment certificates prior to the Substantial Performance Payment Certificate will be based on the percentage of work completed.
- .3 The retained amount is strictly to be used as a warranty security and is in addition to the regular holdback and finishing holdback retained in accordance with the Construction Lien Act, the Contractor's performance bond and any monies withheld due to known incomplete and/or deficient work.
- .4 Where Change Orders are issued which results in the final contract value exceeding the tendered price, the Owner reserves the right to withhold additional warranty security at the same rate (as is determined by dividing the specified maximum warranty security by the awarded Contract Price) on the value of such additional work. Payment for any additional warranty security costs shall be deemed to be included in the respective Change Orders.
- .5 Except as otherwise provided hereunder, the warranty security, less any deductions made therefrom as provided for in the Contract, shall be released to the Contractor following the issuance by the Owner of the Final Acceptance Certificate at the end of the warranty period.
- .6 **No substitute form of security will be permitted.**

1.6 Basis of payment

- .1 Payment for bonds and insurance shall be included in the monthly payment certificate after submission of satisfactory documents.

- .2 Payment for all carrying costs associated with the warranty security holdback, including interest thereon, shall be made under this Section on the appropriate line item in the payment certificate. No other compensation for warranty security holdbacks will be considered. Progress payments will be made as follows:
- 25% on the first progress payment certificate
 - 25% on the Substantial Performance Payment Certificate
 - 50% on the Final Payment Certificate, together with the release of the warranty security holdback at the end of the warranty period, as may be extended in accordance with the Contract.
- .3 The sum of prices bid for bonds, insurance and warranty security holdback carrying costs shall not exceed 2% of the lump sum tendered price.

2 Products – not used

3 Execution – not used

End of section

1 General

1.1 Section includes

- .1 This Section specifies requirements for an extension of the Contract warranty period.

1.2 Related requirements

- .1 CCDC 2 – 2008 General Conditions
- .2 Supplementary Conditions

1.3 Extension of warranty period

- .1 Provide extension of warranty period for one additional year (for a total of two years) according to Appendix B – Supplementary Conditions, Clause 41.1.

1.4 Basis of payment

- .1 Payment for this Section shall be made on the Substantial Performance Payment Certificate.

2 Products – not used

3 Execution – not used

End of section

1 General

1.1 Section includes

- .1 Documents and terminology.
- .2 Associated requirements.
- .3 Work expectations.
- .4 Work by other parties.
- .5 Premises usage.

1.2 Related requirements

- .1 Section 01 21 13 – Cash Allowances.
- .2 Section 01 32 00 - Construction Progress Documentation.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Division 01 sections describe requirements applicable to all Sections within Divisions 03 to 32 inclusive.
- .5 CCDC 2 – 2008 Agreement, Definitions and General Conditions
- .6 Supplementary Conditions.

1.3 References – Words, Terms and Definitions

- .1 Refer to and acknowledge other words, terms, and definitions in CCDC 2 Definitions.

1.4 Complementary documents

- .1 Drawings, Specifications, and schedules are complementary each to the other and what is called for by one to be binding as if called for by all. Should any discrepancy appear between documents which leave doubt as to the intent or meaning, abide by Precedence of Documents article below or obtain direction from the Consultant.
- .2 Drawings indicate general location and route of conduit and wire/conductors. Install conduit or wiring/conductors and plumbing piping not shown or indicated diagrammatically in schematic or riser diagrams to provide an operational assembly or system.

- .3 Install components to physically conserve headroom, to minimize furring spaces, or obstructions.
- .4 Locate devices with primary regard for convenience of operation and usage.
- .5 Examine all discipline Drawings, Specifications, and schedules and related Work to ensure that Work can be satisfactorily executed. Conflicts or additional work beyond work described to be brought to attention of Consultant.

1.5 Location

- .1 The site of the Work is located at 3480 Taunton Road, Orono, Ontario (Regional Road 4 and Regional Road 17).
- .2 The materials and/or services shall be delivered FOB Destination(s), Prepaid.

1.6 Description of the Work

- .1 Work of this Contract comprises the addition of a new material storage shed and demolition of the existing shed.
- .2 Division of the Work among Subcontractors, suppliers and vendors is solely the Contractor's responsibility. Neither the Owner nor Consultant assumes any responsibility to act as an arbiter to establish subcontract terms between sectors or disciplines of work.
- .3 Refer to the Drawings and Specifications for the required Work.
- .4 The Work also includes the examination of the site, submission of samples, scheduling and coordination, project meetings, protection of the existing facility, repair and preparation of surfaces, quality control, inspection reports, project cleanliness, maintenance of data, preparation of record drawings, final cleaning and warranty.

1.7 Contract method

- .1 Construct Work under single, stipulated price contract.
- .2 Refer to Section 01 21 00 for cash allowance amounts applicable to assignable contracts.

- .3 Assume responsibility for assigned contracts as Subcontracts forming part of the Work.
- .4 Contract Documents were prepared by the Consultant for the Owner. Any use which a third party makes of the Contract Documents, or any reliance on or decisions to be made based on them, are the responsibility of such third parties. The Owner accepts no responsibility for damages, suffered by any third party as a result of decisions made or actions based on the Contract Documents.

1.8 Documents provided

- .1 Owner will supply the Contractor with additional sets of Contract Documents for construction purposes. Refer to Supplementary Conditions for number of copies to be provided.

1.9 Performance of the Work

- .1 Refer to Supplementary Conditions for specified Contract Time.

1.10 Work sequence

- .1 Refer to Section 01 32 00 for construction schedule and phasing of the Work.

1.11 Basis of payment

- .1 There shall be no payment for this Section as no actual Work is specified herein.
- .2 All payment for the Work of the Contract shall be included, properly balanced, in other Sections in Appendix - Schedule of Sections and Prices as agreed by the Owner prior to commencing the Work.

2 Products – not used

3 Execution – not used

End of section

1 General

1.1 Section Includes

- .1 Contractor's use of site.
- .2 Connecting to existing services.
- .3 Site access.
- .4 Continuity of existing service.
- .5 Working hours.
- .6 Special scheduling requirements.

1.2 Related Requirements

- .1 Section 01 32 00 – Construction Progress Documentation
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 50 00 – Temporary Facilities and Controls.
- .4 Section 01 53 00 - Temporary Construction.
- .5 This section describes requirements applicable to all Sections within Divisions 03 to 32.

1.3 Contractor's Use of Site

- .1 Accept full responsibility of assigned work and storage areas from the time of Contract award until completion of the Work.
- .2 Do not unreasonably encumber site with materials or equipment.
- .3 Use of site is limited to areas indicated on drawings.
- .4 Do not obstruct entrances, stairs or fire exits.
- .5 Do not prop open any doors.
- .6 Maintain free access route for emergency vehicles, waste disposal trucks and delivery vehicles.
- .7 Provide for all vehicular and pedestrian traffic.
- .8 Parking will be permitted on site.

- .9 The placement of a refuse bin will be allowed in an area agreed by the Owner.
- .10 Repair all damage to paving, grass, walkways, curbs, trees, planting beds, and any other areas, caused by the Contractor's operations.

1.4 Existing Services

- .1 Notify Owner, Consultant and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Owner and Consultant minimum 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work.
- .3 Keep duration of interruptions minimum.
- .4 Perform interruptions after normal working hours of occupants, preferably on weekends.
- .5 Construct barriers in accordance with Section 01 53 00.

1.5 Site Access by Contractor

- .1 Unless stated otherwise, the Contractor will be permitted reasonable access to the site from start of construction until Substantial Performance of the Contract.
- .2 After Substantial Performance of the Contract, the Contractor shall not enter the facility without prior written authorization from the Owner and the Contractor's activities shall be restricted to the work duly authorized by the Owner, including modifications and rectification of deficiencies. If the Contractor proposes to perform additional work other than the authorized work, further written approval must be obtained by the Contractor from the Owner prior to proceeding with such additional work.
- .3 Workers employed on the site shall sign a "Daily Register" provided showing "IN" and "OUT" times and number of hours worked on each shift. Times shall be recorded in 24-hour time (i.e. 00:00 to 23:59).
- .4 All Contractor's workers employed on site shall be orientated by the facility operator prior to start of work.

1.6 Continuity of Existing Service

- .1 Operation of existing facility shall take precedence over Contractor's operations. Keep existing buildings in operation at all times.
- .2 Arrange Work so that services to the existing buildings will not be unduly interrupted at any time. The time duration for an interruption must be kept to a minimum and must be arranged with the Owner and facility operator.
- .3 Provide at least 48 hours' advanced notice for all required interruptions to utility, heating, cooling, mechanical, electrical and life safety systems.

1.7 Working Hours

- .1 Carry out Work between the hours of 7:00 a.m. and 5:00 p.m. local time, Monday through Friday except statutory holidays.
- .2 If the Contractor wishes to complete any work outside of these regular hours, obtain permission from the facility operator through the Owner at least 48 hours prior.
- .3 The Owner will not be responsible for additional costs associated with working after regular hours unless such after-hours work is ordered by the Owner and not specified as a requirement in the Contract Documents.
- .4 The Owner will not be responsible for additional costs associated with working after regular hours if such after-hours work is required for the Contractor to return to the agreed upon construction schedule.

1.8 Special Requirements

- .1 Submit schedule of special requirements or disruptions in accordance with Section 01 33 00.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.1 Section Includes

- .1 Cash allowances.

1.2 Cash Allowances

- .1 Consultant Responsibilities:
 - .1 Consult with Contractor for consideration and selection of Products, suppliers, and installers.
 - .2 Project Manager and Consultant to select Products.
 - .3 Prepare Change Order.
- .2 Contractor Responsibilities:
 - .1 Assist Consultant in selection of Products, suppliers and installers.
 - .2 Obtain proposals from suppliers and installers and offer recommendations.
 - .3 On notification of selection by Consultant or Project Manager, execute purchase agreement with designated supplier and installer.
 - .4 Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
 - .5 Promptly inspect Products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- .3 Supply-only cash allowances shall include:
 - .1 Net cost of products
 - .2 Delivery to Site
 - .3 Applicable taxes and duties, excluding HST
 - .4 Supply and install cash allowances shall include:
 - .5 Net cost of Products
 - .6 Delivery to Site
 - .7 Unloading, storing, handling or Products on Site
 - .8 Applicable taxes and duties, excluding HST
 - .9 Inspection and testing allowances shall include:

- .10 Net cost of inspection and testing services
- .11 Applicable taxes and duties, excluding HST
- .4 Include cash allowances in the Contract Price. Differences in costs will be adjusted by Change Order.
- .5 The following schedule will assist in defining each allowance and what the amount applies to. Coordinate such statements with specifications prepared by other consultants and thoroughly coordinate - cite cash allowance amounts only in this section - do NOT cite them in other specification sections. Have these other spec sections reference this section.
- .6 Allowances Schedule:
 - .1 Include a cash allowance of \$10,000.00 for Storage Racking.

1.3 Use of Cash Allowances

- .1 Expenditures against cash allowance will be made only upon receipt of written authority from the Project Manager.
- .2 No expenditure against a cash allowance shall be made or incurred except as instructed by the Project Manager in writing.
- .3 Submit copies of all invoices for labour, materials and equipment to the Project Manager to substantiate charges against the allowances.
- .4 Any unused portion of cash allowances will be credited to the Region upon completion of the Work.
- .5 The cash allowances do not include Harmonized Sales Tax (HST)

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.1 Section Includes

- .1 This Section includes administrative provisions for coordinating construction operations including, but not limited to, the following:
 - .1 General project coordination procedures
 - .2 Coordination of Drawings
 - .3 Administrative and supervisory personnel
- .2 Each Subcontractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to specific Subcontractors by Contractor.

1.2 Related Requirements

- .1 Section 01 32 00 - Construction Progress Documentation
- .2 Section 01 33 00 - Submittal Procedures
- .3 Section 01 45 00 - Quality Control
- .4 Section 01 78 00 - Closeout Submittals
- .5 Division 23 - Common Work Results: Common work results for heating, ventilating and air conditioning systems
- .6 Divisions 26, 27 and 28 - Common Work Results: Common work results for electrical, communications, and electronic safety and security.
- .7 This section describes requirements applicable to all Sections within Divisions 03 to 32.

1.3 Administrative Requirements

- .1 General Coordination: Coordination that generally applies to all components of the Contract Documents as follows:
 - .1 Subcontractor shall coordinate construction activities as required with Contractor's Schedule to ensure efficient and orderly installation of each part of Work.

- .2 Subcontractors shall notify Contractor where the Subcontractor's installation of one part of Work is dependent on installation of other components.
- .3 Schedule and coordinate construction activities of other Subcontractors in sequence required to obtain best results. Where availability of space is limited, Subcontractor shall coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
- .4 Subcontractors shall make adequate provisions to accommodate items scheduled for later installation by other Subcontractors, under separate contract or by Contractor's own forces.

1.4 Quality Assurance

- .1 Designate an on-site party responsible for instructing workers and overseeing the environmental goals for the project.
- .2 Review environmental procedures and status of Waste Management Plan and Environmental Protection Plan at each construction meeting.

1.5 Existing Site Conditions

- .1 Existing construction shown has been taken from available information. When specific details are unavailable, assumptions have been made regarding probable construction. Any variance from construction, as shown on the Drawings shall be immediately brought to the attention to the Owner.
- .2 Make careful examination of the site, and investigate and be satisfied as to all matters relating to the nature of the Work to be undertaken.
- .3 Check all site dimensions prior to fabrication of materials and construction.
- .4 Confirm the exact location of all outlets with the Owner prior to their installation.
- .5 Report any inconsistencies, discrepancies, omissions and errors between site conditions and Contract Documents to the Consultant prior to the commencement of Work. Ensure that each Subcontractor performing work related to the site conditions has examined it so that all are fully

informed on all particulars which affect the Work thereon in order that construction proceeds competently and expeditiously.

1.6 Coordination

- .1 The Contractor shall cooperate with the Owner's representatives at the place of work in order to minimize disruptions to the building operation and services.
- .2 Coordinate with the Owner's representative regarding access and use of site.
- .3 Coordinate performance and sequencing of the Work with the Owner.

1.7 Owner Access

- .1 The building and parking areas, which are not immediately affected by the Work, will remain occupied by the Owner during the Work.
- .2 Ensure adequate access to areas not occupied for the Work.

1.8 Submittals

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

1.9 Dimensions

- .1 Do not scale directly from Drawings. Obtain clarification from the Consultant if there is ambiguity or lack of information.
- .2 Details and measurements of any Work which is to fit or to conform with Work installed shall be taken at the Place of the Work.
- .3 Verify dimensions at the Place of the Work before commencing Shop Drawings or other submittals. Before fabrication commences report discrepancies to the Consultant in writing. Incorporate accepted variances on Shop Drawings and as-built records.
- .4 In areas where equipment is scheduled to be installed, check dimensional data on equipment to ensure that the area and equipment, including future known equipment are compatible with necessary access and clearances provided. Equipment supplied shall be dimensionally suitable for space allocation.

- .5 Verify that the Work is executed in accordance with dimensions and positions indicated which maintain levels and clearances to adjacent Work, as set out in accordance with the requirements of the Contract Documents and ensure that Work installed in error is rectified at Contractor's expense before construction continues.
- .6 Owner will accept no claims for extra expense on the part of the Contractor for non-compliance.

1.10 Supervision of Work

- .1 Provide all superintendence, labour, equipment, and materials necessary to complete the project in an orderly, competent, and expeditious manner.
- .2 While work is in progress, maintain site superintendence capable of acting competently on site instructions given by the Owner.
- .3 Maintain good order and discipline among workers engaged on the project.

1.11 Maintenance of Documents on Site

- .1 Maintain at the job site, one copy of each of following:
 - .1 Drawings
 - .2 Specifications
 - .3 Addenda
 - .4 Change Orders and Change Directives
 - .5 Shop Drawings and samples
 - .6 Other modifications to the Contract
 - .7 Site instructions
 - .8 Copy of approved work schedule
 - .9 Copy of manufacturer's installation instructions
 - .10 MSDS sheets
 - .11 Contractor's Health and Safety Policy
 - .12 Notice of Project through MOL (Form 1000)
 - .13 Building Permit
- .2 Maintain documents in a clean, dry, legible condition and make documents available at all times for inspection by the Owner

1.12 Security and Protection of Construction Site and Equipment

- .1 Protect the construction site and equipment from damage. Repair any damage to the construction site or equipment to the satisfaction of the Owner.
- .2 Take precautions to protect the site and equipment until final completion.
- .3 The Owner shall not be responsible for damaged, lost or stolen materials and equipment. Contractor is responsible for all materials and equipment left on site until the work is complete. Provide for proper security or storage of any material or equipment left on site.
- .4 When not at the Place of the Work, ensure that the work area is secured, and that all tools and materials are locked up.

1.13 Existing Utilities

- .1 Protect all utilities at the Place of the Work for the duration of the work.
- .2 Maintain all existing services including power and data to the entire building and occupied areas of the suites used by the Region. Any and all shutdowns or disruptions in service are to be approved by the Owner or building Owner.
- .3 Have all utilities located and staked out and provide the Owner with all cable locations supplied by the utilities prior to commencing any excavation or demolition.
- .4 Contact the local municipality, utilities or any other agencies for further information regarding the exact location of all existing utilities, to exercise the necessary care in excavation and demolition operations, and to take such precautions necessary to safeguard the utilities from damage.
- .5 All utilities located within the limits of proposed excavations shall be exposed by hand excavation and carefully supported and protected by the Contractor.
- .6 Removal, relocation, or supporting of existing utilities shall be carried out in consultation with the respective authorities:
 - .1 Bell Canada
 - .2 Hydro One Connections
 - .3 Enbridge Gas

- .4 Rogers Cable
- .5 any other utility/contractor as required.
- .7 Be responsible for paying charges by the Utilities or Agencies for locating cables and the Contractor shall pay any charges for repairs and lost revenue if utility equipment, cables, pipes or other assets are damaged and is responsible to make good any ground and surface damages as well.
- .8 Prior to the commencement of demolition, provide a sign-off sheet from the existing water, gas, electrical, telephone, and sewer service providers.
- .9 Verify that services are cut off, capped, diverted and/or removed as required by local regulating authorities. Ensure all services are in the proper state prior to commencing work.
- .10 Ensure all utilities are capped off at the property line and identify the termination locations on reference drawings.
- .11 No claims will be considered which are based on delays or inconvenience resulting from the removal or relocation of services not being completed before the start of this Contract.

1.14 Contact For After-Hours or Emergency Services

- .1 When after-hours work is permitted by the Owner, provide an after-hours phone or pager number to respond to emergencies or requirements that arise when offices are closed.

1.15 Road Occupancy Restrictions

- .1 Obtain and pay for Road Occupancy Permits from the applicable road authorities required prior to any works being undertaken within a public road allowance.

1.16 Identification and Signs

- .1 Construction personnel shall wear a legible numbered identification photo tag on their person at all times on which the name of the employer company is clearly identified.

- .2 Display no signs or advertisements without the Owner's approval. When signs are permitted, maintain signs in good condition during the Work and remove signs as directed by the Owner upon completion of the Work.

2 Products – Not Used

3 Execution

3.1 Coordination

- .1 Coordinate all construction operations to verify efficient and orderly installation of each part of Work.
- .2 Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation with Subcontractors as follows:
- .3 Scheduling construction operations in sequence required to obtain best results where installation of one part of Work depends on installation of other components, before or after its own installation.
- .4 Coordinating installation of different components with Subcontractors to verify maximum accessibility for required maintenance, service, and repair.
- .5 Making adequate provisions to accommodate items scheduled for later installation.
- .6 Prepare memoranda where necessary, for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings:
- .7 Prepare similar memoranda for Owner where coordination of Owner-installed Work is required.
- .8 Ensure all Subcontractors coordinate scheduling and timing of required administrative procedures with other construction activities, and activities of other contractors and Subcontractors, if any, to avoid conflicts and to verify orderly progress of Work.

3.2 General Installation Provisions

- .1 Ensure that installer of each major component inspects both substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- .2 Comply with manufacturer's installation instructions and recommendations, to extent that those instructions and recommendations are more explicit or stringent than requirements contained in Quotation Documents.
- .3 Inspect Materials immediately upon delivery and again prior to installation. Reject damaged and defective items and arrange for replacement.
- .4 Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.
- .5 Supervise all Subcontractor work. Ensure that Subcontractors:
- .6 Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to Contractor for final decision.
- .7 Install each component during weather conditions and project status that will ensure best possible results. Isolate each part of completed construction from incompatible material as necessary to prevent deterioration.
- .8 Coordinate temporary enclosures with required inspections and tests, to minimize necessity of uncovering completed construction for that purpose.
- .9 Install individual components at standard mounting heights recognized within the industry for particular applications indicated where mounting heights are not indicated. Refer questionable mounting height decisions to Contractor for final decision.
- .10 Coordinate construction activities to ensure that no part of Work, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

3.3 Layout of Work

- .1 Be responsible for laying out the work in compliance with the Drawings, Shop Drawings and schedules.
- .2 Rectify any and all errors resulting from failure to follow or verify Products, Drawings or the proper layout of any element of the installation.

3.4 Removal, Replacement and Relocation of Existing Items

- .1 Remove and reinstall or permanently relocate all electrical fitments, outlets, telephone outlets, and mechanical equipment that interferes with construction and modify existing surfaces as indicated on Drawings. Provide new enclosures, as required.
- .2 Be responsible for the removal of loose furniture and reinstall unless directed otherwise by the Owner.

3.5 Protection of Existing Facility and Personnel

- .1 Do not endanger in any way the personnel, equipment, offices and existing structures of the Owner. Exercise caution to keep the existing facilities free from damage due to the Contractor's work. If the measures observed by the Contractor are not considered sufficient, the Owner may order additional precautions to be taken.
- .2 Take all necessary precautions to adequately protect the building and property from damage. Make good all damage at no extra cost.
- .3 Erect suitable safety barriers as required for security and to make the site safe for pedestrians.
- .4 Supply and erect temporary hoarding and barricades where required. Provide a temporary hoarding plan.
- .5 Remove the barriers from the site at the completion of the work or when directed by the Owner.
- .6 Adequately protect the Work at all stages, and maintain the protection until the Work is completed. Remove and replace any work and materials damaged that cannot be satisfactorily repaired at no extra cost.
- .7 Secure construction area by erecting dust proof barriers, hoarding, as necessary to the approval of the Owner and the building Owner.

- .8 Arrange dust proof partitions in such manner as not to eliminate fire exit-egress ways and provide safety directional signage to Owner's and Authorities approval.
- .9 Protect existing ventilation systems and ductwork interiors from dust contamination from construction area by placing filter media over all duct openings, grilles, diffusers and replacing filters in air handling units upon completion of the work.
- .10 Motorized equipment shall be powered electrically or by battery only. Internal combustion powered equipment shall not be permitted within construction areas unless approved in writing by the Owner.
- .11 All materials shall have a low V.O.C. rating.

3.6 Restoration of Disturbed Areas

- .1 Fill all holes left from mechanical and electrical services removed or relocated to maintain the required fire separations and to maintain the intended finished appearance of the surface.
- .2 Patch and make good all existing floor, wall and ceiling materials and finishes disturbed by construction work.

3.7 Restoration Work for Uncovered Site Hazards

- .1 Make restorations to uncovered or disrupted Mechanical or Electrical services where such services pose a potential health or safety risk. Restorations shall be an extra to the contract only where such work could not have been reasonably foreseen by examination at the time of bidding at the sole opinion of the Owner.

End of Section

1 General

1.1 Section includes

- .1 Pre-construction meeting
- .2 Regular progress meetings

1.2 Related Requirements

- .1 Section 01 32 00 – Construction progress documentation

1.3 Pre-Construction Meeting

- .1 Owner will arrange for a Pre-Construction Meeting. Owner's project team, the Consultant and a representative from the facility user department will participate in the meeting.
- .2 Coordinate and organize attendance at the Pre-Construction Meeting by representatives of major Subcontractors and other parties in contract with the Contractor.
- .3 Owner will arrange attendance of other interested parties not responsible to the Contractor.
- .4 Agenda will include, but not be limited to, the following topics as are pertinent to the Contract:
 - .1 Introduction of key personnel participating in the project
 - .2 Project communications procedures
 - .3 Restrictions on working hours, access, movements on site, etc.
 - .4 Reviewing the approved Work Schedule
 - .5 Contract administration requirements including submittals, payment procedures, and Change Order procedures
 - .6 Identify any product availability problems and substitution requests and procedures
 - .7 Review Consultant's inspection requirements
 - .8 Schedule for project meetings
 - .9 Temporary services to be provided by the Contractor
 - .10 Emergency contact numbers

- .11 Site-specific safety training
- .12 Site security requirements

1.4 Schedules

- .1 Submit preliminary construction progress schedule as specified in Section 01 32 00 to Owner.
- .2 After review, revise and resubmit schedule to comply with revised project schedule.
- .3 During progress of Work revise and resubmit as directed by Consultant.

1.5 Progress Meetings

- .1 Consultant will schedule and administer bi-weekly project meetings throughout progress of Work.
- .2 Provide physical space and make arrangements for meetings.
- .3 Consultant will prepare agenda for meetings.
- .4 Agenda will include, but not be limited to, the following topics as are pertinent to the Contract.
 - .1 Review, approval of minutes of previous meeting.
 - .2 Construction safety
 - .3 Coordination
 - .4 Review of Work progress since previous meeting.
 - .5 Field observations, problems, conflicts.
 - .6 Problems which impede construction schedule.
 - .7 Review of off-site fabrication delivery schedules.
 - .8 Revision to construction schedule.
 - .9 Progress schedule, up to next scheduled meeting.
 - .10 Review submittal schedules: expedite as required.
 - .11 Maintenance of quality standards.
 - .12 Review proposed changes for effect on construction schedule and on completion date.
 - .13 Review site safety and security issues.
 - .14 Requests for information/clarification

- .15 Contemplated changes
- .16 Other business.
- .5 Inform the Consultant in advance of meetings regarding any other items the Contractor wishes to be added to the agenda.
- .6 Ensure key project personnel attend regularly scheduled progress meetings to be held on site at times and dates that are mutually agreed to by the Region and Contractor.
- .7 Coordinate and organize attendance of individual Subcontractors and material suppliers when requested. Relationships and discussions between Subcontractor participants are not the responsibility of the Consultant and do not form part of the meetings content.
- .8 Ensure that Contractor representatives in attendance at meetings have required authority to commit Contractor to actions agreed upon. Assign same persons to attend such meetings throughout the contract period.
- .9 Consultant will preside at meetings.
- .10 Consultant will record minutes.
- .11 Consultant will reproduce and distribute copies of minutes within 3 days after each meeting and transmit to meeting participants and affected parties not in attendance.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.1 Section Includes

- .1 Schedules, form, content, submission.
- .2 Critical path scheduling.
- .3 Progress photographs.
- .4 Submittals schedule.

1.2 Related Sections

- .1 Section 01 33 00 - Submittal Procedures.
- .2 This section describes requirements applicable to all Sections within Divisions 03 to 32.

1.3 General Requirements

- .1 Be responsible for planning and scheduling of the Work.
- .2 Be responsible for ensuring that Subcontractors plan and schedule their respective portions of the Work within the overall project schedule.
- .3 Owner shall include suggested phasing drawings covering main components for the Contractor including any special provisions and any special time-sensitive provisions.

1.4 Schedules

- .1 Submit schedules as follows:
 - .1 Submittal schedule for Shop Drawings and Product data.
 - .2 Submittal schedule for samples.
 - .3 Submittal schedule for timeliness of Owner-furnished Products, where applicable.
 - .4 Product delivery schedule.
 - .5 Cash allowance schedule for acquiring Products only or Products and installation, or installation only.
 - .6 Shutdown or closure activity.

- .2 Schedule Format.
 - .1 Prepare schedule in form of a horizontal Gantt bar chart.
 - .2 Provide a separate bar for each major operation and item of work.
 - .3 Split horizontally for projected and actual performance.
 - .4 Provide horizontal time scale identifying first Working Day of each week.
- .3 Schedule Submission
 - .1 Submit initial format of schedules within 15 days of receipt of Order to Commence Work.
 - .2 Submit one opaque reproduction, plus two copies to be retained by Consultant.
- .4 Consultant will review schedule and return review copy within 10 days after receipt.
- .5 Resubmit finalized schedule within 7 days after return of review copy.
- .6 Submit revised progress schedule with each application for payment.
- .7 Distribute copies of revised schedule to:
 - .1 Job site office.
 - .2 Subcontractors.
 - .3 Other concerned parties.
- .8 Instruct recipients to report to Contractor within 10 days, any problems anticipated by timetable shown in schedule.

1.5 Construction Progress Scheduling

- .1 Submit initial schedule, in duplicate, within 15 days after date receipt of Order to Commence Work.
- .2 Revise and resubmit as required.
- .3 Submit revised schedules with each application for payment, identifying changes since previous version.
- .4 Schedule Format
 - .1 Prepare schedules in form of a horizontal Gantt bar chart using Microsoft Office 2013 or newer.

- .2 Provide a separate bar for each major operation and item of work.
- .3 Split horizontally for projected and actual performance.
- .4 Provide horizontal time scale identifying first Working Day of each week.
- .5 Submit computer generated network analysis diagram using the critical path method.
- .6 Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- .7 Indicate estimated percentage of completion for each item of Work at each submission.
- .8 Indicate submittal dates required for Shop Drawings, Product data, samples, and Product delivery dates, including those furnished by Owner and required by allowances.
- .9 Include dates for commencement and completion of each major element of construction including, but not limited to the following:
 - .1 Site clearing.
 - .2 Site utilities.
 - .3 Foundation Work.
 - .4 Structural framing.
 - .5 Special Subcontractor Work.
 - .6 Equipment Installations.
 - .7 Finishes.
- .10 Indicate projected percentage of completion of each item as of first day of month.
- .11 Indicate progress of each activity to date of submission schedule.
- .12 Indicate changes occurring since previous submission of schedule:
 - .1 Major changes in scope.
 - .2 Activities modified since previous submission.
 - .3 Revised projections of progress and completion.
 - .4 Other identifiable changes.

- .13 Provide a narrative report to define:
 - .1 Problem areas, anticipated delays, and impact on schedule.
 - .2 Corrective action recommended and its effect.
 - .3 Effect of changes on schedules of other prime contractors.

1.6 Critical Path Scheduling

- .1 Include complete sequence of construction activities.
- .2 Include dates for commencement and completion of each major element of construction including, but not limited to the following:
 - .1 Site clearing.
 - .2 Site utilities.
 - .3 Foundation Work.
 - .4 Structural framing.
 - .5 Special Subcontractor Work.
 - .6 Equipment Installations.
 - .7 Finishes.
- .3 Show projected percentage of completion of each item as of first day of month.
- .4 Indicate progress of each activity to date of submission schedule.
- .5 Show changes occurring since previous submission of schedule:
 - .1 Major changes in scope.
 - .2 Activities modified since previous submission.
 - .3 Revised projections of progress and completion.
 - .4 Other identifiable changes.
- .6 Provide a narrative report to define:
 - .1 Problem areas, anticipated delays, and impact on schedule.
 - .2 Corrective action recommended and its effect.
 - .3 Effect of changes on schedules of other prime contractors.

1.7 Progress Photographs

- .1 Digital Photography:
 - .1 Submit electronic copy of colour digital photography in *.jpg format, minimum 6 Megapixel resolution.
 - .2 Identification: Name and number of project and date of exposure indicated.
- .2 Submit digital photographs on a CD, DVD, USB flash drive or other Owner-approved storage media or transfer method.
- .3 Number of Viewpoints: Locations of viewpoints determined by Consultant.
- .4 Frequency: Submit monthly with progress statement.

1.8 Submittals Schedule

- .1 Include schedule for submitting Shop Drawings, Product data, samples.
- .2 Indicate dates for submitting, review time, resubmission time, and last date for meeting fabrication schedule.
- .3 Include dates when delivery will be required for Owner-furnished products.
- .4 Allow 10 Working Days for Consultant's review of each submission.

2 Products – Not Used

3 Execution

3.1 Submission

- .1 Submit Construction Schedule in the form of a Gantt chart clearly identifying the critical path and all project milestones.

End of Section

1 General

1.1 Section Includes

- .1 Shop Drawings and Product data.
- .2 Samples.
- .3 Certificates and transcripts.

1.2 Related Sections

- .1 Section 01 32 00 - Construction Progress Documentation.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Other sections requesting submittals.
- .4 This section describes requirements applicable to all Sections within Divisions 03 to 32.

1.3 Administrative Requirements

- .1 Submit to Consultant submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to avoid delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be permitted.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Present Shop Drawings, Product data, samples and mock-ups in metric units.
- .4 Where items or information is not manufactured or produced in metric units, converted values within the metric measurement tolerances may be acceptable. Review submittals prior to submission to Consultant. 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.
- .5 Submittals not stamped, signed, dated, identified as to specific project, and attesting to their being reviewed will be returned without being examined and shall be considered rejected.

- .6 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.
- .10 Keep one reviewed copy of each submission on site.

1.4 Shop Drawings, Product Data and Engineered Submission

- .1 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 Drawings and Specifications.
- .2 Shop Drawings shall carefully consider architectural intent, and shall be coordinated to ensure items to be exposed in finished work are located to provide best aesthetics as directed or required by the Consultant. Show orientation and relationships between materials where deemed necessary by the Consultant.
- .3 Allow 10 Working Days for Consultant's review of each submission.
- .4 Adjustments made on Shop Drawings by the Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior, and obtain Consultant's approval prior to proceeding with Work.
- .5 Make changes in Shop Drawings as the Consultant may require, consistent with Contract Documents. When resubmitting, notify the Consultant in writing of any revisions other than those requested.
- .6 Accompany submissions with transmittal letter, containing:
 - .1 Date
 - .2 Make

- .3 Company
- .4 Region's project title and tender number.
- .5 Contractor's name and address.
- .6 Identification and quantity of each Shop Drawing, Product data and sample.
- .7 Other pertinent data
- .8 Submissions shall include:
- .9 Date and revision dates.
- .10 Region's project title and tender number.
- .11 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
- .7 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .8 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After Consultant's review, distribute copies.

- .10 Submit electronic (PDF) copies of Shop Drawings for each requirement requested in specification Sections and as Consultant may reasonably request.
- .11 Submit electronic (PDF) copies of Product data sheets or brochures for requirements requested in Specification Sections and as requested by Consultant where Shop Drawings will not be prepared due to standardized manufacture of product.
- .12 Delete information not applicable to project.
- .13 Supplement standard information to provide details applicable to project.
- .14 If upon review by the Consultant, no errors or omissions are discovered or if only minor corrections are made, electronic copies will be stamped "reviewed" or "reviewed as modified" and returned and fabrication and installation of Work may proceed. If Shop Drawings are returned stamped "not reviewed", noted copy will be returned and re-submission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .15 The review of Shop Drawings by the Consultant is for sole purpose of ascertaining conformance with general design concept. This review shall not mean that the Consultant approves detail design inherent in Shop Drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in Shop Drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of all sub-trades.
- .16 Whenever there's a requirement for the contractor to submit stamped engineered drawings, such submissions shall be with the timelines of the project.

1.5 Samples

- .1 When requested by the Consultant, provide samples within 7 working days of such request.

- .2 Submit for review samples as requested in respective Specification Sections. Label samples with origin and intended use.
- .3 Deliver samples prepaid to the Consultant's business address.
- .4 Notify the Consultant in writing, at time of submission, of deviations in samples from requirements of Contract Documents.
- .5 Where colour, pattern or texture is criterion, submit full range of samples.
- .6 Adjustments made on samples by the Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant, and obtain the Consultant's approval prior to proceeding with Work.
- .7 Make changes in samples which Consultant may require, consistent with Contract Documents.
- .8 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

2 Products – Not Used

3 Execution

3.1 Submissions

- .1 Upon notification of award of this project, submit the following to the Owner:
 - .1 Prior to Commencing Work
 - .1 Performance and Labour and Materials Payment Bonds Insurance in accordance with the Requirements of Section 00 61 14.
 - .2 Certificate(s) of Insurance in accordance with the Requirements of Section 00 61 14. Use the Owner's Certificate of Insurance form.
 - .3 Clearance Certificate from Workplace Safety & Insurance Board (WSIB)
 - .4 Permits (if required)

- .5 Workmen Trade Certificates (on request)
 - .6 Construction Schedule and Shop Drawing schedule
 - .7 Notice of Project
- .2 During Construction
 - .1 Progress Reports
 - .2 Update of any Insurance Certificates about to expire
 - .3 Current valid WSIB Clearance Certificate
 - .4 Shop Drawings, Product data and samples
 - .5 Minutes of Meetings
 - .6 Inspection Reports
 - .7 Change Orders and Change Directives
 - .8 Requests for Information (RFI)
 - .9 Updated construction drawings
 - .10 Updated construction schedule
- .3 At Substantial Performance, provide originals of:
 - .1 Statutory Declaration
 - .2 Occupancy Permit
 - .3 Substantial Performance Release of Claims Letter
 - .4 Update of any Insurance Certificates about to expire
 - .5 Current Valid WSIB Clearance Certificate
 - .6 Extended Warranties, if applicable
 - .7 Closeout Submittals. Refer to Section 01 78 00.
- .4 At Completion
 - .1 Update of any Insurance Certificates about to Expire
 - .2 Current Valid WSIB Clearance Certificates
 - .3 Completion Release of Claims Letter
 - .4 Region of Durham Standard Form for Property Owner's Release of and used by the Contractor
- .5 At end of Warranty Period
 - .1 Final Release of Claims Letter

End of Section

1 General

1.1 Section Includes

- .1 Health and safety administrative requirements for contractors performing work for the Region of Durham.

1.2 Health and Safety Policy

- .1 Obtain copies of all Subcontractors' Health and Safety Policies and Programs prior to such Subcontractor commencing work on the site if and when requested.
- .2 Provide a copy of Contractor's current Health and Safety Policies and Program, to implement that policy prior to the commencement of construction.

1.3 Health and Safety Legislation and Requirements

- .1 Comply with all Federal and Provincial Health and Safety Acts, Regulations and Lower Tier Municipality By-Laws and with all applicable industry safety standards.
- .2 Comply with 213/91 (Construction Projects) made under the Occupational Health and Safety Act (OHSA) and all amendments thereto. Copies of the Regulations may be obtained from the Ministry of Labour at their Scarborough office, Publications Ontario at 880 Bay Street, Toronto, Ontario M7A 1N8 (Tel. 416-326-5300).
- .3 Comply with legislative requirements for work performed including, but not limited to, qualifications of workers, training, supervision and use of onsite equipment.
- .4 Provide any and all personal protective equipment for Contractor's own workers where prescribed by legislation.

1.4 SDS

- .1 Provide to the Consultant a list of Designated Substances that will be brought to the site prior to commencing work. Safety Data Sheets (SDS) and the hazardous material inventory for each substance listed must be kept on the Project.

- .2 Maintain copies of current SDS at the Place of the Work at a location accessible to all workers, the Consultant and the Owner.

1.5 Health and Safety Warnings

- .1 The Consultant and the Owner shall have the right to document all Contractors for all health and safety warnings and/or to stop any Contractor's work if the Contractor fails to comply with any requirements under this Section.
- .2 Similarly, the Consultant and the Owner shall have the right to issue warnings and/or to stop work for any Contractor violations of the contract including Regional health and safety policy and programs and/or if the Contractor creates a health or safety hazard.
- .3 Written warnings and/or stop work orders shall be given to the Contractor using the Owner's Contractor Health and Safety Warning / Stop Work Order Form.
- .4 If the Contractor fails to adequately respond to the Consultant's or the Owner's order to correct a hazard, the Owner reserves the right to have the hazard corrected by a third party at the Contractor's expense. The Consultant's or the Owner's decision, as the case may be, as to the urgency for such correction shall be final.

1.6 Notice of Project

- .1 Notify all regulatory bodies required for construction activities, (i.e., Notice of Project, employer notification, etc.). Notifications shall include, but not be limited to, the notification requirements laid out in OHSA Sec 51-53 and the requirements of Ontario Regulation 213/91 for Construction Projects, Sections 5, 6 and 7. For the purpose of this contract the Contractor shall be the "Constructor".

1.7 Confined Space

- .1 Persons intended to work in confined spaces, as defined by the Owner, must have formal training in performing work in confined spaces.
- .2 Provide proof of valid certificates of such training for all workers prior to entry of such workers into confined spaces.
- .3 Provide all necessary safety equipment for entry into confined spaces.

- .4 Where workers are required to enter a confined space, as defined by the OHSA, O. Reg. 632/05 Section 221.2, ensure that workers of the Contractor and all Subcontractors follow the requirements of the above legislation, including but not limited to:
 - .1 having a method for recognizing each confined space to which the program applies
 - .2 having a method for assessing the hazards to which workers may be exposed
 - .3 having a method for the development of confined space entry plans (which include on-site rescue procedures)
 - .4 having a method for training workers
 - .5 having an entry-permit system.
 - .6 Supply the necessary tools and equipment to perform the confined space entry. These items include, but are not limited to, required documentation, gas detectors, breathing equipment, fall protection and rescue equipment.
- .5 Fire Safety Requirements
 - .1 Protect persons and properties.
 - .2 Maintain operable fire protection equipment.
 - .3 Maintain fire fighters' access.
 - .4 Provide temporary fire extinguishing equipment.
 - .5 Maintain existing and temporary fire exit.
 - .6 Where the work requires the Contractor to shut down fire and life safety systems, provide a fire watch for the duration of the shutdown.
 - .7 In occupied buildings, schedule the use of flame, such as torches and volatile substances well in advance with the approval of the Owner and the Consultant.
 - .8 Maintain a fire watch after all welding operations for a period of not less than 7 hours.

2 Products – Not Used

3 Execution – Not Used

3.1 Pre-Start Health and Safety

- .1 Obtain and provide a Pre-Start Health and Safety Review (PSR) report, and submit a copy of the report to the Project Manager. Ensure the products ordered are compliant with the approved PSR Report. The PSR report shall be signed by a Professional Engineer licensed to practice Engineering in the Province of Ontario. Pay all costs associated with the preparation and completion of the PSR.

End of Section

1 General

1.1 Section Includes

- .1 Laws, notices, permits and fees.
- .2 Discovery of hazardous materials.
- .3 Codes and standards.
- .4 Regulations.
- .5 Permits.

1.2 Related Requirements

- .1 This section describes requirements applicable to all Sections within Divisions 03 to 32.

1.3 Laws, Notices, Permits and Fees

- .1 The laws of the Place of the Work shall govern the Work.
- .2 The Owner will obtain and pay for the building permit, permanent easements and rights of servitude. Building Permit approval will be subject to Contractors submission of the prefabricated building structural drawings.
- .3 The Contractor shall be responsible for obtaining all permits, licenses and certificates necessary for the performance of the Work which were in force at the date of executing the Agreement.
- .4 Provide the required notices and comply with the laws, ordinances, rules, regulations or codes which are or become in force during the performance of the Work and which relate to the Work, to the preservation of the public health and to construction safety.
- .5 Construction of the Work is subject to the approval, inspection, by-laws, and regulations of municipal, provincial and federal authorities and organizations concerned with roads, streets, railways, telephones, electrical supplies, gas supplies and other public services having jurisdiction in respect to any matter in the Contract.

- .6 If the Contractor knowingly performs or allows work to be performed that is contrary to any laws, ordinances, rules, regulations or codes, the Contractor shall be responsible for and shall correct the violations thereof; and shall bear the costs, expenses and damages attributable to the failure to comply with the provisions of such laws, ordinances, rules, regulations or codes.
- .7 Determine detailed requirements of authorities having jurisdiction.
- .8 Pay all fees associated with applications, permits and inspections required by authorities having jurisdiction.
- .9 Pay construction damage deposits levied by municipality in connection with the issuance of a building permit.
- .10 Keep a copy of all permits on site.

1.4 Hazardous Material Discovery

- .1 Asbestos: If material resembling asbestos is encountered which has not been identified in the Contract Documents, immediately stop work and notify the Consultant.

1.5 Codes and Standards

- .1 Perform the Work in accordance with the requirements of the latest editions of the following statutes and codes in force at the time of the Agreement:
 - .1 Ontario Building Code
 - .2 Municipal Building and Fire Codes and By-Laws
 - .3 Electrical Safety Authority
 - .4 Ontario Electrical Safety Code
 - .5 National Fire Protection Association
 - .6 National Building Code
 - .7 Ontario Construction Safety Act
 - .8 Ontario Fire Code
 - .9 Ontario Hydro
 - .10 WHIMS

- .11 Canadian Gas Association CSA/CGA B149.1-10 Natural Gas and Propane Installation Code
- .12 Code book B139 for gas installations as per TSSA requirements.
- .2 Comply with any applicable revisions to codes and regulations after the date of the Agreement. Costs of such revisions shall be compensated for through a Change Order.
- .3 Complete all required electrical connections and provide Electrical Safety Authority (ESA) approval on such work.
- .4 Be responsible for all variances and submit application to Technical Standards & Safety Authority (TSSA).
- .5 Revise the installation and engineered drawings at no additional cost to the Owner until they meet the requirements and approval of the TSSA, the ESA and Township of Scugog Fire Department. Provide copies of all authority sign-offs.
- .6 Review Contract Drawings and specifications for any conflicts with the above regulations and where there are apparent discrepancies, notify the Owner in writing and obtain clarification before proceeding with the Work.

1.6 Precedence of Standards

- .1 Where applicable, ensure that all materials and equipment conform to the applicable Standards listed.
- .2 Canadian standards take precedence over American standards in the case of duplication or conflict.

2 Products

2.1 Equipment

- .1 Provide electronically powered equipment, components, and supplies that are CSA and ULC approved.

3 Execution – Not Used

End of Section

1 General

1.1 Section Includes

- .1 Inspection and testing, administrative and enforcement requirements.
- .2 Tests and mix designs.
- .3 Mock-ups.
- .4 Mill tests.
- .5 Written and electronic reports.
- .6 Equipment and system adjust and balance.

1.2 Related Requirements

- .1 Section 01 21 13 – Cash Allowances.
- .2 This section describes requirements applicable to all Sections within Divisions 03 to 32.

1.3 Standards References

- .1 ISO/IEC 17025-2005 - General Requirements for the Competence of Testing and Calibration Laboratories.
- .2 SCC (Standards Council of Canada).

1.4 Review by Consultant

- .1 Consultant may order any part of the Work to be reviewed or inspected if Work is suspected to be not in accordance with Contract Documents.
- .2 If, upon review such work is found not in accordance with Contract Documents, correct such Work and pay cost of additional review and correction.
- .3 If such Work is found in accordance with Contract Documents, Owner will pay cost of review and replacement.

1.5 Quality of Products and Materials

- .1 All materials, fixtures, fittings, appliances and apparatus supplied and installed by the Contractor shall be new, the best of their kind for the application and free from any defects.

1.6 Quality Control Inspection and Testing

- .1 At reasonable times, and giving reasonable notice of at least 24 hours, the Owner may inspect the work site and/or those areas of the Contractor's place of business that are related to the performance of a contract. If the Owner requires an inspection, the Contractor must provide reasonable assistance and arrangements for the inspection to take place.
- .2 Where required by the Consultant, the Contractor shall supply certified copies of all tests upon, all materials to be used in the construction of the works, indicating that materials comply with the Specifications. Such tests shall be made by a testing company which has been approved by the Consultant and shall be at the Contractor's expense.
- .3 Any and all materials or manufactured products, including pipe, may be tested by the Owner. The Contractor shall, at his own expense, supply samples for Quality Assurance (QA) testing as directed of any and all materials or manufactured products which he is using or proposes to use in the work, and he shall not be entitled to any extra remuneration nor any extension of the time allowed to complete the work, as a result of any delays which may be caused or occasioned as a result of compliance with these Specifications
- .4 Materials whose test specimens fail to meet specified requirements and those materials which are rejected upon inspection shall not be permitted to remain on the site of the work, and shall be immediately removed there from by the Contractor at his own expense.
- .5 In addition to the above items, the Contractor shall arrange and pay for the following:
 - .6 Inspection and testing required by law, ordinances, rules, regulations or Authorities having jurisdiction
 - .7 Inspection and testing performed exclusively for the Contractor's convenience

- .8 Testing, adjustment and balancing of mechanical and electrical equipment and systems.
- .9 Mill tests and certificates of compliance
- .10 Vibration monitoring
- .11 Tests specified to be carried out by the Contractor under the supervision of the Consultant
- .12 The cost of all specified testing of piping systems, tanks, etc. shall be included in the cost in the Contract

1.7 Designated Design Qualifications

- .1 In all cases where delegated design services are specified to be performed under the Contract or where Work is specified to be performed by a "Professional Engineer" or "Engineer", including but not limited to sealed shop drawings and quality verification services, the person providing such Work shall be a Professional Engineer, licensed by Professional Engineers Ontario (PEO), providing such services under a Certificate of Authorization issued by the PEO and who carries Errors and Omissions (Professional Liability) insurance coverage. The Owner reserves the right to demand proof of such qualifications and insurance coverage.

1.8 Receipt and Acceptance of Materials

- .1 During the process of unloading any material, etc., it shall be inspected by the Contractor in the presence of the Consultant, for loss or damage in transit. The Contractor shall notify the agent of the carrier of any loss or damage to the shipment.
- .2 All materials supplied by the Contractor and found faulty or defective upon delivery will be rejected by the Consultant and shall be replaced by the Contractor at his own expense, but failure to discover same shall not relieve the Contractor of responsibility for removing all faulty materials supplied by him and replacing same with good materials which he shall supply all at his own cost and expense. The unloading of all equipment shall be carefully done in an approved manner to avoid injury thereto. Ample facilities shall be provided by the Contractor for handling the equipment.

1.9 Metric vs. Imperial Equipment

- .1 Notwithstanding the requirements set out in the preceding paragraphs, because not all trades have adopted metric material or in cases of adapting to existing, where metric and Imperial types of equipment are to be installed under the same contract, the Contractor shall ensure that mating of metric and non-metric equipment is possible.
- .2 Supply shop drawings of proposed transition couplings, etc., to the Consultant prior to assembly. The supply and installation of such couplings, adapters, etc., shall be at no additional cost to the Owner.

1.10 Quality Assurance Testing by the Owner

- .1 The Owner may request any required samples at any reasonable time.
- .2 The Owner will perform Quality Assurance testing using its own forces which are CSA certified. Alternatively, the Owner may appoint a CSA-certified agency to conduct QA testing on its behalf. Quality Assurance testing will be at a frequency determined by the Owner.
- .3 The costs of all Quality Assurance testing, except as noted otherwise, shall be borne by the Owner.
- .4 The Contractor may request that the Owner's, or his agent's, Quality Assurance equipment be tested for CSA compliance. All costs for such tests shall be at the Contractor's expense where such equipment is found to be in compliance.
- .5 The Contractor shall provide clear access to work areas to be inspected and assist as required by providing safety equipment, ladders, materials, etc., for these inspections, including but not necessarily limited to, welding x-ray inspections, concrete testing, painting inspections and compaction tests.
- .6 Additional testing required to prove the adequacy of construction shall be at the Contractor's expense, where the routine test shows the construction to be inadequate, or where the Contractor's materials and procedures have not been as specified, or when work has proceeded without approval or inspection.
- .7 Where the Owner's Quality Assurance testing differs from the Contractor's Quality Control results, the Owner's results shall govern and all additional

Quality Assurance testing shall be billed to the Contractor at a rate of not less than \$250 per re-test except where such re-tests are carried out by the Owner's agency in which case such re-tests shall be billed at a rate of 110% of the invoiced amount.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.1 Section Includes

- .1 The work under this Section includes, but is not limited to, provision of:
 - .1 Access to the site and the work.
 - .2 Temporary facilities including site office, building enclosures, storage areas, shelters and sanitary facilities.
 - .3 Temporary controls, including fire protection, first aid, security, traffic control.
 - .4 Siltation fence, straw barrier and other environmental protection facilities.

1.2 Related Requirements

- .1 Section 01 51 00 - Temporary Utilities.
- .2 This section describes requirements applicable to all Sections within Divisions 03 to 32.

1.3 Reference Standards

- .1 Ontario Traffic Manual (OTM), Book 7 - Temporary Conditions, current revision.

2 Products- Not Used

3 Execution

3.1 General

- .1 Any disruption of facility operations must be accommodated by temporary facilities to the satisfaction of the Consultant.
- .2 All schedules must indicate contingency and alternate date and times in the event of postponement for any reason, or breakdown of temporary bypass equipment during the shutdown.

- .3 Comply with local Police, Fire Department and EMS requirements regarding notification of all interested parties concerning the construction work and provisions for traffic movement.

3.2 Storage of Material and Equipment

- .1 Storage areas are defined on the Drawings, or as designated by the Consultant. Store materials to ensure the preservation of their quality and fitness for the work. Store materials on wooden platforms or other hard, clean surfaces off the ground or in a watertight storage shed of sufficient size for the storage of materials that might be damaged by storage in the open. Provide the shed with a wood floor raised a minimum of 150 mm clear of the ground.
- .2 Store materials to ensure the preservation of their quality and fitness for the work. Store materials on wooden platforms or other hard, clean surface off the ground. Locate stored materials to facilitate prompt inspection.
- .3 Provide weathertight heated storage sheds with raised floors for the storage of equipment, as required by the Consultant and/or equipment manufacturers. Supply to the Consultant all storage instructions from equipment suppliers well in advance of the scheduled delivery dates.
- .4 Handle and store products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions.
- .5 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 the work.
- .6 Store products subject to damage from weather in weatherproof enclosures.
- .7 Store cementitious products clear of earth or concrete floors, and away from walls.
- .8 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.

- .9 Store sheet materials, lumber, etc. on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .10 Store and mix paints in a heated and ventilated room. Remove oily rags and other combustible debris from the site daily. Take every precaution necessary to prevent spontaneous combustion.
- .11 Remove and replace damaged products to the satisfaction of the Consultant.
- .12 Do not use private property for storage purposes without the written permission of the property owner. Pay rental charges and damages associated with occupying private lands.

3.3 Location of Temporary Facilities

- .1 Coordinate the location of temporary facilities with the facility operators subject to the satisfaction of the Consultant.
- .2 Contractor's field office and storage facilities shall be located in an area approved by the Owner that will not affect facility operations.

3.4 Installation and Removal of Temporary Facilities

- .1 Provide temporary utilities, facilities and controls to execute the work expeditiously.
- .2 Remove temporary utilities, facilities and controls at the conclusion of Contract, unless otherwise directed by Consultant.
- .3 Site to be left in tidy and clean condition after removal of temporary facilities.

3.5 Temporary Building Enclosures

- .1 Provide temporary weathertight enclosures and protection for exterior openings until permanent sash and glazing, exterior doors, louvers, etc., are installed.
- .2 Provide temporary enclosures for the work as required for weather protection and heating purposes.
- .3 Erect enclosures to allow accessibility for installation of materials and working inside the enclosure.

- .4 Keep temporary buildings in a clean and sanitary condition at all times and do not permit to become a health hazard or a nuisance to adjoining properties.

3.6 Temporary Shelter and Sanitary Facilities

- .1 Provide and properly maintain in clean condition, a suitable privy or water closet for the Contractor's personnel as required by the Construction Safety Act.
- .2 Provide all required toilet supplies.
- .3 Provide and maintain drinking water and washing facilities as required by the Construction Safety Act.
- .4 Provide shelter for workers.

3.7 Temporary Fire Protection

- .1 During the entire construction period provide fire extinguishers in each construction shed and temporary office, as well as in other locations reasonably required, and all other fire protection necessary to protect the project and to comply fully with the requirements of insurance underwriters for the project and local, provincial and federal authorities.

3.8 Temporary First Aid Facilities

- .1 Provide and maintain the necessary first aid items and equipment as required.
- .2 Designate employees who are properly instructed to be in charge of first aid. Ensure that at least one such employee is always available on the site while work is being conducted.

3.9 Temporary Site Enclosures

- .1 Erect temporary site enclosures using new 2.4 m high plastic orange snow fence wired to rolled T-bar fence posts spaced at 2.4 m on center.
- .2 Maintain all fences in good repair.
- .3 Maintain siltation barriers and straw bale check dams in good repair.

3.10 Maintaining Existing Sewerage Flows

- .1 Maintain existing sanitary sewerage flows, where applicable, and provide alternative interim service utilizing duplicate portable sewage pumps, tank trucks and other approved means. Prevent interruption to service throughout the construction period and until the new works are placed in service.
- .2 Provide and install all temporary sumps, bulkheads and/or other works in existing sewers, maintenance holes and service connections and provide temporary pumps in duplicate and pipelines to dewater and control the sewage.
- .3 Discharge sewerage flows only to those sanitary sewers remaining in service or to tank trucks for approved disposal. Under no circumstances shall contaminated water be discharged or permitted to enter any drainage or natural watercourse.
- .4 Temporarily drain or pump any leakage to permit work to be performed in the dry. The Contractor's method shall be subject to the approval of the Consultant.

3.11 Drainage Ditches and Storm Sewers

- .1 All ditches, drainage channels and/or storm sewer systems, which may be affected by construction shall have their flows maintained at all times during construction, unless permission to the contrary has been obtained from the Consultant. No extra cost shall be incurred by the Owner for this work.
- .2 Make allowance in prices for any problems that may be encountered as a result of ditch flows or storm sewer flows. Drainage shall not be impeded nor shall blockages or water backups be permitted. Any damage as a result of water or flooding shall be the responsibility of the Contractor.

3.12 Security

- .1 Be responsible for the security of construction site materials, tools, equipment, temporary facilities and storage and all construction.

3.13 Removal and Restoration of Temporary Facilities and Controls

- .1 Remove temporary facilities and controls from the site on completion of the works, or as otherwise ordered in writing by the Consultant. Unless specifically stated otherwise in the Contract Documents, maintain ownership over the temporary facilities including furnishings.
- .2 As each portion of the work is completed, as determined by the Consultant, restore disturbed areas, roadways, fences, building, etc. equal to or better than the initial condition and clean up the construction area as instructed by the Consultant.
- .3 Leave clean and in good order, roads, parking areas, walks, grassed areas and other areas disturbed by the construction and Contractor's activities. Failure to make satisfactory progress in the execution of this work within 48 hours of receipt of written notice from the Consultant may result in the Consultant having the surplus material removed, or re-grading any area or performing any work necessary to leave the site in a satisfactory condition and having the costs deducted from payments due under the Contract.

End of Section

1 General

1.1 Section Includes

- .1 Temporary utilities.
- .2 Salvaging products for reuse.

1.2 Related Requirements

- .1 Section 01 53 00 - Temporary Construction.

1.3 Temporary Utilities

- .1 Make arrangements for the supply of water, electrical power, gas, sanitary facilities, heat, and any other temporary services required during construction.
- .2 Be responsible for all fees, permits and charges, including arrangements for all necessary applications, incurred throughout the construction period until the date of Substantial Performance.
- .3 Provide power generators as required to maintain construction activities and all temporary facilities, if temporary electrical power supply is delayed or unavailable from the local authority at no extra cost to the Owner.
- .4 Permanent utilities installed as part of the Work may be used for construction requirements provided that no warranties or guarantees are affected thereby. Make good any damage.
- .5 Operate equipment according to the requirements of the Ontario Ministry of Labour under the Occupational Health and Safety Act and Regulations for Construction Projects.
- .6 Arrange, pay for and maintain temporary electrical power supply until Substantial Performance as follows:
- .7 Temporary facilities for power, where required outside the building, such as pole lines and underground cables with the approval of the local utility company.
- .8 Connection to the existing power supply system in accordance with the Ontario Electrical Safety Code. Provide meters and switchgear as required by the utility company and the Consultant.

1.4 Installation and Removal

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Salvage and assist in recycling products for potential reuse.
- .3 Remove from site all such work after use.
- .4 This section describes requirements applicable to all Sections within Divisions 03 to 32.

1.5 Dewatering

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

1.6 Water Supply

- .1 Provide continuous supply of potable water for construction use.
- .2 Arrange for connection with appropriate utility company and pay all costs for installation, maintenance and removal.
- .3 Pay for utility charges at prevailing rates.

1.7 Temporary Heating and Ventilation

- .1 Provide all temporary heat and ventilation used during the course of construction and include all costs of installation, fuel, operation, maintenance and removal of equipment.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Ventilating:

- .1 Prevent accumulation of dust, fumes, mist, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .5 Maintain strict supervision of operation of temporary heating and ventilating equipment, to:
- .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to the outside.
- .6 Maintain temperatures of minimum 10 °C in areas where construction is in progress.
- .7 Ensure date of Substantial Performance of the Work and warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Consultant.
- .8 Owner will pay utility charges when temporary heat source is existing building equipment.
- .9 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
- .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.

- .10 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.8 Temporary Power and Light

- .1 Arrange, pay for and maintain temporary electrical power supply until Substantial Performance as follows:
 - .1 Provide temporary facilities for power, where required outside the facility, such as pole lines and underground cables with the approval of the local utility company.
 - .2 Connect to the existing power supply system in accordance with the Ontario Electrical Safety Code.
 - .3 Provide meters and switchgear as required by the utility company and the Consultant.
- .2 Provide and maintain temporary lighting throughout project.
- .3 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Consultant provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than 3 months.
- .4 Existing electrical service may be used as a temporary service for lighting and the operation of electrical tools and motors during construction to the extent that there is sufficient capacity. Where capacity of existing service is insufficient, provide a temporary electrical service.
- .5 Arrange with the Owner for use of existing services prior to use and avoid overloading of circuits. Prior approval from the Owner is required.
- .6 The Owner will pay for the cost of the power supply for the existing service only. Where existing service is not sufficient, provide for additional service at Contractor's expense.
- .7 Where existing lighting fixtures and conduits require removal to complete the Work, provide temporary lighting service. Re-install original lighting upon completion of the Work.

1.9 Temporary Communication Facilities

- .1 Provide and pay for temporary high speed internet and telephone hook up, line/lines equipment necessary for own use and use of Consultant.

1.10 Temporary Water Supply

- .1 Existing water service may be used as a temporary water supply for construction.
- .2 Arrange with the Owner for use of existing services. Prior approval from the Owner is required.
- .3 The Owner will pay for the cost of the water supply for the existing service only. Where existing service is not sufficient, provide for additional service at Contractor's expense.
- .4 Supply all hoses and water containers.
- .5 Provide proper shut off valve and backflow preventer on all temporary connections between each existing and temporary service.
- .6 Use of hydrants or fire hoses is not permitted without written consent from the Owner.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.1 Section Includes

- .1 Site enclosure.
- .2 Guardrails and barriers.
- .3 Weather enclosures.
- .4 Dust tight barriers.
- .5 Protection for off-site and public property.
- .6 Protection of applied finishes.
- .7 Protection of surrounding Work.

1.2 Related Requirements

- .1 Section 01 51 00 - Temporary Utilities.
- .2 This section describes requirements applicable to all Sections within Divisions 03 to 32.

1.3 Installation and Removal

- .1 Provide temporary controls in order to execute Work expeditiously.
- .2 Remove from site all such work after use.

1.4 Site Enclosure

- .1 Erect temporary site enclosure (hoarding) using 38 x 89 mm construction grade lumber framing at 600 mm on centre, and 1200 x 2400 mm size, 13 mm thick exterior grade Fir plywood.
- .2 Apply panels vertically flush and butt jointed.
- .3 Provide one lockable truck entrance gate/gates and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys with restricted availability, in the project office.
- .4 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.

- .5 Paint public side of site enclosure in selected colours with one coat of exterior alkyd primer and one coat of exterior alkyd paint. Maintain public side of enclosure in clean condition.
- .6 Erect temporary site enclosure using new 1.2 m high snow fence wired to rolled steel "T" bar fence, posts spaced at 2.4 m on centre.
- .7 Provide one (1) lockable truck gate.
- .8 Maintain enclosure in good repair.
- .9 Provide barriers around trees and plants designated to remain.
- .10 Protect from damage by equipment and construction procedures.

1.5 Guard Rails and Barriers

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

1.6 Protection of Open Trenches and Excavations

- .1 In addition to the provisions of Ontario Regulation 213/91 made under the Occupational Health and Safety Act, R.S.O. 1990, and in particular Part III - Excavations, employ the following protection measures for trenches and excavations left open at the end of the work day or where, during any work day, a trench or excavation is left unattended by the Contractor:
- .2 Where the public has access to the perimeter of an excavation, install a barrier at least 1.1 m high around the complete perimeter of the excavation. Vertical supports must be secure, have a spacing of not more than 1.1 m and be a minimum distance of 300 mm from the top of the wall of the excavation. The barrier shall include a fencing fabric, with openings not exceeding 100 mm, securely attached to the vertical supports at the top, center and bottom and spacing not exceeding 100 mm. If the excavation is greater than 0.3 m in depth, install toe board with the fencing fabric securely fastened to it to prevent persons from slipping under the fabric and into the excavation. If an excavation is adjacent to a sidewalk or an area commonly used by the public as a walkway or recreation area, the fencing fabric shall be a metal mesh.

- .3 Where an excavation is greater than 1.0 m in depth, and the public has access to the perimeter, signs shall be posted indicating "Danger Due to Excavation".
- .4 Ensure barriers are in good condition and stable prior to vacating the project at the end of each work day.
- .5 A Crowd Control Barrier meeting the requirements of Region of Durham Standard Drawing S-301.030 will be deemed an acceptable barrier for this purpose provided the barriers are satisfactorily secured to the ground so that they cannot be moved.

1.7 Weather Enclosures

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure.

1.8 Dust Tight Barriers

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

1.9 Protection for Off Site and Public Property

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.10 Protection of Applied Finishes

- .1 Provide protection for finished and partially finished surfaces and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Consultant locations and installation schedule 3 days prior to installation.

- .4 Be responsible for damage incurred due to lack of or improper protection.

1.11 Protection of Surrounding Work

- .1 Provide protection for finished and partially finished Work from damage.
- .2 Provide necessary cover and protection.
- .3 Be responsible for damage incurred due to lack of or improper or inappropriate protection.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.1 Related Requirements

- .1 Supplementary Conditions: Substitution procedures after award.

1.2 Specified Product Options

- .1 Performance or Prescriptive Standards:
 - .1 Select any product, assembly or component material that meets or exceeds the specified standards for products specified only by referenced standards and performance criteria.
- .2 Acceptable Products:
 - .2 Products specified by component material name, manufacturer, catalogue number, model number, or similar reference establishing the standard of acceptance that the Consultant will consider appropriate for the Work. Select any named Product, assembly or component material contained in the listing of Acceptable Products.
- .3 Acceptable Manufacturers:
 - .1 Select any product, assembly or component material manufactured by the listed Manufacturers that meets or exceeds the specified standards and performance criteria.
 - .2 Submit required Shop Drawing and Product data submissions before starting any work of the relevant Specification Section for review by Consultant.

1.3 Product Substitutions

- .1 Submit proposals for substitute Products or groups of Products in accordance with Appendix B – Supplementary Conditions.
- .2 Owner is under no obligation to accept proposed substitute Products unless the Contractor can provide evidence satisfactory to the Consultant that such proposed substitute Product meets or exceeds the specified performance and other criteria.

1.4 Incorporation of Specified Products

- .1 Contractor agrees to coordinate the installation of the selected Products into the Work:
 - .1 Make any changes in the Work as may be required to accommodate the selected Products.
 - .2 Notify Consultant where a selected Product is inconsistent with the layouts and configurations indicated on Drawings and Schedules.
 - .3 Bear costs and waive claims for additional compensation for costs that are implicit in the use of the selected Products.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.1 Delivery Recommendations

- .1 Fully indemnify the Region of Durham for all damages to persons or property resulting from the services and operations performed by employees of the Contractor and all Subcontractors and suppliers, and all contracted agents or carriers, including the delivery and unloading of goods or equipment at (and transfer and unloading of bulk chemicals or fuels to) Regional facilities.
- .2 Employ delivery vehicles that are suitably licensed, insured, operated and maintained in accordance with the Contract requirements, the Contractor's (and its agent's or carrier's) applicable policies and procedures, and all applicable federal, provincial and municipal legislation, statutes and by-laws.
- .3 Ensure that the Contractor's forces receive and sign off on all deliveries and shipments required for the Work. The Region of Durham will not be responsible for the sign off on any deliveries for the Contractor or unloading of materials and equipment.
- .4 Equip all delivery vehicles with any other material handling equipment required for the delivery person to safely unload the shipment at the receiving location(s) at the Place of the Work and move the Products to the designated receiving area(s) identified in the Contract.
- .5 Equip delivery vehicles, where required, with a hydraulic tailgate for unloading heavy equipment, packages, drums, pallets and similar large, heavy items at receiving locations which are not equipped with a truck loading dock.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.1 Section Includes

- .1 Progressive cleaning.
- .2 Cleaning prior to application for Substantial Performance.
- .3 Cleaning prior to Completion.

1.2 Related Requirements

- .1 This section describes requirements applicable to all Sections within Divisions 03 to 32.

2 Products

2.1 Cleaning Materials

- .1 Cleaning Agents and Materials: Low VOC content.

3 Execution

3.1 Progressive Cleaning

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other contractors.
- .2 Remove waste materials from site or dispose of waste materials as directed by Consultant. Do not burn waste materials on site.
- .3 Clear snow and ice from area of construction, bank or pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Make every reasonable effort to recycle or otherwise salvage the materials removed from the site. Submit a disposal plan to the Owner and do not commence work prior to the Owner's approval of the disposal plan. Include all disposal costs in bid price.

- .6 Separate and recycle waste materials and dispose of them in accordance with local municipal requirements and policies.
- .7 Dispose of unused paint material at official hazardous material collections site approved by Owner.
- .8 Remove waste material and debris from site, or deposit in waste container(s), at end of each working day.
- .9 Waste Containers, if allowed:
 - .1 Provide on-site steel framed, hinged lid containers for collection of waste materials and debris.
 - .2 Provide and use clearly marked, separate bins for recycling.
 - .3 Place waste containers in an area directed by the Owner. Pay for all associated costs and permits. Do not locate bins on a structural slab.
 - .4 Remove and replace waste containers promptly when full and upon completion of the work.
- .10 Storage of waste material and debris outside of the waste containers is not be permitted.
- .11 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.
- .12 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .13 Provide adequate ventilation during use of volatile or noxious substances. Use of enclosure ventilation systems is not permitted for this purpose.
- .14 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .15 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

3.2 Cleaning Prior to Application for Substantial Performance

- .1 Prior to applying for Substantial Performance of the Work, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review, remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris other than that caused by Owner or other contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Consultant. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 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.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Clean and polish surface finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to a sanitary condition; replace filters of mechanical equipment.
- .18 Clean roof surfaces, down-spouts, and drainage components.

.19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.20 Remove snow and ice from access to facilities.

3.3 Cleaning Prior to Completion

.1 Execute final cleaning prior to Completion Acceptance review.

.2 Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.

.3 Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

.4 Replace filters of operating equipment.

.5 Clean site; sweep paved areas, rake clean landscaped surfaces.

.6 Remove waste and surplus materials, rubbish, and construction facilities from the site.

End of Section

1 General

1.1 Section Includes

- .1 Inspections and declarations.
- .2 Spare parts, maintenance materials and special tools.
- .3 Operation and maintenance manual, including formatting.
- .4 Contents each volume.
- .5 Recording actual site conditions.
- .6 Record (as-built) documents and samples.
- .7 Record documents.
- .8 Final survey.
- .9 Extended Warranties.

1.2 Related Requirements

- .1 Section 01 31 00 - Project Management and Coordination
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 45 00 - Quality Control.
- .4 Section 01 79 00 - Demonstration and Training.
- .5 This section describes requirements applicable to all Sections within Divisions 03 to 32.

1.3 Inspections and Declarations

- .1 **Contractor's Inspection:** Contractor and all Subcontractors shall conduct an inspection of the Work, identify deficiencies and defects, issue list of deficiencies and repair as required to conform to the Contract Documents.
- .2 Notify the Consultant in writing of satisfactory completion of the Contractor's Inspection and that corrections have been made.
- .3 Request the Consultant's Inspection.

- .4 **Consultant's Inspection:** Consultant and Contractor will perform an inspection of the Work to identify obvious defects or deficiencies. Consultant will generate a list of deficiencies. Correct defective and deficient Work accordingly.
- .5 Consultant will identify in inspection report all items deemed to affect issuance of Substantial Performance.
- .6 **Substantial Performance:** Contractor shall submit a written certificate that the following has been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested and are fully operational.
 - .4 Certificates required by authorities having jurisdiction have been submitted.
 - .5 Operation of systems have been demonstrated to Owner's personnel.
 - .6 All required documentation has been submitted.
 - .7 Work is complete and ready for Substantial Performance Inspection.
- .7 **Substantial Performance Inspection:** When items noted in 1.3.6 above are completed, request Substantial Performance Inspection of the Work by the Consultant and the Owner. If Work is deemed incomplete by Consultant or Owner, complete all such outstanding items and request re-inspection.
- .8 **Declaration of Substantial Performance:** When the Owner considers deficiencies and defects have been corrected and it appears requirements of the Construction Lien Act with respect to Substantial Performance, as amended by the Supplementary Conditions, have been met, make application for Substantial Performance of the Work.
- .9 **Commencement of Warranty Period:** The date of Substantial Performance of the Work, as certified by the Owner, shall be the date for commencement of the warranty period.

- .10 **Commencement of Lien Period:** The date of publication of the certificate of Substantial Performance of the Work shall be the date for commencement of the lien period.
- .11 **Release of Statutory Holdback:** After issuance of certificate of Substantial Performance of the Work, submit an application for payment of Statutory Holdback amount.
- .12 **Payment of Finishing Holdback:** After issuance of Certificate of Completion, submit an application for payment of Finishing Holdback amount.
- .13 **Final Inspection:** Consultant and Owner will conduct a Final Inspection within 3 months of the end of the warranty period. If deficient or defective Work is identified by Owner, correct deficient or defective Work and request re-inspection.
- .14 **Final Payment:** When the Owner considers final deficiencies and defects have been corrected and it appears all Contractor obligations under the Contract have been fulfilled, the Owner will issue a Final Acceptance Certificate and issue final payment.

1.4 Operation and Maintenance Manual

- .1 Prepare an Operation and Maintenance Manual during the course of construction for all equipment installed.
- .2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .3 At least 2 weeks prior to Substantial Performance of the Work, submit to the Consultant, a single PDF file of the complete draft Operation and Maintenance Manual in Canadian English.
- .4 Copy will be returned after Completion inspection with Consultant's comments.
- .5 Revise content of documents as required prior to final submittal.
- .6 Provide a single PDF file of the complete Operation and Maintenance Manual after acceptance by the Owner of the hard copy. PDF file shall not have any security protection applied (i.e. no passwords).

- .7 Substantial Performance will not be granted until an acceptable Operation and Maintenance Manual has been submitted.

1.5 Operation and Maintenance Manual Format

- .1 Organize data in the form of an instructional manual.
- .2 Submit manual in electronic format (PDF) only.
- .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

1.6 Operation and Maintenance Manual Contents

- .1 Each volume of the Operation and Maintenance Manual shall include each item specified in this Article.
- .2 Table of Contents: Provide:
 - .1 Title of project.
 - .2 Date of submission.
 - .3 Names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .4 Schedule of products and systems, indexed to content of volume.
 - .5 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable

information. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.

- .4 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Certificate of Acceptance: Relevant certificates issued by authorities having jurisdiction, including code compliance certificate and life safety systems performance certificate.
- .6 Training Manuals: Refer to Section 01 79 00.

1.7 Recording Actual Site Conditions

- .1 Record information on set of black line drawings, and within the Project Manual, provided by Owner.
- .2 Annotate with red coloured felt tip marking pen, for recording changed information. As requested by the Consultant, use multiple colored marking pens to differentiate between systems.
- .3 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately recorded.
- .4 Contract Drawings and Shop Drawings: legibly 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 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.

- .5 Specifications: legibly 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.
- .6 Other Documents: Maintain manufacturer's certifications, field test records and inspection certifications as required by individual specifications sections.

1.8 As-Built Documents and Samples

- .1 In addition to requirements in Section 01 31 00, maintain at the site one record copy of:
 - .1 Reviewed shop drawings, product data, and samples.
 - .2 Field test records.
 - .3 Inspection certificates.
 - .4 Manufacturer's certificates.
- .2 Store as-built documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label as-built documents and file in accordance with section number listings in List of Contents of the Quotation Documents. Label each document AS-BUILT DOCUMENTS in neat, large, printed letters.
- .4 Maintain as-built documents in clean, dry and legible condition. Do not use as-built documents for construction purposes.
- .5 Keep as-built documents and samples available for inspection by Consultant.
- .6 Prior to Substantial Performance of the Work, provide final draft As-Built Drawings to the Consultant with as-built dimensions and spatial arrangements.
- .7 The Consultant shall review the As-Built Drawings and send comments back to the Contractor with a copy to the Owner.
- .8 Revise the As-Built Drawings taking the comments from the Consultant into account.

- .9 Submit final As-Built Drawings to the Consultant.
- .10 Substantial Performance will not be granted until final, acceptable As-Built Drawings have been submitted.

2 Products

2.1 Materials and Finishes

- .1 Building Products, Applied Materials, and Finishes: Provide product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Provide instructions for cleaning agents and methods; precautions against detrimental agents and methods; and recommended schedule for cleaning and maintenance.
- .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.
- .4 Building Envelope: Include copies of drawings of building envelope components, illustrating the interface with similar or dissimilar items to provide an effective air, vapour and thermal barrier between indoor and outdoor environments. Include an outline of requirements for regular inspections and for regular maintenance to ensure that on-going performance of the building envelope will meet the initial building envelope criteria.
- .5 Additional Requirements: as specified in individual specifications sections.

2.2 Spare Parts, Maintenance Materials and Special Tools

- .1 Receive and catalog all items. Check inventory against Operation and Maintenance Manual guide. Include approved listing in Operation and Maintenance Manual.
- .2 If requested, furnish evidence as to type, source and quality of products provided.

- .3 If requested, provide receipts for delivered spare parts, materials and tools prior to Substantial Performance of the Work.
- .4 Defective products will be rejected regardless of previous inspections. Replace defective products at own expense.
- .5 Pay all costs of transportation, duties, tariffs, etc.

2.3 Spare Parts

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide identical items of same manufacturer, dye-lot or production run as items in the Work
- .3 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Operation and Maintenance Manual.
- .4 Obtain receipt for delivered products and submit prior to final payment.

2.4 Maintenance 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 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Operation and Maintenance Manual.
- .4 Obtain receipt for delivered products and submit prior to final payment.

2.5 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 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Operation and Maintenance Manual.

3 Execution

3.1 Deliver to Site

- .1 Deliver spare parts, maintenance materials, and special tools to location as directed; place and store.

3.2 Storage, Handling and Protection

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and to satisfaction of Consultant.

End of Section

1 General

1.1 Section includes

- .1 The Section includes the requirements related to submission of extended warranties.

1.2 Related requirements

- .1 CCDC 2 General Conditions
- .2 Appendix B - Supplementary Conditions to CCDC 2 General Conditions
- .3 Section 01 31 00 - Project management and coordination
- .4 Section 01 78 00 - Closeout submittals
- .5 Extended Warranties for specific Products and systems are specified in the relevant Technical Specification Sections of Divisions 03 through 32 as applicable.

1.3 Definitions

- .1 Extended Warranties: Warranties which are required beyond the expiry of the Contract warranty period. Extended warranties commence upon the expiry of the Contract warranty period.

1.4 Administrative requirements

- .1 Inform all manufacturers providing extended warranties of all obligations required under such extended warranties.

1.5 Submittals

- .1 Provide the following information with each extended warranty:
 - .1 Name and address of manufacturer
 - .2 Warranty description and length of warranty
 - .3 Procedure for failure or malfunction
 - .4 Instances which will affect warranty
 - .5 Certification of Contractor's installation
 - .6 Manufacturer's certification

- .2 Extended warranties shall be submitted to the Consultant no later than 30 calendar days after the date of Substantial Performance of the Work. Failure to submit extended warranties may delay release of the 10% Construction Lien Act holdback.

1.6 Payment

- .1 Payment for this section shall be made upon submission of all required documentation as specified in this and related sections.

2 Products

2.1 Extended warranties

- .1 Extended Warranties are required for the following Products and systems. Reference the specific section specification for details.

Product / System	Section	Length of Extended Warranty (years)	Total Length Product Warranty (years)
Sectional Doors	08 36 13	1	3
Pre-Engineered Structures	13 34 19	1	3

3 Execution

3.1 Contractor requirements

- .1 Inform all manufacturers providing extended warranties of all obligations required under such extended warranties.
- .2 Provide access to the work site to all manufacturers required to provide extended warranties in order for such manufacturers to witness installation of equipment and systems requiring an extended warranty as well as related and interconnected products and systems.

3.2 Warrantor requirements under extended warranties

- .1 Manufacturers shall provide extended warranties.

- .2 Extended warranties shall provide the Owner with the same rights as the original contract warranty.
- .3 All work performed under an extended warranty shall be subject to the same warranty as the original work of the Contract, and such warranty shall remain in effect:
 - .1 for the remaining period of the extended warranty, or
 - .2 one year from the completion of such extended warranty work whichever is greater.
- .4 Upon notification of defects in product or services under an extended warranty, remedy any defect identified by the Owner during the period specified in Clause 3.2.3.
- .5 Remedy any damage to Owner-owned or controlled real or personal property, when such damage is the direct result of any defect of equipment, material, workmanship, or design furnished.
- .6 Commence repairs and replacements within 7 calendar days of notification of defect unless a shorter response time is specified elsewhere in the Contract Documents.
- .7 Supplier's/manufacture's standard disclaimers and limitations on product and services warranties shall not relieve the warrantor of their obligations required under the specific extended warranty.
- .8 The warrantor shall not be liable for the repair of any defects of material nor resultant damage where such defect or damage results from any defect in Owner-furnished material or design.

End of section

1 General

1.1 Section Includes

- .1 Procedures for demonstration and instruction of Products, equipment and systems to Owner's personnel.
- .2 Seminars and demonstrations.

1.2 Related Requirements

- .1 This section describes requirements applicable to all Sections within Divisions 03 to 32.

1.3 Description

- .1 Demonstrate operation and maintenance of equipment and systems to Owner's personnel a minimum of 2 weeks prior to handover.
- .2 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.4 Component Demonstration

- .1 Manufacturer to provide authorized representative to demonstrate operation of equipment and systems.
- .2 Instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.

1.5 Submittals

- .1 Submit schedule of times and dates for demonstration of each item of equipment and each system two weeks prior to designated dates, for Consultant's approval.
- .2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 Give time and date of each demonstration, with list of persons present.

2 Products – Not Used

3 Execution

3.1 Preparation

- .1 Verify that suitable conditions for demonstration and instructions are available.
- .2 Verify that designated personnel are present.
- .3 Prepare agendas and outlines.
- .4 Establish seminar organization.
- .5 Explain component design and operational philosophy and strategy.
- .6 Develop equipment presentations.
- .7 Present system demonstrations.
- .8 Accept and respond to seminar and demonstration questions with appropriate answers.

3.2 Preparation of Agendas and Outlines

- .1 Prepare agendas and outlines including the following:
- .2 Equipment and systems to be included in seminar presentations.
- .3 Name of companies and representatives presenting at seminars.
- .4 Outline of each seminar's content.
- .5 Time and date allocated to each system and item of equipment.
- .6 Provide separate agenda for each system.

3.3 Seminar Organisation

- .1 Coordinate content and presentations for seminars.
- .2 Coordinate individual presentations and ensure representatives scheduled to present at seminars are in attendance.

- .3 Arrange for presentation leaders familiar with the design, operation, maintenance and troubleshooting of the equipment and systems. Where a single person is not familiar with all aspects of the equipment or system, arrange for specialists familiar with each aspect.
- .4 Coordinate proposed dates for seminars with Owner and select mutually agreeable dates.

3.4 Explanation of Design Strategy

- .1 Explain design philosophy of each system. Include following information:
- .2 An overview of how system is intended to operate.
- .3 Description of design parameters, constraints and operational requirements.
- .4 Description of system operation strategies.
- .5 Information to help in identifying and troubleshooting system problems.

End of Section

1 General

1.1 Section Includes

- .1 Concrete forming.

1.2 Reference Standards

- .1 Conform to the latest edition of the following:
 - .1 CAN/CSA-S136, North American Specification for the Design of Cold-Formed Steel Structural Members
 - .2 CSA-A23.1, Concrete Materials and Methods of Concrete Construction
 - .3 CSA O121-M, Douglas Fir Plywood
 - .4 CSA S269.1, Falsework for Construction Purposes

1.3 Product Delivery, Storage and Handling

- .1 Store materials on Site in a manner to prevent damage thereto. Protect from the weather. Comply with CSA-A23.1.
- .2 Protect Work of this section from damage. Protect other Work from damage resulting from this Work. Replace damaged Work which cannot be satisfactorily repaired.

1.4 Tolerances

- .1 Construct forms to produce plumb and level concrete, and true to linear building lines. Maximum variations (not accumulative) shall conform to CSA-A23.1.
- .2 A permitted variation in one part of the construction or in one section of the Specification shall not be construed as permitting violation of more stringent requirements for any other part of the construction, or in any other Specification section.

2 Products

2.1 Materials

- .1 Forms
 - .1 Plywood: CSA O121-M, G1S; Douglas fir plywood, sheets as large as practical, exterior grade, waterproof glue, edges sealed with oil-based sealer.
 - .2 Prefabricated steel forms: CAN/CSA S136-M; free of irregularities, dents, sags, rust, and materials that can discolour concrete finish.
 - .3 Used formwork may be used for surfaces which will be concealed.
 - .4 The use of premanufactured commercial "system formwork" is not permitted.
- .2 Form ties: Adjustable snap ties, formed to break 25 mm from surface of concrete after form removal, with a minimum working strength of 13 kN. Do not use wire ties.
- .3 Falsework materials: CSA S269.1. Where patented accessories, fabricated forms, shoring or scaffolding units are to be used, follow manufacturer's instructions for load carrying capacity and bracing.
- .4 Bar type waterstops: Preformed bentonite and butyl rubber-based waterstop, "Waterstop RX 101" by DRE Industries Inc. or accepted equal. Adhesive for concrete, steel, or PVC: water based "WB-Adhesive" by DRE Industries Inc. or accepted equal.
- .5 Chamfer strips: 13 x 13 mm triangular fillets milled from clear, straight grain pine, surfaced each side, or extruded vinyl type.
- .6 Formwork release agent: Imperial Oil "Filmo No 40", Goodco "Noxcrete", W.R. Meadows "Duogard", Euclid "Super Slip", CPD Chemical Form Release Agent, Dayton Superior "Clean-Strip (J-1)" or accepted equal.

3 Execution

3.1 Formwork

- .1 Construct formwork in accordance with CSA-A23.1, except where shown otherwise. Do not leave lumber in concrete.
- .2 Construct falsework in accordance with CSA S269.1.
- .3 Obtain Consultant's approval in writing for use of earth cuts as forms for vertical sides of footings and other Work not exposed to view. If approved, hand trim sides and bottoms and remove loose earth before placing concrete.
- .4 Assume full responsibility for the complete design and engineering of formwork including shoring and bracing to resist loads due to wet concrete, forms, wind, etc. and other forces arising from use of equipment to place concrete.
- .5 Do not set shoring and scaffolding on frozen subgrade. Continuously monitor safety of scaffolding.
- .6 Apply formwork release agent by spray in accordance with manufacturer's recommendations. Ensure surfaces of form receive a uniform coating.
- .7 Align form joints and make watertight. Keep form joints to a minimum.
- .8 Form for depressions, recesses, chases, reglets, anchorages and keys required in concrete.
- .9 Set floor screeds with true and straight top edge to proper elevation.
- .10 Form 13 mm x 13 mm minimum chamfered edges on exposed concrete corners unless shown otherwise. Set chamfer strips to achieve a smooth finish and consistent chamfer size throughout length of concrete.
- .11 Construct forms for concrete exposed in the finished Work to achieve the following:
 - .1 Grout-tight forms at corners, panel joints, recesses, arrises and at construction joints to prevent cement paste from leaking.

- .2 Accurate alignment of concrete surfaces.
- .3 Surfaces without indentations other than those shown.
- .4 Sharp and straight corners.
- .12 Align forms to ensure no visible defects appear on finished Work.
- .13 Locate wall form ties in accordance with reviewed Shop Drawings; align on a particular member both vertically and horizontally. Arrange reuse of forms so tie holes are also reused. Tighten form ties, particularly at corners.
- .14 Take particular care in forming corners and openings. Ensure formwork is tight and braced so no movement occurs.
- .15 Cleaning and tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.2 Construction Joints

- .1 Form construction joints where required and where shown. Construction joints shall conform to CSA-A23.1.
- .2 Form 50 mm x 100 mm bevelled shear keys full length on construction joints, unless detailed otherwise.

3.3 Wall Control Joints

- .1 Form "vee" groove control joints to details shown.

3.4 Installation of Bar Type Bentonite Waterstops

- .1 Install continuous waterstops in all pour joints (i.e. wall-to-slab joint) of a concrete structure that is waterproofed by a bentonite clay waterproofing system or as shown.
- .2 Brush clean debris, dirt, and rocks from dry concrete surface. Verify surfaces are dry.

- .3 Ensure proper waterstop placement for sufficient concrete coverage. Install waterstop along interior side of the outer row of steel reinforcement to allow for minimum concrete cover.
- .4 Apply adhesive by roller or brush to 125 microns thick x width of waterstop to prepared concrete surfaces.
- .5 Allow adhesive to dry 10 - 15 minutes or until adhesive appears black in colour.
- .6 Remove release paper from waterstop and press firmly into dried adhesive. Apply pressure for minimum 15 seconds to ensure adhesion.
- .7 Butt coil ends of waterstop together to form continuous installation. Do not overlap ends.

3.5 Stripping Formwork

- .1 Strip formwork in accordance with CSA-A23.1. Forms may be removed any time after three days from date of placing concrete or otherwise as directed by Consultant.
- .2 Strip formwork for slab sides and other concrete not supporting weight of concrete only when no damage will result from stripping operations.
- .3 Be responsible for the safety of structure, both before and after removal of forms until concrete has reached its specified twenty-eight day compressive strength.
- .4 Take particular care when removing forms to ensure no damage occurs at corners, arris and the like.
- .5 In hot weather, wood forms remaining in place are not adequate for curing purposes. Instead, loosen forms as soon as practical without damage to the concrete, and run a water sprayer such as a soil soaker hose on the inside face of forms so as to keep concrete moist. In any case, loosen forms only following time frames specified for stripping.

- .6 In cold weather, defer removal of formwork or replace formwork with insulation blankets, to avoid thermal shock and consequent cracking of concrete surface.
- .7 When concrete is dry, install temporary polyethylene rope in reglets to prevent contamination of same.

End of Section

1 General

1.1 Section Includes

- .1 Concrete reinforcing.

1.2 Reference Standards

- .1 Conform to the latest edition of the following:
 - .1 CSA-A23.1, Concrete Materials and Methods of Concrete Construction
 - .2 CAN/CSA G30.18, Carbon steel bars for concrete reinforcement

1.3 Submittals

- .1 Shop Drawings
 - .1 Submit Shop Drawings in the form of bar lists and placing drawings for review in accordance with Section 01 33 00.
 - .2 Draw placing drawings to a scale not smaller than 1:50 (1/4" equals 1'-0") and include plans, elevations, sections and details. Drawings shall be in accordance with the latest edition of Reinforcing Steel Institute of Canada's (RSIC) "Manual of Standard Practice".
 - .3 Show openings in walls as to position and size. Cooperate with trades requiring openings to ascertain necessary information.
- .2 Test Reports
 - .1 Submit certification from reinforcing steel manufacturer confirming compliance of supplied Products to specified CSA standard.

1.4 Product Delivery, Storage and Handling

- .1 Store materials on Site in a manner to prevent damage thereto. Protect from the weather. Comply with CSA-A23.1, clause 9.
- .2 Protect Work of this section from damage. Protect other Work from damage resulting from this Work. Replace damaged Work which cannot be satisfactorily repaired.

1.5 Tests of Reinforcing

- .1 Owner will appoint and pay for the services of an independent inspection/testing company to conduct mill tests (physical and chemical analysis), of reinforcing steel supplied.

2 Products

2.1 Materials

- .1 Reinforcing steel: Conforming to CAN/CSA G30.18, Grade 400.
- .2 Chairs and spacers: As manufactured by Drummond and Reeves Ltd., Acrow Richmond, Superior Concrete Accessories Ltd., Max Frank GmbH & Co. or approved equivalent, of sufficient strength to rigidly support weight of reinforcement and construction loads.
 - .1 Use chairs with flat plate base for reinforcing over rigid insulation.
- .3 Epoxy grout for dowels/rebars: conforming to ASTM C-881, 100% solids high modulus high strength epoxy gel adhesive; J-51 by Dayton Superior or Anchor Fix 3/Sikadur 35 by Sika Canada Inc.

2.2 Fabrication of Reinforcing Steel

- .1 Fabricate reinforcing steel in accordance with reviewed Shop Drawings.
- .2 Bend steel cold; no heating will be permitted. Fabricate reinforcement conforming to CSA-A23.1, Clause 12.
- .3 Ship bundles of reinforcing steel, clearly identified in accordance with reviewed bar lists.

3 Execution

3.1 Examination

- .1 Inspect formwork to ensure it has been completed and adequately braced in place before commencing to place reinforcement.

3.2 Placing of Reinforcing Steel

- .1 Place reinforcing in accordance with CSA-A23.1, Clause 12, and reviewed placing Drawings. Support with chairs or spacers in as close a spacing as

possible to prevent displacement of reinforcement from intended bar position, before and during placing of concrete. Pieces of block, wood, etc. are not acceptable as chairs and spacers.

- .2 Before placing, remove all loose scale, dirt, concrete residue from previous pours, oil or other coatings, which would reduce bond.
- .3 Turn the ends of tie wire towards the interior of the concrete.
- .4 Do not eliminate or displace reinforcement to accommodate hardware to be embedded in concrete.
- .5 Replace kinked and bent bars not called for on Drawings.
- .6 Bars shall be in lengths as long as possible. Where bars are joined, lap at least the length required by CSA-A23.1 unless shown otherwise.
- .7 Lap wire mesh sections at least 150 mm and wire together securely.
- .8 Unless shown otherwise on Drawings, provide reinforcing to housekeeping pads as follows:
 - .1 100 mm thick pad: 10M at 300 mm o.c. each way middle layer.
 - .2 150 mm thick pad: 15M at 300 mm o.c. each way middle layer.

3.3 Anchoring of Dowels or Reinforcing Bars

- .1 Drill holes in accordance with grout manufacturer's printed directions.
- .2 Blow out dust and debris from holes with compressed air.
- .3 Dispense grout cartridges with a dispensing gun, filling anchoring holes.
- .4 Insert dowel or reinforcing bar, turning slowly during insertion. After insertion, holes should be full of epoxy.

End of Section

1 General

1.1 Section Includes

- .1 Cast-in-place concrete.

1.2 Reference Standards

- .1 Conform to the latest edition of the following:
 - .1 ASTM A307, Carbon Steel Externally Threaded Standard Fasteners
 - .2 ASTM A563M, Carbon and Alloy Steel Nuts [Metric]
 - .3 ASTM C260, Specification for Air-Entraining Admixtures for Concrete
 - .4 ASTM C494, Specification for Chemical Admixtures for Concrete
 - .5 ASTM C920, Standard Specification for Elastomeric Joint Sealants
 - .6 CAN/CSA-A3001, Cementitious Materials for Use in Concrete
 - .7 CSA-A23.1, Concrete Materials and Methods of Concrete Construction
 - .8 CSA-A23.2, Methods of Test for Concrete
 - .9 CAN/CSA G164-M, Hot Dip Galvanizing of Irregularly Shaped Articles

1.3 Product Delivery, Storage and Handling

- .1 Store materials on Site in a manner to prevent damage thereto. Protect from weather. Comply with CSA-A23.1, Clause 5.1.
- .2 Protect Work of this section from damage. Protect other Work from damage resulting from this Work. Repair damaged Work to the satisfaction of Consultant at no cost to Owner.

1.4 Environmental Conditions

- .1 Conform to CSA-A23.1, Clause 7.4.

- .2 During cold weather, Provide temporary heating and enclosures required. Mix, place and protect concrete in accordance with CSA-A23.1, Clause 7.4.

1.5 Tolerances

- .1 Concrete in place shall be plumb, level and true to linear building lines. Maximum variations (not accumulative) shall conform to CSA-A23.1, Clause 6.4.
- .2 A permitted variation in one part of the construction or in one section of the Specification shall not be construed as permitting violation of the more stringent requirements for any other part of the construction, or in any other Specification section.

1.6 Inspection and Tests

- .1 Refer to Quality Control in Section 01 45 00.
- .2 Materials and concrete Work will be inspected and tested for conformance to CSA-A23.1 and to Specifications by an independent inspection/testing company selected and paid for by the Owner.
- .3 Tests include the following:
 - .1 Obtaining certification of cement.
 - .2 Tests of aggregates.
 - .3 Test for setting mixes of concrete and design of mixes.
 - .4 Concrete cylinder test. Three cylinders from each day's placement for each 75 m³ of concrete or for each 30 m³ of concrete placed in small amounts on successive days.
 - .5 Air entrainment test and slump test which will be made on same batch of concrete from which test cylinders are made.
- .4 Tests will be made in accordance with CSA-A23.2.
- .5 Inspection/testing company's reports of tests will be forwarded to Consultant and Contractor with an opinion or reason for any abnormalities noted thereon.

- .6 Inspection/testing company will inspect and review placement of reinforcing steel bars and verify size of reinforcing in accordance with reviewed Shop and placing Drawings prior to concrete placement. Any and all irregularities may deem installation to be unacceptable and must be rectified prior to concrete placement. Reports of inspection will be forwarded by the inspection/testing company to Consultant and Contractor.

1.7 Submittals

- .1 Product catalogues: Submit as Shop Drawings, up-to-date catalogue of Products proposed for use under this section in accordance with Section 01 33 00. Include the following in submittal:
 - .1 Specified admixtures
 - .2 Sealant
 - .3 Bonding agent
- .2 Concrete mix design: Submit concrete supplier's latest statistical analysis of all concrete mixes to be used on this Project.
- .3 Concrete producer's certification: Certification that plant, equipment and materials to be used in concrete comply with requirements of CSA-A23.1.
- .4 Contractor's quality control: Proposed quality control procedures for hot or cold weather conditions, for ensuring correlation of concrete mix with strength or exposure classification for area of placement, and for finishing and curing methods.
- .5 Anchor bolt setting diagrams: Submit detailed Drawings for anchor bolt setting.

1.8 Records

- .1 Keep a written record of the following:
 - .1 Concrete placements, showing location of placement, date of placement and cubic yards or metres of concrete placed.
 - .2 Signed trip ticket for each truck.

- .3 Ambient air temperature and unusual occurrences during each placement.
- .2 Permit inspection of records by Consultant at any time. At completion of Work, submit a summary of such data in six copies to Consultant.

2 Products

2.1 Materials

- .1 Select one Product from that specified under each material listing. Source liquid admixtures for concrete from one manufacturer.
- .2 Portland cement: CAN/CSA-A3001 Normal, Type GU Portland Cement.
- .3 Cementitious hydraulic slag: Conforming to CAN/CSA-A3001.
- .4 Coarse aggregate: Conforming to CSA-A23.1, Clause 4.2.3.4 and Table 11, Group I, 20-5 mm. Coarse aggregate to be 100% crushed, in cubular size.
- .5 Fine aggregate: Conforming to CSA-A23.1, Clause 4.2.3.3 and Table 10.
- .6 Water: Conforming to CSA-A23.1, Clause 4.2.2.
- .7 Water reducing admixture: Conforming to ASTM C494 Type A:
 - .1 Master Builders "Pozzolith 200N"
 - .2 Euclid "WR 75"
 - .3 Grace "WRDA" series or "Zyla" series
 - .4 Axim "Catexol 1000N"
 - .5 Or accepted equal
- .8 Air entraining admixture: Conforming to ASTM C260:
 - .1 Master Builders "Micro-Air"
 - .2 Euclid "Airextra"
 - .3 Grace "Darex AEA EH" or "Darex AEA ED"
 - .4 Axim "Catexol AE260"/"Catexol AE360" (for low slump concrete)

- .5 Or accepted equal
- .9 Flowable construction grade grout: Pre-mixed, without aggregate fillers, non-shrink, flowable type; complete with forms for flowing in place:
 - .1 Euclid "Euco NS"
 - .2 W.R. Meadows "CG-86"
 - .3 Sika "M-Bed Standard" or "Sika Grout 212"
 - .4 Master Builders "Construction Grout"
 - .5 CPD "Non-Shrink Construction Grout"
 - .6 Dayton Superior "1107 Advantage Grout"
 - .7 Five Star Products "FSP Construction Grout"
 - .8 Or accepted equal
- .10 Flowable premium grout: Pre-mixed, without aggregate fillers, non-shrink, flowable type; complete with forms for flowing in place:
 - .1 Master Builders "Masterflow 713"
 - .2 W.R. Meadows "V3 Grout"
 - .3 Sika "M-Bed Standard OH"
 - .4 Euclid "Euco Hi-Flow Grout"
 - .5 Dayton Superior "Sure-Grip HP Grout"
 - .6 CPD "Non-Shrink (Hi-Flo)"
 - .7 Five Star Products "Five Star Grout"
 - .8 Or accepted equal
- .11 Epoxy grout: Premixed, non-shrink, consisting of thermosetting resin base, with inert fillers, with minimum 7-day compressive strength of 10,000 psi, suitable for use on dry or damp surfaces:
 - .1 Dayton Superior "J-54 Sure-Grip Epoxy Grout"
 - .2 Euclid Chemical Company "E3-G"
 - .3 Sika Chemical Company "Sikadur 42 Grout Pak"
 - .4 W.R. Meadows, Inc. "EG-96 Plus"
 - .5 Five Star Products "DP Epoxy Grout"
 - .6 Or accepted equal

- .12 Bonding agent: Conforming to ASTM C881:
 - .1 Sika Chemical "Sika-Dur Hi-Mod"
 - .2 Euclid "452LV or MV"
 - .3 W.R. Meadows "Resi-Weld 1000"
 - .4 Master Builders "Concresive Liquid LPL"
 - .5 CPD "Epoxcrete (Hi-Mod)"
 - .6 Dayton Superior "Resi-Bond (J-58)"
 - .7 Five Star Products "Bonding Adhesive"
 - .8 Or accepted equal
- .13 Sealant for exposed V-joints: Grey in colour:
 - .1 Sika "RC-1"
 - .2 Euclid "Eucolastic I"
 - .3 Tremco "Vulkem 116"
 - .4 Sonneborn "NP-1"
 - .5 Or accepted equal
- .14 Asphalt coating: Henry "110-14" or accepted equal, including primers recommended by coating manufacturer.
- .15 Bond breaker coating: Dayton Superior "Sure-Lift WB (J5)", Cresset "Crete-Lease 20-VOC" by Form and Build, or accepted equal 2-coat application, brush applied.
- .16 High density insulation: Dow Styrofoam "HI-40", Owens-Corning "Foamular 400" or accepted equal unless shown or noted otherwise.

2.2 Concrete Mix Proportions

- .1 Ready-mixed concrete and concrete proportions to be in accordance with CSA-A23.1, Clause 4.3.1, and as follows:
 - .1 Minimum allowable compressive strengths at 28 days are as follows unless otherwise noted or shown.
 - .1 7.5 MPa: for lean concrete fill
 - .2 25 MPa: for footings

- .3 35 MPa: for piers, walls, curbs and exterior pads
- .2 Minimum cement content: 25 MPa-265 kg/m³; 35 MPa-375 kg/m³. If blended normal Portland cement/cementitious hydraulic slag is used, slag content to be not more than 25% of total volume of cement.
- .3 Slump at point of deposit: 80 mm with a maximum tolerance of plus or minus 20 mm.
- .4 Keep water-cement ratio to a minimum to increase strength and durability of concrete.
- .5 Exposure classification: as defined in Table 2 of CSA-A23.1 and as follows:
 - .1 F-2 for exterior reinforced concrete
 - .2 N for interior footings
 - .3 C-1 for exterior reinforced concrete; C-2 for exterior non-reinforced concrete.
- .6 Air content for exterior concrete: conforming to CSA-A23.1, Clause 4.3.3, Table 4.

2.3 Admixtures

- .1 Add admixtures to concrete mix in accordance with manufacturer's recommendations. Have admixture manufacturer make available, at no cost, upon 72 hours' notice, the services of a qualified, full-time field representative to assure proper use of admixtures.
- .2 Except where specified otherwise herein, comply with CSA-A23.1.
- .3 The use of calcium chloride or additional admixtures, other than that specified, is not acceptable.

3 Execution

3.1 Examination

- .1 Confirm surfaces on which concrete is to be placed are free of frost, water, and debris before placing concrete.

- .2 Confirm that reinforcement, inserts and other built-in Work are in place and secured before placing concrete.
- .3 Prior to placement of concrete, confirm that reinforcement is secured in correct location.
- .4 Replace incorrectly fabricated reinforcement, relocate misplaced reinforcement and install omitted reinforcement before concrete is placed, as directed by Consultant. Incorrectly fabricated, misplaced or omitted reinforcement will be considered defective Work performed by this section.

3.2 Setting and Building-in

- .1 Set and build into formwork anchorage devices and other embedded items required for other Work that is attached to or supported by cast-in-place concrete. Use setting Drawings, diagrams, instructions, and directions provided by suppliers of items to be attached. Refer to CSA-A23.1 "Fabrication and Placement of Hardware and Other Embedded Items" for acceptable tolerances.
- .2 Advise trades well in advance of scheduled concrete placements to allow adequate time for supply of items to be built in. Have respective trades verify location of items supplied by them.
- .3 Set column anchor bolts to comply with the following tolerances:
 - .1 Tolerance of anchor bolt location: conform to CSA-A23.1, Clause 6.7.
 - .2 Allowable anchor bolt height tolerance: to within plus or minus 12 mm maximum.
 - .3 Tolerance for placing embedded items: conform to CSA-A23.1, Clause 6.7.
- .4 Set bumper posts in concrete footings and fill with ram packed 20 MPa concrete. Form top of fill to a crown, smooth finish.

3.3 Placing of Concrete

- .1 Place concrete in accordance with CSA-A23.1, Clause 6.8.5.4.

- .2 Install sluices to limit height of free fall of concrete to 1200 mm maximum. Place concrete to prevent layering and segregation and vibrate sufficiently to ensure thorough compaction, maximum density and according to CSA-A23.1, Clause 6.8.5.4. Hand spade concrete adjacent to forms.
- .3 Before placing fresh concrete against set or partially set concrete, clean surfaces to remove dirt, scum, shavings, debris, laitance, etc. On set surfaces, brush generously with a bonding compound.
- .4 Check work frequently with accurate instruments during placing of concrete.

3.4 Treatment of Formed Concrete

- .1 Treat and finish exposed formed surfaces in accordance with CSA-A23.1, Clause 7.7.
- .2 Where top of foundation walls will be exposed to view in the finished Work, steel trowel same to a level, smooth finish.
- .3 Treat and prepare surfaces to be waterproofed to a smooth and even finish free from projecting mortar, concrete fins, honeycombing and other irregularities and with juncture of wall and footing coved with masonry mortar. Patch as required in accordance with CSA-A23.1, Clause 7.7.2.

3.5 Finishing of Concrete Pits

- .1 Pit bottoms (floors) and rooftop: Screed, float and trowel surface to smooth level and dense condition free from trowel marks, ridges and depressions except where otherwise specified. Water cure as specified herein.
- .2 Inside surfaces of perimeter walls: Finish to a smooth and even finish free from projecting mortar, concrete fins, honeycombing and other irregularities and with juncture of wall and footing coved with masonry mortar. Patch as required in accordance with CSA-A23.1, Clause 7.7.2.
- .3 Outside surfaces of perimeter walls: Treat and prepare wall surfaces in accordance with "Treatment of Formed Concrete" article herein.

3.6 Grouting

- .1 Grout column base plates prior to installation of siding or decking. Shims or double nuts alone are not structurally stable to carry the foregoing loads.
- .2 Place grout in accordance with the grout manufacturer's printed directions. Form around bases, place grout in a manner which will ensure positive bearing of the full area of the steel plate on top of the supporting surface. Thoroughly compact, leaving no voids.

3.7 Sealant Application

- .1 Sealant at V-joints: Prime, prepare substrate and apply sealant full joint depth in accordance with manufacturer's printed directions. Tool to a smooth semi-concave finish. Exclude joints in surfaces to receive waterproofing treatment.

3.8 Site Clean Up

- .1 Remove excess materials including waste hardened concrete and other debris resulting from Work of this section from Site and leave premises in a condition acceptable to Consultant.

End of Section

1 General

1.1 Section Includes

- .1 Concrete floors and finishing.

1.2 Reference Standards

- .1 Conform to the latest edition of the following:
 - .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
 - .2 ASTM C156, Test Method for Water Retention by Concrete Curing Materials
 - .3 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - .4 ASTM C494, Standard Specification for Chemical Admixtures for Concrete
 - .5 ASTM C920, Standard Specification for Elastomeric Joint Sealants
 - .6 ASTM C1018, Standard Test Method for Flexural Strength of Concrete
 - .7 ASTM D1752, Standard Specification For Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
 - .8 CAN/CSA-A3001, Cementitious Materials for Use in Concrete
 - .9 CSA-A23.1, Concrete Materials and Methods of Concrete Construction
 - .10 CSA-A23.2, Methods of Test for Concrete
 - .11 CAN/CSA G30.18-M, Billet-Steel Bars for Concrete Reinforcement
 - .12 CE, Conformance Europeene (European Conformity)

1.3 Submittals

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

- .2 Submit manufacturer's product data, performance criteria and other documentation for each material specified in this section that is proposed for use, including:
 - .1 Admixtures
 - .2 Liquid curing/sealing, curing/hardener
 - .3 Premoulded joint filler
 - .4 Joint sealant and primer
 - .5 Bonding agent
 - .6 Prefabricated drainage trenches
- .3 Also submit the following:
 - .1 Proposed method for bulkheads and formwork
 - .2 Proposed placement equipment
 - .3 Schedule of events and casting plan regarding placement operations, and records of concrete casts
- .4 Concrete mix design: Submit concrete supplier's latest statistical analysis of all concrete mixes to be used on this Project.
- .5 In addition to that specified above, submit other documents as defined in the referenced CSA standards which are applicable to Work of this section.

1.4 Records

- .1 Keep a written record of concrete placements, showing location, date, cubic metres of concrete including signed trip ticket for each truck, ambient air temperature, and unusual occurrences during each placement. Permit inspection of records by Consultant at any time. At completion of Work, submit a summary of such data in triplicate to Consultant.

1.5 Quality Assurance

- .1 Subcontractor
 - .1 It is the intent of this section to establish a single competent source being the concrete floor finishing trade Subcontractor to be responsible for providing complete, durable concrete floors and

other concrete structures as specified herein, including provision of formwork, reinforcing, concrete and finishing complete as specified herein.

- .2 Slab placing and finishing shall be done by an established Subcontractor with at least five years of proven, accredited and satisfactory experience in this trade, employing skilled personnel. Submit proof of this requirement to Consultant.

1.6 Inspection and Tests

- .1 Materials and concrete Work will be inspected and tested for conformance to CSA-A23.1 and to Specifications by an independent inspection/testing company selected and paid for by Owner.
- .2 Tests include the following:
 - .1 Obtaining certification of cement
 - .2 Tests of aggregates
 - .3 Test for setting mixes of concrete and design of mixes
 - .4 Concrete cylinder test. Three cylinders from each day's placement for each 75 m³ (of concrete, or for each 30 m³ (of concrete placed in small amounts on successive days.
 - .5 Slump tests made on the same batch of concrete from which test cylinders are made.
- .3 Tests will be made for conformance of Work to CSA-A23.1 in accordance with CSA-A23.2.
- .4 Inspection/testing company's reports of tests will be forwarded to Consultant and to Contractor with an opinion or reason for any abnormalities noted thereon.

1.7 Pre-construction Meeting

- .1 Prior to start of Work of this section, arrange for a Project site meeting of all parties associated with Work of this section. Presided by Consultant, meeting to include Contractor, floor finishing Subcontractor, admixture manufacturer representative, floor products manufacturer representative, Owner's Representative, and testing company's representative.

- .2 In the meeting, review Specifications for Work included under this section and determine a complete understanding of requirements and responsibilities relative to Work included, storage and handling of materials, materials to be used, placing of underslab vapour retarder or waterproofing, installation of materials, sequence and quality control, Project staffing, restrictions on areas of concrete placements, and other matters affecting the construction, so as to permit compliance with the intent of this section.

1.8 Product Delivery, Storage and Handling

- .1 Store materials on Site in a manner to prevent damage thereto. Protect materials from inclement weather. Comply with CSA-A23.1, Clause 5.1.
- .2 Protect materials and Work of this section from damage. Protect other Work from damage resulting from this Work. Replace damaged Work which cannot be satisfactorily repaired.

1.9 Environmental Conditions

- .1 During hot weather, conform to CSA-A23.1 Clause 7.4.
- .2 During cold weather, provide temporary heating and enclosures required. Mix, place and protect concrete in accordance with CSA-A23.1, Clause 7.4.
- .3 Use insulated polyethylene blankets over top of interior concrete slabs in addition to geosynthetic cloth when curing concrete in periods of cold weather.
- .4 Do not use propane heaters. All temporary heaters to be vented to outside. Do not use propane or gas powered vehicles during concrete placements.

1.10 Verification

- .1 Verify actual sizes of equipment pads with the mechanical, process and/or electrical Contractors, in advance of placing concrete. If there is deviation from dimensions shown on Consultant's Drawings, inform the Consultant and request authorization to proceed.

1.11 Tolerances

- .1 Concrete in place shall be plumb, level and true to linear building lines. Maximum variations (not accumulative) shall conform to CSA-A23.1, Clause 6.4.
- .2 Slabs-on-grade: slab flatness tolerances in accordance with CSA-A23.1, Table 22, Class C: $F_F=35$ and $F_L=25$ specified overall, and $F_F=20$ and $F_L=17$ minimum local. Levelness tolerances (F_L) do not apply to inclined surfaces. Refer to CSA-A23.1 Clause 7.5.1.3.
- .3 A permitted variation in any part of the construction or in any section of Specification shall not be construed as permitting violation of more stringent requirements for any other part of construction or in any other Specification section.

2 Products

2.1 Materials

- .1 Use one Product from that specified under each material. Source liquid admixtures for concrete from one manufacturer.
- .2 Portland cement: Normal, type GU Portland cement conforming to CAN/CSA-A3001-03.
- .3 Coarse aggregate: CSA-A23.1, Clause 4.2.3.4, Group I, and Table 11; 40-5 mm for Repair Bays and Material Storage Shed generally; 20-5 mm for other areas. Coarse aggregate to be 100% crushed, in cubular size.
- .4 Fine aggregate: Conforming to CSA-A23.1, Clause 4.2.3.3 and Table 10.
- .5 Water: Conforming to CSA-A23.1, Clause 4.2.2.
- .6 Steel dowels: Round, smooth type bars conforming to CSA G40.21. Use at floor slab construction joints.
- .7 Column isolators: 1 mm thick (20 ga) sheet metal with Z275 galvanized coating to ASTM A653/A653M.
- .8 Chairs and spacers: Rigid type, as manufactured by Drummond and Reeves Ltd., Acrow Richmond, or Superior Concrete Accessories Ltd. of sufficient strength to rigidly support weight of reinforcement and

construction loads. Use precast concrete chairs with embedded tie wires for support of bottom and top reinforcing steel bar in slabs on grade.

- .9 Water reducing, high range admixture (superplasticizer): Conforming to ASTM C494 Type A & F. Use one of the following:
 - .1 BASF Corporation "MasterGlenium" Series or "Master Rheobuild 1000".
 - .2 Euclid "Eucon 37"
 - .3 Grace "Daracem" series or "ADVA" series
 - .4 Axim "Catexol 1000 SP-MN"
 - .5 Or accepted equal
- .10 Water reducing, high range, and retarding admixture: Conforming to ASTM C494 Type G. Use one of the following:
 - .1 Euclid "Eucon 537"
 - .2 Grace "Daracem 100"
 - .3 Or accepted equal
- .11 Water reducing and retarding admixture (for set retarding in hot weather): Conforming to ASTM C494 Type B & D. Use one of the following:
 - .1 BASF Corporation "MasterSet R" Series
 - .2 Euclid "Eucon 727"
 - .3 Grace "Daratard 17"
 - .4 Axim "Catexol 1000 RX"
 - .5 Or accepted equal
- .12 Water reducing admixture: Conforming to ASTM C494 Type A. Use one of the following:
 - .1 BASF Corporation "MasterSet AC 534" or "MasterSet FP 20"
 - .2 Euclid "WR 75"
 - .3 Grace "WRDA" series or "Zyla" series
 - .4 Axim "Catexol 1000N"
 - .5 Or accepted equal
- .13 Water reducing and accelerating admixture (for set accelerating in cold weather): Conforming to ASTM C494 Type C & E:

- .1 Master Builders "Pozzutec 20"
 - .2 Euclid "Accelguard 90"
 - .3 Grace "Polarset", "Daraset" series, "DCI"
 - .4 Axim "Catexol 1000 RHE"
 - .5 Or accepted equal
- .14 Premoulded joint filler: Rigid grade, closed cell polyethylene or PVC foam, 6 mm thick, unless shown or noted otherwise, conforming to ASTM D1752, Type 1:
- .1 W.R. Meadows "Deck-O-Foam" pre-scored, conforming to ASTM 1622 and ASTM 3575.
 - .2 CPD "Closed Cell Foam Joint Filler", conforming to ASTM D1056 and ASTM D1667.
 - .3 Or accepted equal
- .15 Premoulded joint filler adhesive: For securing joint filler to abutting adjacent structures, as recommended or supplied by manufacturer of joint filler used.
- .16 Backer rod type "A": "Spal-Pro Rod" by Metzger-McGuire Co., "CRL Retainer Spline" by C.R. Laurence, Mississauga, Ontario or accepted equal. Use with epoxy sawcut joint sealant for floor slab on grade only. Backer rod size to be slightly greater than joint width to ensure a snug, secure fit.
- .17 Heavy duty sawcut joint filler - soft-cut sawcuts on grade: A choice of either epoxy or polyurea as follows:
- .1 Epoxy: 2-component, 100% solids, self-levelling with minimum Shore "A" hardness of 80, tensile strength of 4.1 - 6.4 MPa and elongation of 60%. Install in sawcuts cut using a "Soff-Cut" saw by Soff-Cut International:
 - .1 Euclid "Euco 700"
 - .2 Sika "Loadflex"
 - .3 W.R. Meadows "Sealtight Rezi-Weld Flex"
 - .4 Dayton Superior "Poxy Fil Soff Cut (J-52)"
 - .5 Metzger/McGuire "Edge-Pro XL"
 - .6 BASF Corporation "MasterSeal CR 190"

- .7 Or accepted equal
- .2 Polyurea: 2-component, 100% solids, self-levelling with minimum Shore "A" hardness of 80 and tensile strength of 6 - 9.65 MPa:
 - .1 Euclid "Euco QWIKjoint 200"
 - .2 Thoroc "IC-2250"
 - .3 Chemtron "2010"
 - .4 BASF Corporation "MasterSeal CR 100"
 - .5 Or accepted equal

2.2 Sealant

- .1 Standard joint sealant: 2-component chemically reactive polyurethane-modified conforming to ASTM C920, Type M, Grade NS, Class 25, grey. Use one of the following:
 - .1 Euclid "Eucolastic II"
 - .2 Sika "Sikaflex 2C NS/SL"
 - .3 Tremco "Vulkem 245"
 - .4 Sonneborn "Sonolastic SL2"
 - .5 Or accepted equal
- .2 Traprock hardener: Factory pre-mixed dry shake:
 - .1 CPD "Floor Hardener Pre-Mix (Premium)"
 - .2 Euclid "Surflex TR"
 - .3 Or accepted equal
- .3 Liquid curing/sealing compound - water based acrylic: Conforming to ASTM C309, Type 1, Class B and CSA-A23.1:
 - .1 BASF Corporation "MasterKure CC 160 WB"
 - .2 Euclid "Aqua-Cure"
 - .3 W.R. Meadows "Vocomp-20"
 - .4 Sika "Florseal W.B."
 - .5 CPD "Cure & Seal 20 (Water Based)"
 - .6 Dayton Superior "Safe Cure + Seal (J-18)"
 - .7 Or accepted equal

- .4 Water for curing: Conforming to CSA-A23.1, Clause 4.2.2, clear and entirely free from any elements which might cause staining of concrete.
- .5 Liquid densifying/hardening compound: Proprietary blend of silicate polymers:
 - .1 "Ashford Formula" by Duracon Consulting
 - .2 Euclid "Euco Diamond Hard"
 - .3 Dayton Superior "Day-Chem Sure Hard (J-17)"
 - .4 W.R. Meadows "Liqui-Hard"
 - .5 Sika "Sikafloor 3S"
 - .6 BASF Corporation "MasterKure HD 200 WB"
 - .7 Or accepted equal
- .6 Geosynthetic cloth for wet curing: Terrafix 240R or approved equivalent.
- .7 Polyethylene film for wet curing: Minimum 0.1 mm thick, complying with maximum allowable moisture loss requirements of ASTM C156.
- .8 Bonding agent: Conforming to ASTM C881:
 - .1 Sika Chemical "Sika-Dur Hi-Mod"
 - .2 W.R. Meadows "Rezi-Weld 1000"
 - .3 Euclid "452 LV or MV"
 - .4 Cappar "Capbond E"
 - .5 CPD "Epoxcrete (Hi-Mod)"
 - .6 Dayton Superior "Resi-Bond (J-58)"
 - .7 BASF Corporation "MasterEmaco ADH 326" (formerly "Concressive Liquid LPL")
 - .8 Or accepted equal
- .9 Bond breaker: Dayton Superior "Sure-Lift WB (J5), Cresset "Crete-Lease 20-VOC" by Form and Build or accepted equal, 2-coat application, brush applied.
- .10 Prefabricated Drainage Trenches: 100 mm prefabricated precast polymer concrete complete with built-in ductile iron rails with boltless Powerlock system, "F" load rated ductile iron grates, catchbasin system complete with trash bucket and ductile iron grate and frame also "F" load rated. Trench shall have a 0.6% slope and installed with polyurethane sealant

supplied by trench manufacturer. Trench drain shall be ACO S100K with 630 catch basin system as supplied by Unistrut Northstar or accepted equal.

2.3 Floor Finishes Schedule

- .1 Material Storage Shed
 - .1 Screed
 - .2 Soft swirl finish
 - .3 Water cured

2.4 Concrete Mix Proportions

- .1 Furnish ready-mixed concrete conforming to CSA-A23.1, Clause 5.2.
- .2 Concrete Proportions
 - .1 Proportion concrete in accordance with CSA-A23.1, Clause 4.3.1, and as follows:
 - .1 Concrete member: Concrete slabs-on-grade
 - .2 Minimum compressive strength at 28 days: 35 MPa
 - .3 Minimum cement content: 375 kg/m³
 - .4 Maximum W-C ratio: 0.55
 - .2 Slump on arrival on Site prior to addition of superplasticizer: 60 mm with a maximum tolerance of ± 20 mm for floors, 80 mm with maximum tolerance of ± 20 mm for other concrete.
 - .3 Keep water-cementitious material ratio to a minimum to increase strength and durability of concrete, or as specified above.
 - .4 Add superplasticizer as required.
 - .5 Confirm mix design to ensure conformance with requirements specified herein.
- .3 Admixtures
 - .1 Add admixtures to concrete mix in accordance with manufacturer's recommendations. Have manufacturer make available, at no cost, upon 72 hours' notice, services of a qualified, full-time field representative to assure proper use of admixtures.
 - .2 Except where specified otherwise, comply with CSA-A23.1.

- .3 The use of calcium chloride or additional admixtures, other than those specified, is not permitted.

3 Execution

3.1 Examination

- .1 Examine previously constructed Work including placement and compaction of underfloor materials. Check thicknesses and review compaction test results of sub-floor fill to receive this Work. Report to Consultant in writing any defects or discrepancies. Commencement of Work implies acceptance of existing conditions.
- .2 Establish elevations of compacted underfloor base prior to commencing Work.
- .3 Ensure that placing of limestone is sequenced with placing of concrete to avoid displacement of limestone by construction traffic.

3.2 Placing of Reinforcing Steel

- .1 Place reinforcing steel in accordance with reviewed Shop Drawings.

3.3 Setting and Building-in

- .1 Set and build in inserts, anchors, frames, angles, sleeves, plates, etc. supplied by other trades. Advise trades well in advance of scheduled placements to allow adequate time for supply of items to be built in. Have respective trades verify location of items supplied by them.
- .2 Install prefabricated drainage trenches in accordance with manufacturer's printed directions and recommendations.

3.4 Placing Concrete

- .1 Check formwork immediately before placing concrete and make all adjustments as necessary.
- .2 Place concrete in accordance with CSA-A23.1, Clause 6.8.5.4, except as specified otherwise.
- .3 Place concrete in squares or rectangles. "L" shaped placements are not permitted.

- .4 Work concrete into complete contact with forms and embedded items. Consolidate concrete adjacent to side forms along the entire length of forms and ensure smooth surface finish after stripping of formwork.
- .5 Install sluices to limit height of free fall of concrete to 1.2 m maximum. Place concrete to prevent layering and segregation and vibrate sufficiently to ensure thorough compaction, maximum density and in accordance with CSA-A23.1, Clause 6.8.5.4. Hand spade concrete adjacent to forms with metal spatulas.
- .6 Check Work frequently for lines and levels with accurate instruments during placing of concrete. Closely monitor and record floor elevations using laser instruments.
- .7 Before placing fresh concrete against set concrete at construction joints, clean surfaces to remove dirt, scum, shavings, debris, laitance, etc.; grease dowels generously at construction joints. Provide bond break between pours.
- .8 Where floor drains occur, level floor around walls and provide minimum uniform slope of 1.6 mm per 300 mm to drains.
- .9 Install premoulded joint filler for full depth of slabs.
 - .1 Except in areas to receive subsequent architectural floor finish, knife score joint filler through 75% of its thickness 6 mm from top of material to be set at finish floor elevation.
 - .2 Set premoulded joint filler in adhesive.
 - .3 Set scored face of filler against existing structure and ensure no adhesive is applied to top 6 mm portion which will be stripped just prior to installation of sealant.

3.5 Construction Joints

- .1 Form construction joints. Dowels occur on construction joints unless detailed otherwise. Grease dowels generously just prior to new pour. Place bond break to adjacent slabs. Place galvanized circular steel forms as column isolation joints as shown.

3.6 Floor Finishing

- .1 Screed, machine float and machine trowel floor surfaces to smooth, level and dense surfaces free from trowel marks, ridges and depressions.
- .2 Use hand-held vibrators and hand screed, float and trowel surfaces in areas inaccessible to power equipment, to same density and surface quality specified for floors finished with power operated equipment.
- .3 Exterior Slabs
 - .1 Power screed exterior floor slabs with mechanical vibratory screeding equipment. Float surface to provide a sidewalk "swirl" texture.
- .4 Do not contaminate or adulterate various floor finishing mixes.

3.7 Traprock Shake Hardener

- .1 Over freshly floated concrete, apply premixed traprock shake in two equal applications at right angles to a total minimum application rate specified. Distribute evenly. Float between application of shake and after second shake applications with power floats. Machine trowel to smooth, level and dense surface, in uniform colour, free from trowel marks, ridges, pinholes and other defects.

3.8 Sawcutting Control and Construction Joints – Soft Cut Joints

- .1 Sawcut control joints and construction joints in slab in straight lines.
- .2 Perform "dry method" using "Soft-Cut saw" as soon as the slab will support the weight of the saw and operator without disturbing the final finish. Perform sawcutting from zero to two hours after final floor finishing or within a concrete cutability window of 1.1 MPa/10.5 kg/cm² to a maximum of 5.6 MPa/56.3 kg/cm². Replace manufacturer's patented anti-ravel skid plate with each new blade to avoid spalling and ravelling.
- .3 Take sawcut joints to face of columns.
- .4 After sawcutting, vacuum clean joints to remove dust and debris.
- .5 When cleaned joints are dry and prior to traffic being allowed over area, install temporary polyethylene backer rod in joints to prevent contamination of same.

3.9 Curing/sealing of Slabs – General

- .1 At premoulded joints to be subsequently caulked, and after curing/sealing operations are complete, remove scored strip from top of isolation joints in floor slab. Clean joints above premoulded joint filler and place temporary polyethylene rope to prevent contamination of joint until sealant is applied.
- .2 Refer to "Floor Finishes Schedule" as specified previously herein for type of curing/sealing for various floor areas.

3.10 Water Curing and Liquid Densifying/Hardening Compound

- .1 Winter concreting
 - .1 After sawcutting operations have been completed, water down entire area and cover with geosynthetic cloth and overlay with insulated polyethylene blankets. Remove geosynthetic cloth and blanket after three consecutive days minimum and allow substrate to dry. On the fifth day, apply one coat of liquid densifying/hardening compound by method recommended by manufacturer.
 - .2 Immediately after first coat of liquid densifying/hardening compound has dried, and prior to traffic being allowed over area, apply a second coat at the rate of 25% of the volume of the first coat.
 - .3 Dry buff applied compound after it has cured for minimum 24 hours, to provide immediate gloss.
- .2 Non-winter concreting
 - .1 After sawcutting operations have been completed, water down entire area and cover with filter cloth. Remove cloth after three consecutive days minimum and allow substrate to dry. On the fifth day, apply one coat of liquid densifying/hardening compound by method recommended by manufacturer.
 - .2 Immediately after first coat of liquid densifying/hardening compound has dried, and prior to traffic being allowed over area, apply a second coat at the rate of 25% of the volume of the first coat.
 - .3 Dry buff applied compound after it has cured for minimum 24 hours, to provide immediate gloss.

3.11 Liquid Compound Curing/Sealing

- .1 After sawcutting operations have been completed, cure and seal floor with one coat of liquid curing/sealing compound at rate and by method recommended by manufacturer.
- .2 Apply second coat at same rate as first coat immediately after first coat has dried, and prior to traffic being allowed over area.

3.12 Water Curing

- .1 Water cure floors designated to be surfaced with ceramic or quarry tile, and epoxy or urethane. Do not use curing/sealing compound.
- .2 Using geosynthetic cloth: Immediately after floors have been power trowelled and water sheen has dissipated, cover slabs with geosynthetic cloth for a minimum of seven days. Remove geosynthetic cloth in sections to execute required sawcutting of slabs, then replace as specified herein. Upon completion of curing period, remove and dispose of geosynthetic cloth cover, boards and ballast from the Site.
- .3 Using polysheet: Immediately after floors have been power trowelled and water sheen has dissipated, cover slabs with polyethylene sheet for a minimum of seven days. Lap end and side laps between polyethylene sheets a minimum of 300 mm and apply wood boards over laps to prevent sheet from displacing. Apply additional wood boards or other form of ballast in field of sheet as required to prevent wind and other forms of displacement. Remove polyethylene sheet in sections to execute required sawcutting of slabs, then replace as specified herein. Upon completion of curing period, remove and dispose of polyethylene sheet cover, boards and ballast from the Site.

3.13 Joint Filler

- .1 Do not apply filler in areas of concrete slab which are to receive ceramic tile, carpet, resilient flooring or epoxy system.
- .2 Do not fill isolation joints, construction joints, and control joints sooner than 120 days after concrete pours. Execute joint sealing during cool, dry ambient conditions when slab is in contracted state to minimize future joint separation at sealant-filled joints. Provide filler maintenance if filler must be applied sooner than specified as approved by Consultant.

- .3 Clean sawcut joints with a high power industrial vacuum cleaner to remove dust and debris. Do a second pass of vacuum cleaner as required to render joints clean.
- .4 Fill sawcuts in concrete floor slab on grade using heavy duty sawcut joint filler (epoxy or polyurea), as follows:
 - .1 Using epoxy: provide Type "A" backer rod in sawcut joints, push to the bottom of sawcut. Fill joint with filler, finish top flush with the surface of the slab.
 - .2 Using polyurea: fill joint full depth with filler, finish top flush with the surface of the slab.
- .5 Prime walls of joint as recommended by filler manufacturer. Mix filler as directed by manufacturer. Coat surfaces of metal in contact with filler primer as recommended by filler manufacturer.
- .6 Comply with sealant manufacturer's primer, application and temperature requirements. Mask floor to edge of joints and fill joint with joint filler. After initial set prime sealant surface and refill joints with sealant as required to produce slightly convex joint surface.
- .7 Remove 6 mm scored strip from top of premoulded joint filler. Caulk over premoulded joint filler with standard joint sealant.
- .8 Fill exterior sawn construction and control joints and over premoulded isolation joint filler with specified standard joint sealant (hydrocarbon resistant joint sealant).

End of Section

1 General

1.1 Section Includes

- .1 Sectional overhead doors.

1.2 Definitions

- .1 Operation cycle: One complete cycle of a door begins with the door in the closed position. The door is then moved to the open position and back to the closed position.
- .2 NEMA ICS: National Electrical Manufacturers Association Industrial Control and Systems standard.

1.3 Design Criteria

- .1 Design exterior doors to withstand the following specified (unfactored) wind loads in the closed position, with a maximum deflection under full design load of $L/240$ of the span:
 - .1 1.54 kN/m^2 positive (inward, toward the interior of the building)
 - .2 1.68 kN/m^2 negative (outward, toward the exterior)
- .2 Design operators to function against loading consequential to the foregoing.
- .3 Use the same design criteria where interior doors can be subjected to wind forces due to building arrangement.

1.4 Codes and Regulations

- .1 For electrical equipment and installation thereof, comply with all local and provincial laws, and with all other mandatory requirements. Be responsible to ensure an installation which is in compliance with all such laws and regulations, and all changes or alterations required by the authorized inspector of the authority having jurisdiction made without charge to the Owner.
- .2 It is the door manufacturer's responsibility to ensure that specified colour coding is acceptable to local jurisdiction.

1.5 Quality Assurance

- .1 Installer: Retain door manufacturer or an installation specialist company licensed or franchised by door manufacturer.

1.6 Submittals

- .1 Shop Drawings
 - .1 Submit in accordance with Section 01 33 00.
 - .2 Show and describe in detail:
 - .1 Detailed door assemblies
 - .2 Door elevations, sections and details, tracks, hardware and operating components, dimensions, gauges, finishes
 - .3 Door operators, make, and horsepower rating
 - .4 The relationship of the foregoing components to adjacent construction.
 - .5 Complete electrical schematics and wiring diagrams and sequence of door operation.
 - .3 Prepare Shop Drawings on one standard size drawing sheet. Standard cuts or stock drawings will not be acceptable.
 - .4 Confirm with a note that exterior doors meet the design requirements specified.
- .2 Operation and Maintenance Data
 - .1 Submit printed operation instructions and maintenance data in accordance with Section 01 33 00.
 - .2 Indicate the following:
 - .1 "As built" straight line wiring diagrams showing electrical connections and control circuitry.
 - .2 Instructions explaining operation.
 - .3 Lubrication chart indicating lubrication points and type of lubricant recommended for equipment.

1.7 Handling, Storage and Protection

- .1 Handle components with care. Protect against damage, dirt, disfigurement and weather.

- .2 Store on site off the ground, and in a covered location.

1.8 Warranty

- .1 Refer to Section 01 78 37 Extended Warranties.
- .2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective Work satisfactory to the Consultant and at no expense to the Owner.

2 Products

2.1 Door Systems

- .1 Provide a door system that is complete in all respects and smoothly operating. Provide all components and accessories as specified or as required to meet this requirement.

2.2 Overhead Doors

- .1 Sectional, steel faced, foam-in-place insulated, having a thermal value of minimum RSI 2.818 (R16), torsion spring counterbalanced, electrically operated and as follows:
- .2 Acceptable Products
 - .1 Upwardor "Thermalex 2000" Series (44 mm thick)
 - .2 Richards-Wilcox "Thermatite 175/20" (44 mm thick)
 - .3 Steelcraft "Therm-O-Dor TD 134-20" (44 mm thick)
 - .4 Garaga Inc. "G-3000" (44 mm thick)
 - .5 Overhead Door Corporation "Thermacore 595" (41 mm thick)
 - .6 Wayne Dalton "Thermospan 200" (41 mm thick)
- .3 Component Minimum Requirements
 - .1 Facing panels: Embossed prepainted galvanized sheet steel complying with ASTM A653/A653M, core insulated with polyurethane foam, non-corrosive end caps and thermal break. Exterior: 20 gauge. Interior: 24 gauge.
 - .2 Vision lites: Full vision window sections with white aluminum extrusions (service station type).

.4 Hardware

- .1 Track: 84 mm overall outside dimension, 3 mm thick steel with track hangers and brackets to suit, all in Z275 zinc coating.
 - .2 Track angle: Continuous 3 mm thick steel with Z275 zinc coating.
 - .3 Rollers: 75 mm diameter, ball bearing, with 11 mm diameter case hardened axles.
 - .4 Roller bracket hinges and intermediate hinges: Heavy duty 3 mm thick steel with Z275 zinc coating.
 - .5 Counterbalance: Job rated torsion springs helically wound from oil tempered steel wire for a minimum 50,000 cycle quality.
 - .6 Jack shaft: 25 mm diameter solid steel with die cast aluminum cable drums.
 - .7 Cables: Galvanized aircraft type with minimum 4 mm diameter and safety factor of 8:1.
 - .8 Locking device: Self-locking through electric brake.
 - .9 Hand chain: "Endless", stainless steel.
 - .10 Safety bottom bar: "Featheredge" by the Cookson Company or or approved equivalent reversing safety bottom bar, electric type complete with neoprene weatherstripping combination able to withstand severe weather conditions. Use a heavy duty coil cord power cable.
 - .11 Weatherstripping to head, jambs and meeting rails: Factory applied, of type to ensure a weathertight seal. Design weatherstripping assembly for easy replacement when weatherstrip is worn.
 - .12 Track guards: 1500 mm high formed from Z275 zinc coated steel.
 - .13 Hoisting mechanism: Power operator and controls as specified and emergency hand chain hoist with clutch release cable of design to operate doors to meet speed and cycle frequency specified herein.
- .5 Supplementary steel supports: New material conforming to CAN/CSA-G40.20/G40.21-M, hot dipped galvanized.
- .6 Paint finish: Two-component polyurethane paint system or two-coat baked-on system (primer and acrylic or polyester finish) in colour as selected by the Consultant (in custom colour as selected by the Consultant).

2.3 Door Fabrication

- .1 Provide framing required to support doors, tracks and operators from structure.
- .2 Fabricate section panels as follows, with:
 - .1 Exterior and interior ribbed steel facing or plain exterior and ribbed interior steel facing as dictated by specified panel thicknesses.
 - .2 Space between facings solidly filled with foamed-in-place insulation, fully face bonded to steel.
 - .3 All ends closed and sealed.
 - .4 Top and bottom edges rebated to fit tightly together, and to provide weathering.
 - .5 Top panel sufficiently stiffened to carry load of panels below.
- .3 There shall be no visible welds, bolts, screws.
- .4 Fabricate the work true to dimensions and square. Accurately fit joints and intersecting members with adequate fastenings.

2.4 Electric Operators and Controls

- .1 Operators: For high lift and vertical lift doors, provide side mounted operators, Manaras MGH Jackshaft, Kinnear Modified Link GJ, Doorlec GH or approved equivalent. For standard lift doors, provide industrial grade trolley operators, Product of the same manufacturers specified above. Provide complete with emergency hand chain hoist with cleat and keeper, of type to operate doors at specified speed.
 - .1 Include motors, speed reducers with all gears running in oil, sheaves, adjustable gear ratio, racks, levers, cables and brakes, disconnect switches, reversing starters, controls, conduit and wiring to make all required connections.
 - .2 Assume all responsibility for the operators, size of motors, and all other mechanical devices.
 - .3 Make provision for emergency manual operation including reduction unit, sheaves, etc., operable from side of doors to suit conditions. Device to be such that when set for manual operation, the brake is automatically released and control circuit is broken,

- making doors electrically inoperable until device is set for motor operation.
 - .4 Chain gear operators to be easily removable, with chain installed within easy reach of floor.
 - .5 Operators to be of design which allows removal of electric motor without affecting manual operation of the door through chain operator.
 - .6 Provide a wall mounted disconnect lever with rubber handle; install such that pinch points are eliminated.
- .2 Motor: 208 volt, 3 phase, 60 hertz, totally enclosed, ball bearing, continuous duty, of design and horsepower matched to the work load requirements, and of capacity sufficient to operate the door at a speed of 0.30 m/s.
- .3 Control boxes: NEMA 12 in dry areas, by Allen Bradley, Ralston, Hammond or approved equivalent, of size that provides easy access for removal of all components, with a separate wall mounted fused disconnect switch.
- .1 Interior pushbuttons: "Open-Close-Stop", momentary contact, mounted on control cabinet cover.
 - .2 Photoelectric sensor: Unit consisting of a one-piece photoelectric sensor with long-range optical performance. The receiver shall feed modulated signal back to amplifier mounted in door control box. Provide two sets at each door, crossing beams to form an "X" through the door opening. Mount 1 set at each side of door opening. Acceptable manufacturer: Banner Engineering Corp. "QS303E".
 - .3 Timer: Adjustable unit with range of 0.5-90 seconds. Reset each time an opening control is activated during timer cycle.
 - .4 Starter: Size 1 reversing starter with electro mechanical interlocks.
 - .5 Transformer: Step down type for 24V control voltage. Provide additional transformers if required for door operator and 120 V equipment.

- .6 Door heater limit switch: To enable door heater to operate as soon as exterior door rises, provide 120V limit switch which will provide a dry contact closure when door is not in the fully closed position.
- .4 Wire: Type RW90, 600 V, not less than #12 AWG for power wiring, and #14 AWG for control.
- .5 Conduit: Rigid galvanized steel with compression fittings.
- .6 Control voltage: 24 V.

2.5 Fabrication

- .1 Fabricate Work with materials and with component dimensions and gauges, reinforcing, attached anchors and fastenings of adequate strength to prevent warping, buckling, opening of joints and seams, loosening of hardware, distortion and displacement within limits of intended and specified use.
- .2 Conceal and weld connections wherever possible.
- .3 Fit joints and junctions between components tightly and in true planes.
- .4 Isolate from each other dissimilar metals, and metal from concrete or masonry to prevent electrolysis.

2.6 Shop Finishing of Door System

- .1 Phosphatize all galvanized metal surfaces to provide for adhesion of finish paint. Clean ferrous metal surfaces except working parts of machinery and faying surfaces and prime with a rust inhibitive primer. Clean supplementary steel supports and likewise, prime with a rust inhibitive primer.
- .2 Apply in the shop, specified paint system to a minimum dry film thickness of 100 microns in accordance with paint finisher's standards. For baked system, bake components prior to foam insulation application.

3 Execution

3.1 Installation

- .1 Supply information and templates required for installation work. Assist and/or supervise setting of anchorage built into work of other sections.

- .2 Drill, tap and cut frames and other work as required to install doors, tracks, operators, hardware, fittings, etc., and provide necessary bolts, anchors, inserts, and supplementary framing and supports required to complete the work.
- .3 Bolt door tracks to supports. Welding is not permitted.
- .4 Supply and install material required to suspend tracks from walls or roof steel including members between joists.
- .5 Do not use fasteners which penetrate through walls.
- .6 Furnish inserts and anchoring devices which must be set in concrete or built in masonry for the installation of doors. Provide setting drawings, templates and printed instructions for the installation of the anchorage devices.
- .7 Install units to fit tight at edges of jambs and heads of frames and ensure smooth and free operation under all conditions of operation. Leave in proper condition in all respects.

3.2 Electrical Work

- .1 Provide wiring, conduit and fittings, and interconnect all electrical components of door system back to control box. Terminate wiring in control box.
- .2 Where conduit is installed in slab, coordinate with Section 03 35 00.
- .3 Identify control and indicating devices on front panel of door control box with lamacoid nameplates.
- .4 Nameplates shall be laminated phenolic plastic, white front with black core, with lettering etched through the outer covering. Letters to be black.
- .5 Tag motors, limit switches, etc, with brass tags indicating component number or function.
- .6 Identify conductors at all points of connection with Wieland Type Z wire markers. The identification shall correspond to the shop drawings.
- .7 Identify components, including inside of control box.

.8 Colour Coding: Utilize the following throughout:

- | | | | |
|----|--------|---|-----------|
| .1 | Red | - | Phase A |
| .2 | Black | - | Phase B |
| .3 | Blue | - | Phase C |
| .4 | Green | - | Ground |
| .5 | White | - | Neutral |
| .6 | Orange | - | Control |
| .7 | Yellow | - | Interlock |

3.3 Field Touch-up

- .1 Touch up pre-painted finishes disturbed during transport and installation using a spray formulation of the baked enamel paint.

3.4 Lubrication

- .1 Upon completion of erection of units and operating equipment, lubricate moving parts before operation.
- .2 Grease all sprockets, bearings, cables, link chains and guides. Lubricant shall be as recommended by the manufacturer.

3.5 Adjustment and Demonstration

- .1 Test-operate doors and demonstrate the operation of same at the time of acceptance of the completed Work.
- .2 Adjust Work to provide free-running, tightly closing and properly counterbalanced operation. Ensure that installation is free from warp, twist, or other distortion.
- .3 Clean Work on completion of installation.

End of Section

1 General

1.1 Section Includes

- .1 This section specifies testing of concrete floor slabs to guarantee a suitable substrate to receive the floor finishes specified in Division 09. Perform and pay for the following:
 - .1 Moisture tests using calcium chloride quantitative test method
 - .2 Humidity tests
 - .3 Dew point tests
 - .4 pH tests
 - .5 Verify 28-day curing of concrete
 - .6 Coordinate HVAC requirements for testing purposes
 - .7 Notify all parties of test results

1.2 Reference Standards

- .1 Perform tests in accordance with the latest edition of the following standards:
 - .1 ACI 302.2R-06, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials
 - .2 ASTM D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete
 - .3 ASTM D4263, Standard Test Method for Indicating Moisture in Concrete by Plastic Sheet Method
 - .4 ASTM F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
 - .5 ASTM F1869, Standard Test Method for Measuring Moisture Vapour Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 - .6 ASTM F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes
 - .7 ASTM F2420, Standard Test Method for Determining Relative Humidity on the Surface of Concrete Floor Slabs Using Relative Humidity Probe Measurements and Insulated Hood

- .8 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete
- .9 ICRI Guideline No. 03732, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays

1.3 Submittals

- .1 Technicians' qualifications: Submit the following in accordance with Section 01 33 00:
 - .1 Confirmation of technicians' qualifications as specified.
 - .2 Confirmation of test method to be used.
- .2 Test Reports
 - .1 Submit to the Consultant, summary of tests leading to satisfactory results, prior to floor finish installation. Report to follow specified contents and format. No floor finish installation shall proceed without satisfactory test results reported to, and acknowledged by, the Consultant.

1.4 Quality Assurance

- .1 Technicians: Individuals from a company engaged in the business of performing construction testing and inspection services of the type required by this section, for a minimum of two years within the past five years. Tasks involved include the following:
 - .1 Testing in accordance with specified ASTM testing standards.
 - .2 Keeping a record of testing inspection details.
 - .3 Coordination with floor finishes trades.
 - .4 Electronic reporting of test results to Consultant.

2 Products – Not Used

3 Execution

3.1 Floor Finishes Schedule Coordination

- .1 Coordinate testing with the schedule of floor finishes operations. Installation of finishes is predicated upon a concrete substrate that is suitable for installation of finishes as proven by satisfactory test results.

3.2 Site Meeting

- .1 Prior to start of Work, attend a site meeting with the Construction Manager and Consultant, Contractor and Floor Finishes Subcontractors. Purpose of the meeting is to ensure familiarity with the requirements of the Work, common understandings reached, methodologies, relationships and protection of work criteria are understood.

3.3 Testing

- .1 An appropriate environment is required during testing. Coordinate provision of HVAC during test periods.
- .2 Remove curing compound and/or sealer at test locations using hand-held grinders.
- .3 Perform moisture testing in accordance with ASTM F1869 methods. No alternative test methods accepted.
- .4 Follow ASTM standards for number and frequency of tests. At any rate, satisfactory test results must be representative of the total floor.
- .5 Perform relative humidity tests in accordance with ASTM F2170.
- .6 Perform pH testing in accordance with ASTM D4262 and ASTM F710.

3.4 Reporting

- .1 All reports shall be prepared by the technician conducting the test, who shall affix his/her signature to the reports. The reports shall confirm compliance of the Work with the Contract Documents and be signed by the technician.

- .2 Report format shall be columnar, containing the information listed below, and, where applicable, contain notations of the specified standard or other reference covering the items to be tested.
- .3 Information required in the reports:
 - .1 Test location.
 - .2 Test method used (indicate passing result).
 - .3 Confirm surface for testing has been prepared.
 - .4 Start time and date of placing calcium chloride test.
 - .5 Relative humidity (RH) at start time.
 - .6 Ambient temperature (AT) at start time.
 - .7 Results after test period.
 - .8 Relative humidity (RH) at end of test.
 - .9 Ambient temperature (AT) at end of test.
 - .10 Satisfactory or unsatisfactory results. Repeat tests if results not satisfactory. Coordinate results with floor finishes trades.
 - .11 Observations or comments.
 - .12 Name and signature of technician; date report sent to Consultant.

End of Section

1 General

1.1 Section Includes

- .1 Section includes design and provision of a pre-engineered building including but not limited to, the following:
 - .1 Rigid frame and miscellaneous framing for openings and penetrations
 - .2 Secondary steel framing such as purlins, columns and girts with sag rods
 - .3 Supply of column anchor bolts
 - .4 Grouting of column base plates
 - .5 Metal insulated roof assembly with rolled-on-site standing seams and self centering sliding roof support clips and insulation with reinforced white vinyl backing.
 - .6 Metal insulated siding assembly with reinforced white vinyl backing
 - .7 Eave and gable trim, gutter and downspout assemblies
 - .8 Pre-painted metal snow guards
 - .9 Metal flashings
 - .10 Cutting of, and reinforcing of openings for doors, louvres, mechanical air intake and exhaust fans and other wall and roof openings
 - .11 Hollow metal doors, door frames and finish hardware for same
 - .12 Louvres
 - .13 Sealant
 - .14 Mechanical and electrical services
 - .15 Cleaning and prime painting of all steel framework
 - .16 Final inspection and cleaning

1.2 Reference Standards

- .1 Conform to the standards referenced by the manufacturers used for the Work of this Section.

1.3 Building Parameters/Design Criteria

- .1 General Design of Building
 - .1 To dimensions indicated, incorporating manufacturer's standard components and construction systems except where specified otherwise.
 - .2 Rigid frame structure design for strength and serviceability in accordance with CAN/CSA S16.1-M and CAN/CSA S136-M, and accommodating additional loads on roof and wall systems for ceilings, fans and light fixtures, etc.
 - .1 All tension members to have $KL/r < 300$.
 - .2 All compression members to have $KL/r < 200$.
 - .3 Design rigid frame pinned at bottom.
- .2 Design Loads
 - .1 Design building frame, including purlins and cladding to safely support snow, rain and wind loads as required by the latest edition of the Ontario Building Code for the area of the Project.
 - .2 Design shall reflect snow build-up as required by the latest edition of the Ontario Building Code.
 - .3 Design building frames and purlins to include a dead load allowance of 10 psf on the structure for the support of mechanical and electrical services. Use steel frames and purlins to support services suspended from roof purlins and rigid frame.
 - .4 Design roof purlins to take the weight of sectional doors.

1.4 Submittals

- .1 Submit Shop Drawings in accordance with Section 01 33 00.
- .2 Show construction, framing, gauge thickness of components, accessories, fittings, method of installation, and other items as required, including but not limited to the following:
 - .1 All necessary Drawings and calculations required to obtain building permits for this building.
 - .2 Elevations and details.
 - .3 Framing for roof and wall air intake/exhaust openings.

- .4 Manufacturer's product data on roof insulation, wire and polyester mesh, siding and metal roofing profiles, gauges and section properties. If manufacturer's catalog is submitted, clearly identify the particular system and materials proposed.
- .5 Shop Drawings and/or manufacturers product data on doors, frames, and finish hardware.
- .6 Written verification that level of structural steel surface preparation has been provided.
- .3 Design Calculations and Certification
 - .1 As part of Contractor Drawing and product data submittal, submit design calculations bearing the seal and signature of a Registered Professional Engineer in Ontario, for the structural framing and roof and siding panels. Such design calculations shall be either manual or electronic at the discretion of the manufacturer.
 - .2 Certify that materials used in the Work meet specified or required loading requirements and codes. Certification must reference specific dead loads, live loads, snow loads, wind loads/speeds, concentrated loads, collateral loads, seismic loads and fire loads. Countersign the letter of certification and submit duplicate copies with shop drawing submittal. Do not proceed with fabrication until submittal and certifications have been reviewed by Consultant.
- .4 Layout Drawings: Supply necessary anchor bolt layout drawings and templates to the anchor bolt installer.

1.5 Samples

- .1 Submit the following in accordance with Section 01 33 00:
 - .1 600 x 600 mm assembled samples of roofing and siding for review.
 - .2 Structural steel primer applied on 150 x 150 mm steel plate.
 - .3 600 x 600 mm insulation, vapour retarder and continuous tab connection.

1.6 Qualifications

- .1 Retain an authorized agent of the pre-engineered building manufacturer to perform Work of this section.

1.7 Full-Time Field Supervision

- .1 Retain and pay for a fully qualified representative of the pre-engineered building manufacturer to provide full time field supervision.

1.8 Pre-erection Meeting

- .1 Prior to start of erection, Consultant will arrange for a project site meeting of all parties associated with Work of this section. Presided by Consultant, meeting must be attended by Pre-Engineered Building Subcontractor, Supplier and major Subcontractors.
- .2 In the meeting, review Specifications for Work included under this section and determine a complete understanding of requirements and responsibilities relative to Work included, storage and handling of materials, installation of materials, latest installation techniques, sequence and quality control, interfacing with Work of other contracts, and other matters affecting the installation, so as to permit compliance with the intent of this section.

1.9 Warranty

- .1 Refer to Section 01 78 37 Extended Warranties.
- .2 Promptly make good defects and deficiencies which become apparent within the Warranty Period by replacing defective Work satisfactory to the Consultant and at no expense to the Owner.

2 Products

2.1 Acceptable Manufacturers

- .1 Butler Manufacturing Company
- .2 Robertson Building Systems
- .3 Varco-Pruden Buildings
- .4 Steelway Building Systems
- .5 American Buildings Company
- .6 Behlen Industries
- .7 Or approved equal.

2.2 Cladding Materials

- .1 Exterior sheets: Siding profile to be "Dura Rib" and roof "Star Shield Standing Seam" conforming to ASTM A653M, Grade B, with a minimum base steel thickness of 0.559 mm (24 gauge) with Z275 zinc coating; roof galvanized to Z275 sheets in 0.60 mm (24 gauge) minimum base steel thickness; both siding and roof finished with Ultra Premium 20 Kynar 500 polyvinylidene fluoride resin finish in colour selected by Consultant from manufacturer's standard colours.

2.3 Framing

- .1 Structural shapes, plates, etc.: New material conforming to CAN/CSA-G40.20M/G40.21-M, Grade 300W.
- .2 High strength bolts with nuts and washers: Conforming to ASTM A325, hot dip galvanized. Furnish each type and size of bolt and nut of same manufacture and of same lot.
 - .1 Bolts: heavy, hexagon head, high strength structural bolts, of standard size, of lengths required for thickness of members joined and for type of connection.
 - .2 Nuts: heavy, hexagon semi-finished nuts.
 - .3 Washers: flat and smooth, hardened washers, quenched and tempered.
- .3 Machine bolts and anchor rods: As specified below, complete with hexagon heads and nuts, hot dip galvanized:
 - .1 Common bolts: conforming to ASTM A307, Grade A, of lengths required to suit thickness of material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.
 - .2 Anchor rods: conforming to ASTM F1554, grade 36, of lengths noted, but projecting not less than 13 mm beyond nut unless otherwise noted.
 - .3 Nuts: per ASTM A563M.
- .4 Welding electrodes: To meet CSA W48 Series on welding electrodes. Any process which produces deposited weld metal meeting requirements of applicable CSA W48 series standard for any grade of arc welding electrodes shall be accepted as equivalent to use of such electrodes.

- .5 Cladding fasteners: Stainless steel, self-tapping sheet metal screws with colour matched nylon heads.
- .6 Primer paint: Light grey, in fast drying, lead and zinc-chromate free formulation conforming to CISC/CPMA 2.75. Use one brand of primer paint throughout the work, in any of the following, tinted to the specified colour:
 - .1 "97-680" by PPG Canada Inc.
 - .2 Selectone "MR-05-3" by Selectone Paints Ltd.
 - .3 "B50 AV 8431" by Sherwin-Williams
 - .4 "Rustguard 4140-6120 by ICI Paints

2.4 Miscellaneous

- .1 Anchor bolts: To meet specified requirements of ASTM A307, Section 1.3. Provide suitable nuts and washers to meet specified requirements of ASTM A563M, Table 11 hot dip galvanized to CSA G164-M.
- .2 Flowable construction grade grout: Pre-mixed, non-shrink, flowable type without aggregate fillers. Furnish forms for flowing in place. Use one of the following:
 - .1 Euclid "Euco NS Grout"
 - .2 W.R. Meadows "CG-86"
 - .3 Sika "Grout 212"
 - .4 Sternson "M-Bed Standard"
 - .5 Master Builders "Construction Grout"
 - .6 CPD "Non-Shrink Construction Grout"
- .3 Sealant: Silicone type. Use one of the following:
 - .1 Dow Corning "790"
 - .2 General Electric "1200 Series"
 - .3 Tremco "Proglaze"
 - .4 Or approved equivalent
- .4 Exposed sealant: Urethane type. Use one of the following:
 - .1 Sika "RC-1"
 - .2 Sonneborn "NP-1"

- .3 Tremco "Dymonic"
- .4 or approved equivalent
- .5 Bollards: Concrete fill full length of galvanized pipe bollard, painted safety yellow.
- .6 Sectional Doors
 - .1 As specified in Section 08 36 13.
- .7 Personnel access doors and frames: 45 mm thick, flush type, face sheets of 0.91 mm thick (18 gauge) "wiped coat" galvanized sheet steel, rib reinforced and foam or fibreglass insulated; frames of 1.6 mm thickness (16 gauge) hollow metal construction, "wiped coat" galvanized. Incorporate galvanized jamb anchors and drip caps at head of frames. Double glazed windows. Reinforce and prepare doors and frames for finish hardware. Provide each door with the following finish hardware:
 - .8 Single Door 914 mm x 2135 mm x 95 mm
 - .1 3 heavy weight hinge Hager BB1168 – 114x101-NRP-630
 - .2 1 storeroom lock L9080Px038x630
 - .3 1 temporary construction cylinder
Schlage 20-021 Permanent cylinder
 - .4 1 closer LCN 4040XP – scush, O/H stop
 - .5 1 kickplate K.N. Crowder 1905 x 203 x 863 x 630
 - .6 1 head seal K.N. Crowder W13 x door width x 628
(install before closer)
 - .7 2 jamb seal K.N. Crowder W13 x door height x 628
 - .8 1 door sweep K.N. Crowder W13S x door width x 628
 - .9 1 threshold K.N. Crowder CT-10 x door width x 630
 - .10 1 electric strike T.C. Securities 9600 x 630 on one door
only
 - .11 Or approved alternative manufacturers
- .9 Ridge ventilator: 300 mm throat opening, complete with birdscreen and manual damper. Finish to match roof.

- .10 Louvres: Sheet steel components in stormproof profile finished in the same paint system as siding. Provide galvanized bird screen in removable steel framing. Louvre free area: 50%. Sheet steel thickness: 16 gauge (.060").

2.5 Surface Preparation and Prime Painting of Ferrous Steel

- .1 Clean structural steel to SSPC SP3-Power Tool Cleaning.
- .2 Prime Painting
 - .1 Shop prime steel with 1 coat of primer paint to a dry film thickness of 0.051 to 0.064 mm (0.064 to 0.076 mm). Clean but do not paint surfaces to be field welded or buried in concrete.
 - .2 Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 °C.
 - .3 Paint surfaces which will be inaccessible after assembly with 2 coats of primer paint before assembly. Paint surfaces inaccessible during general painting of the building with 2 shop coats before erection.
 - .4 Paint materials under cover and leave under cover until paint is thoroughly dry. Thoroughly work paint into joints and open surfaces. Follow paint manufacturer's recommendations regarding application methods, equipment, and temperature and humidity conditions.
 - .5 Use one brand of paint throughout the Work.

3 Execution

3.1 Erection

- .1 General
 - .1 Erect components, and install products and systems in accordance with reviewed Shop Drawings, manufacturers' product data and published erection manual procedures and to requirements of the Specifications.
 - .2 As steel is erected, clean bolt heads, washers and nuts, previously unprimed connections, surfaces damaged during erection, welds

and burned or scratched surfaces, with power wire brush to SSPC SP3, then touch-up with same primer used in the shop, and to shop paint dry film thickness. Coverage of touch-up paint to a given area shall be concentrated to disturbed, damaged or unpainted portion, and extend to limits as required to maintain continuity and integrity of paint film and appearance. Likewise, touch up marred or scratched surfaces of galvanized steel with zinc-rich primer.

- .3 As steel is erected, thoroughly wash down with clean water, or other means as approved by paint manufacturer, to remove mud, erection marks and other foreign matter from steel.
- .4 Provide steel shims under column base plates to carry the dead load of the steel frame plus the weight of the roofing and siding until grouting is completed.
- .5 Do not use siding to support girts. Install permanent sag rods suspended from main structure frame above to support wall girts before installing siding.
- .6 Cut openings through siding and roofing to accommodate doors and service penetrations.
- .7 Apply a continuous bead of sealant between the base angle and the concrete foundation wall to prevent air and water penetration at these locations. Remove excess sealant with solvent, resulting in a tidy finished appearance.
- .8 Affix roof sheeting to the building frame utilizing a clipped system which allows all thermal expansion and contraction to occur. Design clip system to afford resistance to wind uplift pressures to satisfy the latest edition of the Ontario Building Code.
- .9 Roof sheeting lengths to be such that there is a maximum of two end lap joints per slope. Consider fixing the sheets at mid slope and allowing expansion and contraction to occur at eave and ridge in order to minimize movement.
- .10 Thermally isolate the roof sheeting and clips from the building frame with thermal blocks in such a fashion that the overall thermal resistance of the roof is uniform throughout.

- .11 Use cell closures which accurately match metal roofing and siding profiles. Place cell closures at the top of wall cladding and at eave and ridge of roof.
- .12 Flash bottom of siding, around windows, doors, louvres, all mechanical and electrical items protruding through roof and wall areas and other necessary components of building to provide a complete weathertight installation with a continuous 0.60 mm thick (24 gauge) pre-painted sheet metal drip flashing. Slope flashing from the wall. "J" closure flashings are not permitted.
- .2 Insulation: Connect all joints of vinyl faced roof insulation blankets by adhering self-adhesive side tabs from the preceding insulation to the next to achieve a continuous air/vapour retarder. Do not remove wax paper release off self-adhesive side tabs until insulation sheets have been properly aligned and butted.
- .3 Louvres
 - .1 Secure support frames to openings: Install louvres plumb or true to slope, and at correct location in openings, with birdscreens on inside. Method of attachment shall be concealed.
 - .2 Apply sealant around perimeter of frames to wall construction using joint backing and sealant. Neatly tool and finish joints.

3.2 Hollow Metal Doors, Frames and Hardware

- .1 Install hollow metal frames with rigid anchors to wall construction. Install hollow metal doors to swing shut with 1.6 mm clearance at heads, 2.4 mm at jambs and 6 mm finished floor. Installed doors shall swing freely on their hinges, to close tightly and evenly on their frames without binding.
- .2 Install finish hardware and adjust for ease of operation.
- .3 Retain finish hardware supplier to provide on-site inspection service during hardware installation and upon completion.
- .4 Adjust or rectify finish hardware items found to be improperly installed. Remove defective materials and replace with new materials supplied by finish hardware supplier at no cost to the Owner.

3.3 Electrical Work

- .1 Provide wiring, conduit and fittings and interconnect all electrical devices of the system back to door control box. Wire all controls to a terminal strip and clearly mark to correspond with terminals in electric operator.
- .2 Identify control and indicating devices on front panel of door control panels with lamacoid nameplates.
- .3 Nameplates to be of laminated phenolic plastic, white front with black core, with lettering etched through the outer covering. Letters to be black.
- .4 Tag motors, limit switches, etc. with brass tags indicating component number of function.
- .5 Identify conductors at all points of connection with Wieland Type Z wire markers. The identification shall correspond to the shop drawings.
- .6 Identify components, including inside control panels.
- .7 Colour coding: Utilize the following colour coding throughout:
 - .1 Red - Phase A
 - .2 Black - Phase B
 - .3 Blue - Phase C
 - .4 Green - Ground
 - .5 White - Neutral
 - .6 Orange - Control
 - .7 Yellow - Interlock

3.4 Grouting

- .1 Grout column base plates in accordance with grout manufacturer's printed directions. Form around bases and place grout in a manner which will ensure positive bearing of the full area of the steel plate on top of the supporting surface. Thoroughly compact, leaving no voids.

3.5 Touch-up

- .1 Touch up all primed and pre-painted finishes which may be damaged during the erection and installation process to the satisfaction of the Owner.

3.6 Sealant

- .1 In addition to sealant work specified above, apply sealant around door frames and other penetrations through siding. Apply to both interior and exterior side of building.
- .2 Clean recesses to receive compound, to be free of dirt, dust, loose material, oil, grease, form release agents and other substances detrimental to compound's performance. Remove lacquer or other protective coatings from metal surfaces, without damaging metal finish, using oil-free solvents.
- .3 Apply masking tape to metal surfaces adjacent to recesses to prevent smearing or staining of such metal surfaces.
- .4 Depth of recess to receive compounds are not to exceed $\frac{1}{2}$ the joint width up to a maximum of 12 mm and not less than 6 mm at centre of joint.
 - .1 Where depth of recess is in excess of specified depth, place back-up material in recess, forced into place under compression, to provide specified recess depth.
 - .2 Where recess is less than specified depth, cut the back surface of recess to specified recess depth.
- .5 Install compound immediately after adjoining work is in condition to receive such Work. Fill joints completely, regardless of variation of joint widths, and to proper depth as specified. Install compounds under pressure, without smearing adjacent surfaces. Sealant compounds must have full and uniform contact with, and adhesion to, side surfaces of recess.
- .6 Finish face of compound in recesses smooth and even. At recesses in angular surfaces, finish compound with a flat face, flush with face of material at each side. At recesses in flush surfaces, finish compound with a concave face, flush with face of material at each side.
- .7 Compound may be tooled, provided that such tooling does not damage seal nor tear compound. Surface of compounds to be free from dirt, stain or other defacements and be uniform in colour.

3.7 Certification

- .1 Submit certification, signed, dated and sealed by a Professional Engineer registered in the province of Ontario, that all structural bolts and fasteners related to the pre-engineered building have been checked since erection and torqued to Ontario Building Code and CISC requirements, and manufacturer's standards.
- .2 The Owner may hire an independent inspection and testing firm to verify compliance with the foregoing and will pay costs in connection thereto. Pay the costs for correcting defects such as connections with threads exposed between joints, connections with less than 25 mm bearing, bolts not snugged, including related extra inspection and Consultant costs.

3.8 Final Cleaning

- .1 In preparation for Substantial Performance or occupancy, conduct final inspection of interior and exterior surfaces exposed to view, and of concealed spaces.
- .2 Remove waste materials, rubbish, tools, equipment, machinery, and surplus materials.
- .3 Clean all surfaces; leave project clean and ready for handing over to Owner. Cleaning to include but not limited to the following:
 - .1 Firstly, mop wash top of metal roofing with mild detergent and water. After mopping, rinse spray with clean water. Use non-metallic mop holders to avoid damage to paint finish. Pressure washing is not permitted.
 - .2 Secondly, wash and rinse exterior siding face sheets same as roof.
 - .3 Wipe clean siding interior face sheets and all structural members with a moist cloth. Occasionally wash cloth in clean water and wring, to remove dirt accumulation.
 - .4 Vacuum clean or otherwise remove mud or dirt which may have been deposited in structural members during handling such as within box type bottom chords of truss purlins, tops of girts, bottom flanges of primary structural beams, etc.

- .5 Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from all sight-exposed interior and exterior finished surfaces.
- .6 Vacuum clean building floors.
- .7 Broom-clean paved surfaces; rake clean other surfaces of grounds.
- .4 Repair, patch and touch up marred surfaces to specified finish, to match adjacent surfaces.
- .5 Employ experienced workmen, or professional cleaners, for final cleaning.

End of Section

1 General

1.1 Section Includes

- .1 HVAC fans.

1.2 Reference Standards

- .1 Comply with the latest edition of the standards referenced herein:
 - .1 Fans: designed and constructed in strict conformity with the AMCA Standards and bearing the "Certified Rating Seal".
 - .2 Applicable sections of CSA C22.2 No. 113 for fan construction and installation.
 - .3 Occupational Health and Safety Act, O.Reg 851.

1.3 Submittals

- .1 Shop Drawings
 - .1 Submit Shop Drawings in accordance with Section 01 33 00.
 - .2 Submit manufacturer's certified Shop Drawings to the Consultant and include:
 - .1 Complete information on fan construction and performance.
 - .2 Performance curves over full range from shut-off to free delivery.
 - .3 Drive details.
 - .4 Make, type and catalogue number of bearings.
 - .5 State hour rating of bearings when specified.
- .2 Operation and Maintenance Data
 - .1 Submit printed operating instructions and maintenance data in accordance with Section 01 33 00.

2 Products

2.1 General Requirements

.1 Performance Ratings

- .1 Type, size and capacity shown on Drawings for each specific application and conforming to requirements of manufacture, operation and performance as specified.
- .2 Select fan size, operating rpm and rating point on stable head flow curve with smooth characteristics.
- .3 Operating at least 20% below first critical speed when operating at maximum speed for class of construction.
- .4 Dynamically and statically balance wheels of free standing or unitary fans to acceptable tolerances relative to size and speed.

.2 Cleaning and Metal Protection

- .1 Blades of fans

.3 Bearings

.1 Service life

- .1 To L10 Life standard in accordance with latest AFBMA Code.
- .2 Unitary, axial and free standing fans: 100,000 hour service
- .3 Other fan bearings: 40,000 hour service

.2 Type

- .1 Grease lubricated ball or roller type fan bearings with ample thrust provision to prevent end play during normal life of bearings.
- .2 Shaft adapter sleeve type bearings utilizing horizontally split pillow blocks and mechanical flinger type grease valves.
- .3 Interference fit bearings may be used in lieu of adapter sleeve type.

.3 Bearings in air stream

- .1 Well secured extended grease lubricating lines unless bearing is easily accessible through man-size access door.

- .2 Pack bearings with low temperature grease in factory.
- .4 Axial flow fans
 - .1 Conform to these specifications except where inner cylinder mounting methods are used or dimensions do not permit it and special or flange mounted type bearings are required.
- .4 Motors and Drives
 - .1 Motor ratings
 - .1 Type, kW (HP) rating, motor speed and electrical characteristics shown on Drawings.
 - .2 Capable of satisfactory operation over range of performance from shut-off to run-out at 110% of rated rpm at point of selection.

2.2 Fan Types

.1 Arrangements

Fan Type	Arrangement
Belt driven single inlet single width (SWSI) fans up to and including 915 mm (wheel diameter	#1 or #2
Belt driven single inlet single width (SWSI) fans with wheel diameter larger than 915 mm (diameter	#3
Belt driven double width double inlet (DWDI) fans	#3
Belt drive plenum (plug) fans, single width single inlet (SWSI) fans	#3
Direct connected double width double inlet (DWDI) fans	#7
Direct connected single inlet single width (SWSI) fans	#8
Utility sets	#10
Tubular single width single inlet (SWSI) fans	#1 or #9

.2 Ceiling Fans

- .1 Multi-bladed propellers of sheet or airfoil shape.
- .2 Permanently lubricated ball bearings suited for operation in any position.
- .3 Direct driven, variable speed, with motor as indicated.
- .4 Acceptable manufacturers:
 - .1 Canarm
 - .2 Westinghouse
 - .3 Altra-Air
 - .4 Or approved equal

3 Execution

3.1 General

- .1 Fan Installation
 - .1 Install fans complete with resilient mountings and restraining snubbers.
 - .2 Provide flexible connections on inlet and outlet ductwork.
 - .3 Align shafts, belt drive and motor, adjust belt tension and check motor rotation before start-up.
 - .4 Protect motors and fans during construction and rotate fans, by hand, every month between delivery and acceptance of building.

End of Section

1 General

1.1 Section Includes

- .1 This section includes requirements common for all electrical work.

1.2 Reference Standards

- .1 These Specifications supplement the referenced standards.
- .2 Where standards differ between authorities, the most rigid apply.
- .3 Where requirements of the Specifications exceed referenced standards, the Specifications apply.

1.3 Codes, Permits and Inspections

- .1 Applicable Codes
 - .1 Ontario Electrical Safety Code
 - .2 Ontario Building Code
 - .3 Ontario Fire Code
- .2 Comply with Ontario Electrical Safety Code, all local, provincial and federal laws, where applicable and with authorities having jurisdiction. Make any changes or alterations required by authorized inspector of authority having jurisdiction.
- .3 Equipment and material must be acceptable to Electrical Safety Authority.
- .4 Where materials are specified which require special inspection and approval, obtain such approval for the particular installation with the co-operation of the material supplier.
- .5 Obtain and pay for permits and inspections required for Work performed.
- .6 Supply and install warning signs, nameplates and glass covered single line diagrams as required by Electrical Safety Authority.
- .7 Submit required documents and Shop Drawings to authorities having jurisdiction in order to obtain approval for the Work. Copies of Contract Drawings and Specifications may be used for this purpose.

1.4 Coordination

- .1 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences. Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.
- .2 Coordinate Work of this division such that items will properly interface with Work of other divisions.
- .3 Architectural Drawings, or in the absence of Architectural Drawings, Mechanical Drawings govern all locations.

1.5 Dimensions and Quantities

- .1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to Shop Drawings and field measurement.
- .2 Quantities or lengths indicated in Contract Documents are approximate only and shall not be held to gauge or limit the Work.
- .3 Make necessary changes or additions to routing of conduit, cables, cable trays, and the like to accommodate structural, mechanical and architectural conditions. Where raceways are shown diagrammatically run them parallel to building column lines.

1.6 Equipment Locations

- .1 Devices, fixtures and outlets may be relocated, prior to installation, from the location shown on the Contract Drawings, to a maximum distance of 3 m (, without adjustment to Contract Price.
- .2 Switch, control device and outlet locations are shown diagrammatically.

1.7 "As Built" Record Drawings

- .1 Refer to and comply with Section 01 33 00 and Section 01 78 00. Maintain a set of Contract Drawings on Site and record all deviations from the Contract Documents. As a mandatory requirement, recording must be done on the same day deviation is made. Be responsible for full compliance with this requirement.

- .2 Mark locations of feeder conduits, junction and terminal boxes and ducts or conduits run underground either below the building or outside the building.
- .3 Where conduit and wiring are underground or underfloor, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades.
- .4 Record deviations from branch circuit numbers shown on Drawings.
- .5 Prepare diagrams of interconnecting wiring between items of equipment including equipment supplied by Owner and under other Specification sections.

1.8 Single Line Diagram

- .1 Reproduce this diagram in Drawing form under glazed frame and mount in main switchgear room. Provide a copy of this diagram to the Consultant and include in the Maintenance Manuals. Size minimum 610 mm x 914 mm.

1.9 Test Reports

- .1 For each check and test performed prepare and submit a test report, signed by the test engineer, and where witnessed, by the Consultant.
- .2 Include record of all tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test engineer, witnesses, also calibration record of all test instruments used together with manufacturers name, serial number and model number.
- .3 Include calibration record, percentage error and applicable correction factors.
- .4 Submit a certified test report from each manufacturer, signed by the certifying inspector, confirming correct installation and operation of each product and part of Work. Include name of certifying inspector, date and times of inspection, ambient conditions.

1.10 Shop (Vendor) Drawings and Parts Lists

- .1 Refer to and comply with Section 01 33 00.

- .2 Submit for review, manufacturer's or Vendor's Drawings for all Products being furnished except cable (up to 1000 V), wire and conduit. Include rating, performance, Specification sheets, descriptive literature, schematic and wiring diagrams, dimensional layouts and weights of components as well as complete assembly.
- .3 Drawings for equipment assemblies, such as switchgear and unit substations, must include the entire assembly on a single drawing having a minimum size of 420 mm x 594 mm (.).

1.11 Operating and Maintenance Manuals

- .1 Refer to and comply with Section 01 33 00 and Section 01 78 00.

1.12 Area Classification

- .1 Refer to area classification drawing for hazardous areas.

2 Products

2.1 Approvals and Quality

- .1 Provide new materials bearing certification marks or labels acceptable under Ontario Electrical Safety Code.
- .2 Equipment must bear, on manufacturer's label, certification mark or label acceptable under Electrical Safety Authority.
- .3 Provide units of same manufacture where two or more units of same class or type of equipment are required.
- .4 Manufacturer's names are stated in this Specification to establish a definite basis for Tender submission and to clearly describe the quality of product that is desired for the Work.

2.2 Standard Specifications

- .1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all Products provided comply with latest issue of applicable standard Specifications issued by authorities having jurisdiction, but such standard Specifications shall not be applied to decrease the quality of workmanship, Products and services required by the Contract Documents.

2.3 Housekeeping Pads

- .1 Provide 100 mm high concrete pads under floor mounted electrical equipment. Extend pads 50 mm outside the equipment perimeter.

2.4 Fire Barriers

- .1 Where electrical material or devices pass through fire rated separations, make penetrations and provide fire barrier seals with a fire resistance rating equivalent to the rating of the separation.
- .2 Prior to installation, submit for review, proposed fire barrier seal materials, method of installation and ULC system number.
- .3 Acceptable Manufacturers
 - .1 A/D Fire Protection Systems
 - .2 Dow Corning
 - .3 Fire Stop Systems
 - .4 IPC Flamesafe Firestop
 - .5 Nelson Electric
 - .6 3M
 - .7 Tremco
 - .8 Approved equivalent

2.5 Enclosure Types

- .1 Provide electrical enclosure types as follows:
 - .1 Dry indoor areas (offices, areas, electrical room) in parks/operations building: NEMA 1
 - .2 Outdoor areas, wash bay and garage areas: NEMA 4
 - .3 Sand and salt building: NEMA 4X
 - .4 Hazardous locations: NEMA 7 or 9, to suit location.

2.6 Products Furnished by Owner

- .1 Carefully examine the Vendor or manufacturers' Drawings and provide any incidental and miscellaneous materials, mounting hardware and supports required for complete systems.

3 Execution

3.1 Manufacturer's Attendance

- .1 Provide manufacturer's representatives to initially start-up each part of the Work, as specified, to check, adjust, calibrate and balance as applicable all components including controls and field wiring. Provide these services for such period and for as many visits as necessary to achieve complete working order in the subject Work.

3.2 Field Inspection

- .1 Provide field engineer for inspection and certification of equipment during installation, testing and commissioning as required.

3.3 Painting

- .1 Touch up finishes on electrical equipment found to be marred on completion of the Work using same colour and type of finish as originally used.
- .2 Prime paint field fabricated metalwork.

3.4 Core Drilling

- .1 Core drilling procedure
 - .1 Examine locations to be core drilled where:
 - .1 Diameter is greater than 25 mm
 - .2 Multiple drillings required and where the distance between centres is less than ten times the diameter of the hole
 - .2 Examine by most suitable method including:
 - .1 X-ray
 - .2 Ferro scan
 - .3 Cable detection
 - .3 Examine from both sides of the structure to be drilled.
 - .4 Examine proposed core drilling locations to determine:
 - .1 Possible interference with
 - .1 Services
 - .2 Structural components

- .2 Possible presence of asbestos tile or other asbestos based material. Report any occurrence or suspected occurrence to the Consultant immediately.
- .5 Select locations as suitable for core drilling and label them:
 - .1 Uniquely number each drilling location and core so that markings will be legible after drilling
 - .2 Mark each core with a north pointing arrow where drilling a slab or upward pointing arrow where drilling a wall
- .6 Without interfering with or damaging any services or structural elements, drill pilot holes sufficient to verify location of potential obstructions or for alignment purposes.
- .7 Use impact drill when drilling holes of 25 mm diameter or less. For holes of greater diameter use core drill.
- .8 Prepare report showing intended core drill locations including printouts, X-ray images. Submit the report for approval prior to drilling to Consultant.
- .9 Proceed with core drilling only after approval has been received from Consultant.
- .10 Confine drilling operation to time-of-day as stipulated by Consultant.
- .11 Position suitable warning notices of a type acceptable to Consultant and exercise caution to ensure safety and protection of personnel and property during drilling especially from effects of water, dust damage, or falling objects below the slab or behind the wall being drilled.
- .12 Stop drilling immediately, and report to Consultant, if contact is made with foreign objects such as reinforcing steel (rebar), electrical conduit, water pipes, drainage pipes.
- .13 Cover open holes with secured covers to guard against fall through of objects.
- .14 Provide necessary firestopping, temporary or otherwise, sufficient to firestop holes that would be otherwise open during hours that the location is unattended. Coordinate placement of firestopping with Consultant.

- .15 Store all cores or core fragments on site and make them available for inspection by Consultant. Dispose of the cores or core fragments after permission is received from Consultant.

End of Section

1 General

1.1 Section Includes

- .1 Electrical basic materials and methods.

1.2 Reference Standards

- .1 Conform to latest issues, amendments and supplements of following standards:
 - .1 CISC/CPMA 2.75, Canadian Institute of Steel Construction/
Canadian Paint Manufacturers Association, A Quick Drying Primer
For Use on Structural Steel
 - .2 CAN/CGSB-1.40-M, Primer, Structural Steel, Oil Alkyd Type
 - .3 CAN3-C21.1-M, Control Cable - 600V
 - .4 CAN3-C21.2-M, Control Cable for Low Energy Circuits 150V and
300V
 - .5 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings
 - .6 CAN/C22.2 No. 26, Wireways, Auxiliary Gutters and Associated
Fittings
 - .7 CSA C22.2 No. 38-M, Thermoset Insulated Wires and Cables
 - .8 CSA C22.2 No. 40-M, Cutout, Junction and Pull Boxes
 - .9 CSA C22.2 No. 42-M, General Use Receptacles, Attachment Plugs
and Similar Wiring Devices
 - .10 CSA C22.2 No. 45-M, Rigid Metal Conduit
 - .11 CSA C22.2 No. 49, Flexible Cords and Cables
 - .12 CAN/CSA C22.2 No. 51-M, Armoured Cables
 - .13 CSA C22.2 No. 52-M, Service-Entrance Cables
 - .14 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible
Metal Conduit
 - .15 CSA C22.2 No. 62, Surface Raceway Systems
 - .16 CSA C22.2 No. 65, Wire Connectors
 - .17 CSA C22.2 No. 75-M, Thermoplastic Insulated Wires and Cables
 - .18 CSA C22.2 No. 76-M, Splitters

- .19 CSA C22.2 No. 83-M, Electrical Metallic Tubing
- .20 CAN/CSA-C22.2 No. 85-M, Rigid PVC Boxes and Fittings
- .21 CAN/CSA C22.2 No. 94-M, Special Purpose Enclosures
- .22 CSA C22.2 No. 127, Equipment Wires
- .23 CAN/CSA-C22.2 No. 131-M, Type Teck 90 Cable
- .24 CSA C22.2 No. 182.1, Industrial Type, Special Use Attachment Plugs, Receptacles, and Connectors
- .25 CSA C22.2 No. 182.2-M, Industrial Locking Type, Special Use Attachment Plugs, Receptacles, and Connectors
- .26 CSA C22.2 No. 182.3-M, Special Use Attachment Plugs, Receptacles, and Connectors
- .27 CSA C22.2 No. 211.2-M, Rigid PVC (Unplasticized) Conduit
- .28 CSA C22.2 No. 214-M, Communications Cables
- .29 CSA C22.2 No. 227.1, Electrical Nonmetallic Tubing
- .30 CSA C22.2 No. 227.2, Flexible Liquid-Tight Nonmetallic Conduit
- .31 CSA C22.2 No. 227.3-M, Flexible Nonmetallic Tubing
- .32 CSA C22.2 No. 232-M, Optical Fiber Cables
- .33 SSPC, Steel Structures Painting Council, "Steel Structures Painting Manual, Vol. 2"

1.3 Submittals

- .1 Consultant reserves the right to require Contractor to submit samples of any materials to be used in this project.

2 Products

2.1 Wire - Low Voltage up to 1000V Service

- .1 Conductors
 - .1 ASTM class B, soft drawn, electrolytic copper
 - .2 Stranded

.2 Insulation

.1 CSA type RW90 XLPE (-40°C)

- .1 Heat and moisture resistant
- .2 Low temperature, chemically cross-linked thermosetting polyethylene material
- .3 600V rated
- .4 For maximum 90°C conductor temperature
- .5 For installation at minimum -40°C temperature
- .6 To CSA C22.2 No. 38

.2 CSA type RWU90 XLPE (-40°C)

- .1 Heat and moisture resistant
- .2 Low temperature, chemically cross-linked thermosetting polyethylene material
- .3 1000V rated
- .4 For maximum 90°C conductor temperature
- .5 For installation at minimum -40°C
- .6 To CSA C22.2 No. 38

.3 CSA type T90 NYLON (-10°C)

- .1 Heat resistant
- .2 Flame retardant
- .3 Thermoplastic PVC material with extruded nylon cover
- .4 600V rated
- .5 For maximum 90°C conductor temperature dry and 75°C in wet locations
- .6 For installation at minimum -10°C
- .7 To CSA C22.2 No. 75-M

.4 CSA type TEW

- .1 Heat resistant
- .2 600V rated
- .3 For maximum 105°C conductor temperature
- .4 To CSA C22.2 No. 127

- .5 CSA type SEW-2
 - .1 Heat resistant
 - .2 600V rated
 - .3 For maximum 200°C conductor temperature
 - .4 To CSA C22.2 No. 127

2.2 Cable - Low Voltage up to 1000V Service

- .1 CSA Type AC90 XLPE (-40 °C)
 - .1 Conductors
 - .1 ASTM class B, soft drawn, electrolytic copper
 - .2 Solid for sizes #10 AWG and smaller
 - .3 Stranded for sizes #8 AWG and larger
 - .2 Insulation
 - .1 Heat and moisture resistant
 - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
 - .3 600V rated for sizes #10 AWG and smaller
 - .4 1000V rated for sizes #8 AWG and larger
 - .5 For maximum 90°C conductor temperature
 - .6 For installation at minimum -40 °C temperature
 - .7 To CSA C22.2 No. 38
 - .3 Construction
 - .1 2, 3 or 4 insulated conductors
 - .2 Bare ground conductor
 - .3 Overall interlocking aluminum armour
 - .4 To CSA C22.2 No. 51
 - .4 Acceptable manufacturers
 - .1 BICC Philips
 - .2 Nexans
 - .3 Prysmian Cables
 - .4 Approved equivalent

2.3 Cable Connectors

- .1 Connectors for type AC90 cable
 - .1 Steel or malleable iron
 - .2 Insulated throat

2.4 Wire and Cable Connectors

- .1 Copper compression type wire and cable terminations for #8 AWG and larger conductors, colour keyed, sized to suit. Long barrel NEMA 2 hole lugs for sizes #1/0 AWG and larger.
- .2 Twist type splicing connectors, copper, sized to suit, with nylon or plastic shroud for tee connections in #10 AWG and smaller conductors.
- .3 Conductor compression splice for #10 AWG or smaller.

2.5 Heat Shrinkable Tubing Insulation, Heavy Wall

- .1 Representative Products
 - .1 Thomas & Betts, Shrink-Kon series
 - .2 Ideal Thermo-Shrink, TS-46
 - .3 Raychem tubing WCSM
 - .4 3M cable sleeve ITCSN
 - .5 Approved equivalent

2.6 Motor Lead Connection Kits, 600 Volt

- .1 Connection kits for low voltage motors.
- .2 Representative Products
 - .1 3M, motor lead splice kit, pigtail, 5300 series
 - .2 Raychem, motor connection kit, MCK, type V
 - .3 Approved equivalent

2.7 Conduit and Fittings

- .1 Rigid Steel Conduit
 - .1 To CSA C22.2 No. 45-M
 - .2 Rigid thickwall galvanized steel threaded conduit
- .2 Coated Steel Conduit
 - .1 Corrosive resistant coated rigid thickwall steel threaded conduit, CSA approved.
- .3 Rigid PVC Conduit
 - .1 To CSA C22.2 No. 211.2-M
 - .2 Rigid PVC conduit
- .4 Flexible Steel Conduit
 - .1 To CSA 22.2 No. 56
 - .2 Liquid-tight flexible steel conduit with PVC cover
- .5 Non-metallic Flexible Conduit
 - .1 Non-metallic extra flexible PVC conduit
- .6 Rigid Steel Conduit Fittings
 - .1 To CAN/CSA C22.2 No. 18
 - .2 Galvanized or polymer coated cast steel fittings
 - .3 Expansion fittings, watertight with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions
 - .4 Sealing condulets for hazardous areas
 - .5 Corrosive resistant coated cast steel fittings for corrosive resistant conduit
- .7 Rigid PVC Conduit Fittings
 - .1 To CSA C22.2 No. 85-M
 - .2 Rigid PVC fittings of same manufacture as rigid PVC conduit
- .8 Liquid tight Flexible Steel Conduit Fittings
 - .1 Watertight connectors with nylon insulated throat

2.8 EMT and Fittings

- .1 EMT
 - .1 To CSA C22.2 No. 83-M
 - .2 EMT galvanized cold rolled steel tubing
- .2 EMT Fittings
 - .1 Compression type, steel
 - .1 Gland compression connectors with insulated throats
 - .2 Compression couplings
 - .2 Set screw type, steel, concrete-tight
 - .1 Connectors with insulated throats
 - .2 Couplings

2.9 Fastenings, Supports and Sleeves

- .1 Fastenings
 - .1 Galvanized steel straps, beam clamps and threaded rods
- .2 Sleeves
 - .1 Schedule 40 steel pipe, minimum I.D. 13 mm larger than O.D. of conduit or cable passing through.
- .3 Strut
 - .1 Continuous slotted channel
 - .2 12 gauge pre-galvanized steel
 - .3 41.2 mm x 41.2 mm minimum

2.10 Junction Boxes

- .1 Galvanized steel NEMA type 1 to suit location, size as required by code for number and size of conduits, conductors and devices, complete with covers, corrosion resistant screws, terminal blocks and mounting rails.
- .2 Screw-on sheet steel covers to match enclosure for surface mounting boxes.

- .3 Covers with 25 mm minimum extension around for flush-mounted junction boxes.
- .4 Galvanized steel barriers as required.

2.11 Terminal Blocks - Surge Protection

- .1 Terminal blocks, rail mounted, with surge voltage protection, rated for circuit voltage.
- .2 Representative Product
 - .1 Phoenix Contact Termitrab SLKK5
 - .2 Approved equivalent

2.12 Pull Boxes

- .1 Galvanized sheet steel welded construction, NEMA type to suit location.
- .2 Screw-on galvanized sheet steel covers for surface mounting boxes.
- .3 Covers with 25 mm minimum extension around, for flush mounted pull boxes.
- .4 Galvanized steel barriers as required.

2.13 Conduit Boxes - General

- .1 Boxes for EMT
 - .1 Galvanized pressed steel
- .2 Boxes for Rigid Steel Conduit
 - .1 Galvanized cast iron alloy FS boxes with mounting feet for surface mounted switches and receptacles
 - .2 Gasketed cover plate for exterior location
 - .3 For corrosive resistant coated conduit: cast boxes with same finish as conduit
- .3 Boxes for Rigid PVC Conduit
 - .1 PVC boxes

2.14 Outlet Boxes - Sheet Steel

- .1 Pressed steel single and multi-gang flush device boxes, minimum size 100 mm x 50 mm x 38 mm 100 mm square outlet boxes where more than 1 conduit enters 1 side, with extension rings as required.
- .2 100 mm square or octagonal outlet boxes.
- .3 119 mm square outlet boxes with extension and plaster rings as necessary for flush mounting devices in gypsum board, plaster or panelled walls.

2.15 Masonry Boxes

- .1 Pressed steel masonry single and multi-gang boxes for devices flush mounted in exposed masonry walls with extension and plaster rings as required.

2.16 Concrete Boxes

- .1 Pressed steel concrete type boxes for flush mount in concrete with extension and plaster rings as required.

2.17 Outlet Boxes - Fittings

- .1 Bushings and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of foreign materials.
- .3 Double locknuts and insulated bushings for sheet steel metal boxes.

2.18 Wiring Devices - Switches

- .1 Specification grade, general purpose AC switches, manual toggle operated, white and brown colour, 15A, 20A, 120-277V, single pole, double pole, three-way, four-way switches as required.

2.19 Wiring Devices - Receptacles for General Service

- .1 Receptacles: specification grade suitable for back and side wiring, complete with grounding terminal, colour as required for type of area for straight blade devices and black colour for twistlock devices.
- .2 Receptacles of one manufacturer.
- .3 Acceptable Manufacturers
 - .1 20A, 125V, (5-20R) duplex, straight blade.
 - .2 20A, 125V, (5-20R) duplex, GFCI, straight blade.
 - .3 20A, 125V, (L5-20R) single, locking, 2 pole, 3 wire, grounding.
 - .4 30A, 125/250V, (14-30R) single, straight blade, 3 pole, 4 wire, grounding.
 - .5 50A, 125/250V, (14-50R) single, straight blade, 3 pole, 4 wire, grounding.

2.20 Block Heater Receptacles

- .1 Dual circuit 20A, 125V, (5-20R), straight blade, microprocessor controlled, integral temperature sensor and indicating lights.
- .2 Acceptable manufacturers: IPLC or approved equivalent.

2.21 Wiring Devices - Cover Plates

- .1 Stainless steel type 301 alloy, horizontally brushed, 0.8 mm thick cover plates.
- .2 Pressed steel, galvanized.
- .3 Cast covers for cast boxes with gaskets.
- .4 Cover plates of same manufacture as devices.

2.22 Welding Receptacles

- .1 Circuit Breaking Receptacle
 - .1 Receptacle and back box assembly, 600 volt, 30 amp, 3 wire, 4 pole, weatherproof, aluminum housing.
 - .2 Pin configuration to match Owner's existing weld plugs (Hubbell HBL430P5W).
 - .3 Acceptable Manufacturers
 - .1 Appleton AE Unilet, AEE mounting box and spring door.
 - .2 Approved equivalent.

2.23 Plywood Backboards

- .1 Plywood backboards, good one side, 1220 mm x 2440 mm x 19 mm unless indicated otherwise. Treat with primer and two coats of fire retardant paint.

2.24 Finish

- .1 Equipment enclosure finish: baked grey enamel, ANSI 49 or ANSI 61.

3 Execution

3.1 Wire and Cable

- .1 Install wiring in raceways unless noted otherwise.
- .2 Minimum wire sizes:
 - .1 Power and lighting: No. 12 AWG
 - .2 Control: No. 14 AWG
 - .3 Fire alarm: No. 18 AWG
 - .4 Wire and cable application and type:
 - .5 Lighting branch circuit where connection to luminaire is AC90 cable T90 nylon
 - .6 Receptacle branch circuit: T90 nylon
 - .7 Ceiling boxes to luminaires in suspended ceiling: T90 nylon or AC90 cable

- .8 Wiring inside high temperature equipment: TEW or SEW-2
- .9 Branch circuits other than those covered above: RW90
- .10 Equipment feeders, circuits: RW90
- .11 Underground and under slab raceways, duct banks, direct burial: RWU90
- .3 Type AC90 cable Length Limitations
 - .1 Ceiling box to luminaire: 1.2 m maximum in non-accessible ceilings; 1.8 m in accessible ceilings
 - .2 Junction box to outlet: 3.6 m maximum
- .4 Load Current Limitations
 - .1 Conductors rated for more than 75°C: 75°C code ampacity rating
 - .2 Motor connection: 75°C code ampacity rating

3.2 Connectors

- .1 Install compression terminations and splices in accordance with manufacturer's written instructions.
- .2 Make splices in junction boxes.
- .3 Make connections in lighting circuits with twist type splicing connectors.
- .4 Terminate and splice conductors No. 8 and larger at terminal blocks in junction boxes.
- .5 Seal terminations and splices exposed to moisture, corrosive conditions or mechanical abrasions with heavy wall heat shrinkable insulation.
- .6 Install fixture type connectors and tighten. Replace insulating cap.

3.3 Motor Lead Connection Kits, 600 Volt

- .1 Install motor lead connection kits for low voltage motors.

3.4 Conduit and EMT - General

- .1 Run parallel or perpendicular to building lines.

- .2 Group raceways wherever possible. Support on channels.
- .3 Install expansion joints as required.
- .4 Run raceways in web portion of structural steel columns and beams.
- .5 Do not drill structural members to pass through.
- .6 Locate raceways behind infrared or unit heaters with 1500 mm clearance.
- .7 Locate raceways not less than 125 mm clear where parallel to steam or hot water lines with a minimum of 75 mm at crossovers.
- .8 Do not install horizontal runs in masonry walls.
- .9 Use metallic raceway where temperatures exceed 75°C or where enclosed in thermal insulation.
- .10 EMT and non-metallic conduits to contain insulated green ground wire.
- .11 Install 6 mm diameter nylon pull cord in empty raceways.

3.5 Conduit and Fittings

- .1 Minimum conduit sizes:
 - .1 Surface installation: 21 trade size conduit
 - .2 Embedded in concrete: 27 trade size conduit
 - .3 Directly buried: 53 trade size conduit
- .2 Conduit application and type:
 - .1 Corrosive areas: rigid steel corrosion resistant coated or rigid PVC
 - .2 Hazardous areas: rigid steel
 - .3 Outdoor areas: rigid steel
 - .4 Embedded in concrete, other than grade slab: rigid PVC
 - .5 In or below grade slab: rigid PVC
 - .6 Exposed in unfinished areas up to 3 m above finished floor. Use EMT above 3 m: rigid steel

- .7 Connection to motors and equipment subject to vibration: liquid tight flexible steel conduit
- .8 Final connection to dry type transformer: flexible steel conduit
- .9 Whip connection to modular furniture: non-metallic extra flexible PVC
- .3 Use field threads on rigid conduit of sufficient length to draw conduits up tight.
- .4 Do not bend coated steel conduit. Use elbows for deflections.
- .5 Do not install conduit in or under slab except where indicated.
- .6 Use factory "ells" where ninety degree bends are required for 1 trade size and larger conduits.
- .7 Bend conduit offsets cold. Do not install crushed or deformed conduits and avoid trapped runs in damp or wet locations. Prevent the entrance of water and lodging of concrete, plaster, dirt, or trash in conduit, boxes, fittings, and equipment during course of construction.
- .8 Where conduit joints occur in damp or wet locations, make joints watertight by applying an approved compound on the entire thread area before assembling. Draw up all conduit joints as tightly as possible.
- .9 Cap exposed empty conduits which do not terminate in outlets, panels, cabinets, etc., with standard galvanized plumber's pipe caps.
- .10 Plug empty conduits which terminate flush with floors or walls with flush coupling and brass plug.
- .11 Install conduit sleeves for all exposed conduits and cables passing through walls, ceilings, or floors, and fill void between sleeve and conduit with caulking. If fire-rated caulking is required by code, use same class as walls, ceilings or floors.
- .12 Terminate conduit stubbed up through concrete floor for connection to free standing equipment with a coupling flush with finish floor, and extend rigid conduit to equipment, except where required, use flexible conduit from a point 150 mm above floor.

- .13 Install double locknuts and bushings on all rigid conduit terminations into threadless openings. Increase length of conduit threads at terminations sufficiently to permit bushing to be fully seated against end of conduit.
- .14 Mechanically bend steel conduit.
- .15 Install sealing condulets in conduits at hazardous area boundaries.
- .16 Conduits in Poured Concrete
 - .1 Locate to suit reinforcing steel. Secure firmly to prevent movement during pour.
 - .2 Clear each conduit with mandrel and brush before concrete sets.
 - .3 Protect conduits from damage where they stub out of concrete.
 - .4 Install sleeves where conduits pass through slab or wall.
 - .5 Provide oversized sleeve before membrane is installed where conduits pass through waterproof membrane. Use cold mastic between sleeve and conduit.
 - .6 Encase conduits completely in concrete; provide 50 mm minimum concrete cover.
 - .7 Replace with exposed conduit, any conduit run found to be obstructed after concrete sets.

3.6 EMT and Fittings

- .1 Minimum EMT size: 0.75" trade size conduit.
- .2 EMT Application
 - .1 Exposed in unfinished areas, above truss level and for drops in column web to 3 m above finished floor. Use rigid steel conduit below 3 m.
 - .2 In block walls and stud partitions.

3.7 Fastenings and Supports

- .1 Provide supports and fastenings for the Work of this division. Do not use supports or equipment provided by other trades.

- .2 Equipment fastenings and supports shall conform to manufacturers recommendations.
- .3 Do not attach to, or suspend any electrical product or service from the roof deck, mechanical ductwork or piping.
- .4 Do not use wire lashing or perforated strap to support or secure raceways or cable.
- .5 Support rods for any suspended item must not be attached to or extended through steel pan type roofs or through concrete slab roofs.
- .6 For surface mounting of two or more raceways or cables use channels.
- .7 Where there is no wall support for raceways and cables dropped vertically to equipment, provide channel properly secured to floor and structure.
- .8 Hang supports from structural members. Where location does not permit direct support from structure provide necessary brackets, frames, channels secured to structural members.
- .9 Fasten exposed conduit and cables to building construction or support systems using straps. Use beam clamps on exposed steelwork.
- .10 Masonry, tile and plaster surfaces: use lead anchors.
- .11 Poured concrete: use expandable inserts. Low velocity powder activated fastenings may be used only in poured concrete.
- .12 Steel structures: use clips, spring loaded bolts, cable clamps, designed as accessories to basic channel members.
- .13 Do not use powder activated fasteners in, tile, precast concrete or steel structure.
- .14 Do not install conduits or cables on the bottom chord of joists or trusses.
- .15 Use beam clamps of the 2-bolt design and of such type that the rod load is transmitted only concentrically to the beam web centreline. The use of "C" and "I" beam side clamps will not be allowed.

- .16 Where the roof or floor framing consists of open web or long span steel joists and/or trusses, ensure that hangers are located at or within 150 mm of the joist or truss top or bottom chord panel points, otherwise provide additional structural steel as required where hanger spacing does not coincide with joist or truss spacing. Design suspension assembly such that the hanger load is transmitted only concentrically to the supporting joist or truss. The use of "C" and "I" beam clamps, brackets, etc., will not be allowed.
- .17 Locate secondary structural steel members between joists or trusses at or within 150 mm of top or bottom chord panel points. Where the secondary structural steel member cannot be located at or near a joist or truss panel point, provide additional diagonal structural steel web member/members designed for the applicable load to the nearest panel point in the opposite chord member. Diagonal hangers which will induce lateral stresses in the chord members of the joist will not be permitted. Submit Shop Drawings of the suspension assembly indicating the location of suspension or support points, the maximum load at each suspension point, location and size of hangers, brackets and intermediate framing members when required, and also details of connection to building structure.

3.8 Junction Boxes

- .1 Install junction boxes in inconspicuous but accessible locations. Secure to structure.
- .2 Install terminal blocks on mounting rails, for termination of each wire and cable regardless of size.
- .3 Only one voltage source is permitted in a junction box.
- .4 Install barriers to separate different auxiliary systems.

3.9 Terminal Blocks - Surge Suppression

- .1 Install surge suppression terminal blocks.

3.10 Pull Boxes

- .1 Install pull boxes in inconspicuous but accessible locations. Secure to structure.
- .2 Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.
- .3 Only one voltage source is permitted in a pull box.
- .4 Install barriers to separate different auxiliary systems.

3.11 Outlet and Conduit Boxes

- .1 Install conduit outlet boxes for conduit up to 32 mm and pull boxes for larger conduits.
- .2 Support boxes independently of connecting conduits.
- .3 Seal boxes during construction to prevent entry of debris, dust and dirt.
- .4 For flush installations mount plaster rings to box, flush with wall surface to permit wall finish to come within 6 mm of opening.
- .5 Provide correct size of openings in boxes for conduit, armoured cable connections. Reducing washers will not be acceptable.
- .6 Install switches and other controls close to door lock or latch jambs and other openings, maintaining a minimum of 100 mm from trims of doors (except where installed in door frames of metal partitions) check door swings.
- .7 Install 100 mm square or octagonal outlet boxes for lighting fixture outlets.

3.12 Masonry Boxes

- .1 In block walls use deep boxes to provide clear space around knockout for AC90 cable entry.

3.13 Wiring Devices - Switches

- .1 Install single throw switches with handle in UP position when switch is closed.
- .2 Install switches in gang type outlet box when more than one switch is required in a location.
- .3 Mount toggle switches at height indicated.
- .4 Install switch colours as follows:
 - .1 Gypsum board, plaster or panelled: white
 - .2 Office: white
 - .3 Unfinished service areas: brown

3.14 Wiring Devices - Receptacles

- .1 Install receptacles vertically, use gang type outlet box where more than one receptacle is required in a location.
- .2 Where split receptacle has a portion switched, mount vertically and switch upper portion.
- .3 Coordinate with architectural and interior design drawings for final positioning and mounting heights of power and voice/data receptacles. Where there is disagreement between electrical and architectural drawings, take the architectural drawings as correct.
- .4 Maintain clearances between receptacle outlet boxes and millwork as stipulated on the drawings.
- .5 Align and evenly space outlet boxes that are mounted as a group.
- .6 Install receptacle colours as follows:
 - .1 Gypsum board, plaster or panelled: white
 - .2 Interior: white
 - .3 Service, exterior: brown

3.15 Wiring Devices - Cover Plates

- .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .2 Install suitable common cover plates where wiring devices are grouped.
- .3 Do not use cover plates designed for flush outlet boxes on surface-mounted boxes.
- .4 Provide plaster ring where necessary.
- .5 Install cover plates as follows:
 - .1 Gypsum board, plaster or panelled: stainless steel
 - .2 Factory, service: galvanized steel
 - .3 Exterior: cast cover

3.16 Control Devices

- .1 Install as indicated.

3.17 Plywood Backboards

- .1 Install plywood backboards.

3.18 Field Fabricated Metal Work

- .1 Clean and prime paint field fabricated metal work.
- .2 After fabrication deburr, scrape, grind smooth, wire brush with power brush and degrease metal work.
- .3 Prime paint steel with one coat of CISC/CPMA 2.75 oil alkyd primer.
- .4 Prime paint aluminum as follows: wash with detergent solution and wipe down with SSPC-SP1 solvent. Apply Glidden #Y-5229 primer to 1.5 mils DFT.

- .5 For brass and bronze alloy materials, prepare as for aluminum but apply one coat of CAN/CGSB-1.40-M zinc chromate primer.

End of Section

1 General

1.1 Section Includes

- .1 This section includes common requirements for all modifications to existing buildings.

1.2 Coordination

- .1 Modifications, demolition and installation of services within this building require utmost care due to vital operation of systems involved. Removal and installation of systems require constant communication with Consultant.

1.3 Coordination Between New and Existing Installations

- .1 Provide interfacing components between new and existing systems as necessary for proper performance and operation.

1.4 Existing Services

- .1 Ensure existing services remain undisturbed and energized except where indicated to be disconnected.
- .2 Disconnect and remove abandoned wiring materials and devices.
- .3 Cut raceways flush where embedded in structure.
- .4 Retain abandoned embedded outlet boxes and close with pressed steel coverplates.
- .5 Make safe all circuit wiring left for future use.

1.5 Interruption of Services

- .1 Obtain Consultant's written approval before interrupting any service. Long outages are not acceptable.
- .2 Provide temporary services to maintain continuity in the event that services must be interrupted.

2 Products

2.1 Existing Material and Equipment

- .1 Unless noted otherwise, existing panels, boxes and wiring materials may be reused if acceptable to inspection authority.
- .2 Unless noted otherwise, provide additional equipment of same type and manufacture to supplement existing equipment.
- .3 Re-used luminaires: Furnish new lamps.

3 Execution

3.1 Existing Material and Equipment

- .1 Equipment to be reused or relocated: Test for proper operation and repair as necessary.
- .2 Repair or replace existing equipment which is damaged in process of relocation.
- .3 Reused Luminaires: Install lamps, clean fixtures and touch up damaged finish.
- .4 Relocate existing junction, pull or terminal boxes which become inaccessible due to new mechanical ductwork or equipment.

3.2 Demolition

- .1 Demolish existing work, where indicated, and remove from site.
- .2 Execute all demolition work so as to create minimum vibration or dust within and outside the building. Obtain Consultant's approval of methods before proceeding.

3.3 Penetrations in Existing Structure

- .1 Perform cutting, patching and repairing. Before proceeding obtain Consultant's approval.

- .2 Where necessary to penetrate existing floors, walls, ceiling, roof or structural members Provide sleeve and follow Consultant's instructions.
- .3 Restore surfaces to same finish and condition as existed prior to penetration.
- .4 Core Drilling Procedure
 - .1 Examine locations to be core drilled where:
 - .1 Diameter is greater than 25 mm
 - .2 Multiple drillings required and where the distance between centres is less than 10 times the diameter of the hole
 - .2 Examine by most suitable method including:
 - .1 X-ray
 - .2 Ferro scan
 - .3 Cable detection
 - .3 Examine from both sides of the structure to be drilled.
 - .4 Examine proposed core drilling locations to determine:
 - .1 Possible interference with
 - .1 Services
 - .2 Structural components
 - .2 Possible presence of asbestos tile or other asbestos based material. Report any occurrence or suspected occurrence to the Consultant immediately.
 - .5 Select locations as suitable for core drilling and label them:
 - .1 Uniquely number each drilling location and core so that markings will be legible after drilling
 - .2 Mark each core with a north pointing arrow where drilling a slab or upward pointing arrow where drilling a wall
 - .6 Without interfering with or damaging any services or structural elements, drill pilot holes sufficient to verify location of potential obstructions or for alignment purposes.
 - .7 Use impact drill when drilling holes of 25 mm diameter or less. For holes of greater diameter use core drill.

- .8 Prepare report showing intended core drill locations including printouts, X-ray images. Submit the report for approval prior to drilling to Consultant.
- .9 Proceed with core drilling only after approval has been received from Consultant.
- .10 Confine drilling operation to time-of-day as stipulated by Consultant.
- .11 Position suitable warning notices of a type acceptable to Consultant and exercise caution to ensure safety and protection of personnel and property during drilling especially from effects of water, dust damage, or falling objects below the slab or behind the wall being drilled.
- .12 Stop drilling immediately, and report to Consultant, if contact is made with foreign objects such as reinforcing steel (rebar), electrical conduit, water pipes, drainage pipes.
- .13 Cover open holes with secured covers to guard against fall through of objects.
- .14 Provide necessary firestopping, temporary or otherwise, sufficient to firestop holes that would be otherwise open during hours that the location is unattended. Coordinate placement of firestopping with Consultant.
- .15 Store all cores or core fragments on site and make them available for inspection by Consultant. Dispose of the cores or core fragments after permission is received from Consultant.

3.4 Salvage Materials

- .1 Remove from site materials in renovated areas that are not to remain or be reused, unless noted as remaining property of Owner.

End of Section

1 General

1.1 Section Includes

- .1 Grounding requirements.

2 Products

2.1 Ground Conductors

- .1 Copper conductors, soft drawn, ASTM class B stranded.
- .2 Insulated or bare conductors. Insulation colour green.

2.2 Buried Connections - Exothermic Type

- .1 Cable to rod, cable to pipe or cable to cable.
- .2 Moulds, weld metal and accessories.
- .3 Approved Product
 - .1 Erico (Cadweld)
 - .2 Approved equivalent

2.3 Buried Connectors - Compression Type

- .1 Cable to rod and cable to cable.
- .2 Approved Product
 - .1 Burndy type YGHR (cable to rod) and type YGHC (cable to cable)
 - .2 Approved equivalent

2.4 Connections to Structural Steel

- .1 Exothermic connection or compression ground connector.
- .2 Approved Products
 - .1 Erico (exothermic)
 - .2 Burndy Groundlink type YGIB and cable connector

- .3 Approved equivalent

2.5 Miscellaneous Hardware

- .1 Silicon bronze ground studs, bolts, washers, nuts and accessories necessary for grounding system, including but not limited to:
 - .1 Grounding and bonding bushings
 - .2 Bolt type conductor connectors
 - .3 Bonding jumpers, straps
 - .4 Pressure type wire connectors

2.6 Ground Rods

- .1 Copper-clad steel, minimum 19 mm diameter, 3 m long.
- .2 At manholes provide screw-down lugs on ground rods.

2.7 Ground Bus

- .1 Ground bus: Copper, 50 mm (x 6 mm (0.25 thick complete with insulated supports, fastenings, connectors, length as indicated.

3 Execution

3.1 General

- .1 Clean all paint, rust and dirt from all surfaces to which ground lugs are bolted.
- .2 Protect exposed grounding conductors from mechanical damage.
- .3 Ensure that molds, for exothermic type connections, are not used for more than 50 connections.
- .4 At junction and terminal boxes, bond grounding conductors to ground stud.

- .5 Bond the main substation ground grid to the building grounding system. Bond the building grounding system to the main water supply pipe on the street side of main water valve and meter using plated copper ground strap bolted to pipe flange or welded bracket.

3.2 Buried Grounding

- .1 For buried grounding use exothermic or compression connection types.

3.3 Cables

- .1 Bond multi-conductor cable armour to equipment enclosures.
- .2 Bond grounding conductor of multi-conductor armoured and non-armoured cable to ground bus or lug in equipment enclosures.

3.4 Duct Banks

- .1 Bond metal raceway within duct banks to system ground.
- .2 Connect grounding conductor in duct banks to ground bus or ground rods in electrical rooms, substations, manholes, etc.

3.5 Structural Steel and Building Grounding

- .1 Ground building structural steel columns to buried perimeter grounding conductor. Ensure perimeter cable is slack to avoid stressing the connections.
- .2 Install grounding jumpers across building expansion joints.
- .3 Install ground rods close to column foundations and drive top of rod 150 mm below grade or finished floor level of slab on grade.

3.6 Electrical Rooms

- .1 Install a copper ground bus mounted on stand-off supports on walls of electrical rooms. Connect electrical panels and equipment ground buses and lugs to electrical room perimeter ground bus. Make connections to bus with cable lugs, bolted through the copper bus with shake-proof

lockwashers and nuts. Use minimum No. 2/0 AWG bare copper conductor to bond ground bus to grounding system.

3.7 Raceways

- .1 On raceways, lock-up tight all couplers and connections to boxes and enclosures. Install bonding jumpers at expansion joints, and where necessary. Maintain ground continuity throughout run of raceway.
- .2 Install bonding jumpers on both ends of flexible conduit. Use grounding bushing, solderless lug, clamp or cup washer and screw connection. Install grounding conductor inside flexible conduit.
- .3 EMT and non-metallic raceways: install insulated grounding conductor in raceway.
- .4 Branch and feeder circuits in rigid steel conduit: use raceway as bonding conductor.

3.8 Testing

- .1 Perform tests as required by inspection authority.

End of Section

1 General

1.1 Section Includes

- .1 Underground ducts, raceways
- .2 Pullboxes
- .3 Handholes.

1.2 Reference Standards

- .1 Conform to latest issues, amendments and supplements of following standards:
 - .1 ASTM A153, Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - .2 CSA C22.2 No. 45-M, Rigid Metal Conduit
 - .3 CSA C22.2 No. 211.1-M, Rigid Types EB1 and DB2/ES2 PVC Conduit
 - .4 CSA C22.2 No. 211.2-M, Rigid PVC (Unplasticized) Conduit
 - .5 CSA C22.2 No. 227.1, Electrical Nonmetallic Tubing

2 Products

2.1 Rigid Steel Conduit

- .1 Rigid steel conduit, threaded, zinc coated and hot dipped galvanized inside, outside, and over threads.
- .2 Rigid steel fittings, long sweep bends.

2.2 Coated Steel Conduit

- .1 Corrosive-resistant coated rigid thickwall steel threaded conduit, CSA approved.

2.3 Rigid PVC Conduit

- .1 Rigid PVC conduit.

- .2 Rigid PVC fittings, long sweep bends.

2.4 Rigid Type DB2/ES2 PVC Conduit (Duct for Concrete Encasement)

- .1 Rigid DB2/ES2 PVC conduit.
- .2 Rigid DB2/ES2 PVC fittings and long sweep bends. Fittings solvent weld type.
- .3 Duct cleaner and solvent cement: Supplied by duct manufacturer.

2.5 Concrete

- .1 Concrete to Section 03 30 00.

2.6 Reinforcing Steel

- .1 Steel reinforcing bar to Section 03 20 00.

2.7 Lighting Pole Bases

- .1 Anchors: Hot dipped galvanized high tensile steel to ASTM A153 with formed threads and removable bolts of same material and finish.
- .2 Nylon bushings to isolate bolt heads where aluminum pole bases are used.
- .3 Reinforcing steel to Section 03 20 00.
- .4 Concrete to Section 03 30 00.

2.8 In-ground Pullboxes

- .1 Concrete tile size as indicated on drawings.
- .2 MTO rated cast iron manhole frame and cover.

2.9 Handholes (Precast)

- .1 Handholes, concrete, prefabricated.
- .2 Cover plate secured with tamper resistant fasteners

.3 Walls, 20 MPa concrete strength.

.4 Acceptable Manufacturers

.1 Lafarge

.2 Brooklin Concrete Products

.3 Duracon

.4 Approved equivalent

2.10 Handhole Frame and Cover

.1 Cast iron frame and cover. Frame depth 75 mm (.

.2 Cover plate secured with tamper resistant fasteners

.3 Acceptable Manufacturers

.1 McCoy

.2 Imbleau

.3 Utility Structures (USI)

.4 Approved equivalent

2.11 Warning Tape

.1 Tape labelled "caution buried electrical line below" or "caution buried electric line", 150 mm wide, yellow colour, black lettering.

2.12 Flame Retardant Tape

.1 Acceptable Manufacturers

.1 3M, Scotch Brand 77, fire and electric, are proofing tape and Scotch Brand 69 glass cloth tape for binding in place.

2.13 Granular Fill

.1 Granular materials required for bedding and backfilling of trenches to Section 31 23 33.

3 Execution

3.1 Installation - General

- .1 Perform trenching, backfilling and compacting Work per Section 31 23 33.
- .2 Slope ducts and conduits 75 mm (in 30 m (, away from building.
- .3 Seal and make all joints watertight. Use adhesive supplied or recommended by manufacturer.
- .4 Use 900 mm (minimum bending radius for conduit.
- .5 When cleaning conduits, if obstructions are encountered which cannot be removed by cleaning methods described; advise Consultant of problems encountered.
- .6 Maintain 1 m (separation between duct banks and underground services such as electrical conduits, cables, other ductbanks.
- .7 Inform Consultant one week prior to backfilling conduit, duct banks, manholes, pole bases.

3.2 Identification

- .1 Install warning tapes.

3.3 Duct Banks

- .1 Install rigid type DB2/ES2 PVC conduits.
- .2 In hazardous areas, install coated steel conduit.
- .3 After cutting duct, remove sharp edges or burrs from duct interior. At fittings, clean duct ends with duct cleaner and apply solvent cement to both surfaces.
- .4 Use plastic spacers supplied by conduit manufacturer to space conduits.

- .5 Place conduit spacers at a maximum interval space of two per 3 m of conduit and located within 600 mm (each side of couplers along entire length of each duct bank. Secure conduits to spacers with non-metallic twine.
- .6 Stagger couplings at least 200 mm (apart.
- .7 Lay conduits so as not to leave low spots.
- .8 Install anchors at 3 m (intervals to prevent floating during concrete placement.
- .9 On completion of concrete encased conduit duct bank installation, clean out by pulling a steel wire brush and mandrel of the correct size through each conduit. For example use a 94 mm (3.75 diameter mandrel for a 100 mm (conduit. Use a brush of same diameter as the conduit. In addition, immediately prior to pulling in cables pull brush through ducts. Blow out debris.
- .10 Install ground wire.
- .11 Install 6 mm (0.25 diameter nylon pull cord in each conduit after cleaning bore.

3.4 Underground Conduits

- .1 Install rigid PVC conduits.
- .2 Terminate conduits in pole bases with coupler flush with top of base. Seal with plastic plug.
- .3 Terminate conduits inside building with coupler flush with floor. Seal with plastic plug.
- .4 Install sleeves where conduits pass through walls, foundations or footings. Seal sleeves to concrete and masonry. Seal conduits to sleeves. Make watertight.
- .5 Where conduits rise up exposed on poles or structures, use rigid steel conduit or rigid PVC with steel guard.

- .6 Clean out conduits with a mandrel or ball 6 mm (0.25 to 13 mm (0.5 smaller than conduit diameter.
- .7 Install 6 mm (0.25 diameter nylon pull cord in each conduit run after cleaning bore.

3.5 Lighting Pole Bases

- .1 Install pole bases.
- .2 Ensure anchors are correctly oriented in base formwork.
- .3 Seal bolt holes in anchors to prevent ingress of concrete during pour.
- .4 Install reinforcing steel.
- .5 Install conduits in bases. Secure so as to prevent movement during pour. Extend conduits 150 mm (above top of bases.
- .6 Install route markers to indicate direction of conduits.

3.6 In-ground Pullboxes

- .1 Install in-ground pull boxes.
- .2 Install concrete tile with top below finished grade and conduit turned up through crushed stone base.
- .3 Set manhole cover frame on tile with poured in place concrete with cover flush with finished grade.

3.7 Handholes (Precast)

- .1 Assemble and install handholes with cover flush with grade.

3.8 Grounding

- .1 Install grounding conductors.
- .2 Connect duct bank grounding conductors to manhole ground rods and/or grounding system.

- .3 Interconnect ground rods with conductors of the same size as the duct bank grounding conductors.
- .4 Ground all cable racks and ladders with minimum #6 AWG bare copper grounding conductor.

End of Section

1 General

1.1 Section Includes

- .1 Identification requirements for electrical systems.

1.2 Quality Assurance

- .1 Obtain prior approval of Consultant prior to installing all identification.

2 Products

2.1 Wire and Cable Markers

- .1 Wire and cable diameter less than 13 mm
 - .1 Approved Products
 - .1 Wieland Z type
 - .2 Approved equivalent
 - .2 Cable diameter 13 mm (0.5 and larger)
 - .1 Approved Products
 - .1 Wieland K type
 - .2 Approved equivalent
 - .3 Non-Circular Wire
 - .1 Representative Product
 - .1 Raychem Shrinkmark sleeves
 - .2 Approved equivalent

2.2 Conduit and Electrical Metallic Tubing Markers

- .1 Stick-on Marker
 - .1 Raceway Size Minimum Character Height
 - .1 ¾" - 1¼ " 15 mm
 - .1 1½" - 2" 19 mm
 - .2 Over 2" 32 mm

.2 Acceptable Manufacturers

- .1 Brady, vinyl cloth, black on orange, type B-500
- .2 Panduit, vinyl cloth, black on yellow, type PCL
- .3 Wieland, Mylar, black on yellow, type NL
- .4 Approved equivalent

2.3 Panel board Identification

- .1 Engraved laminated plastic, black lettering on white background, 6 mm character height.
- .2 Typical 2-line identification for lighting panel:
"Lighting Panel C, 120/208V, 3 ph, 4 W"
"Supplied from panel BB"
- .3 Directories: Typewritten identification of breaker number, ampere rating and connected equipment.

2.4 Switchboard Identification

- .1 Engraved laminated plastic, black lettering on white background, 15 mm minimum character height.
- .2 Typical identification: "Switchboard AAA, 347/600V, 3 ph, 4 W"; for branch feeders "Power Panel B.

2.5 Motor Starter, Contactor and Disconnect Switch Identification

- .1 Engraved laminated plastic, black lettering on white background, 6 mm character height.
- .2 Typical identification: "Pump S4, 208V, 3 ph".

2.6 Receptacles

- .1 Where receptacle is controlled by occupancy sensor, Provide engraved laminated plastic identification plate.

2.7 Warning Signs

- .1 Outdoor - metal, porcelain enamel finish. Indoor - rigid vinyl.
- .2 Typical identification: "Danger - High Voltage".

2.8 Marker Tape, Service and Phase Identification

- .1 Representative Product
 - .1 3M, Scotch Code Tape, type STD with SDR colour refills or 3M Scotch 35 colour tape.
 - .2 Approved equivalent

3 Execution

3.1 Systems Identification

- .1 Identify outlet boxes for various systems with distinctive paint colour. Apply a small area of paint to inside of outlet, junction and pull boxes and panels. In suspended ceiling areas, apply paint to inside and outside of junction boxes. System colours:

System	Normal	Emergency	UPS
120/208 Volt	black	black/red	black/blue
Fire alarm	red		
Intercom	brown		
Low voltage control	black		
PA and sound	light green		

3.2 Power Company Service Identification

- .1 Identify service conductors with coloured marker tape as follows:
 - .1 Phase A - red
 - .2 Phase B - black
 - .3 Phase C - blue
 - .4 Neutral - white

- .5 Ground - green

3.3 Wire and Cable Identification

- .1 Identify power, control, lighting and receptacle wires with continuous colouring as follows:
 - .1 Phase A - red
 - .2 Phase B - black
 - .3 Phase C - blue
 - .4 Neutral - white
 - .5 Ground - green
 - .6 Control - red
 - .7 Interlock - yellow
- .2 For larger wire sizes available only in black, install coloured wire marker tape in accordance with above coding.

3.4 Wire and Cable Identification

- .1 Control/Indication Conductors
 - .1 Install conductor identification markers at switchgear, motor control centres and motor starter terminal blocks and at remote devices.
 - .2 Identification in accordance with the Drawings and reviewed Shop Drawings.
- .2 Lighting and Receptacle Branch Circuits
 - .1 Install conductor identification markers at panel, outlet box connections to lighting fixtures and device outlet boxes.
 - .2 Typical identification if fixture or device is connected to panel A, circuit 5: A-5.
- .3 Low Voltage Lighting Control
 - .1 Install conductor identification marker at relay phase conductors. Typical identification if connected to panel A, circuit 5: A-5.
 - .2 Install conductor identification marker on conductors between control locations and relay panels. Identify in accordance with reviewed Shop Drawings.

.4 Fire Alarm and Miscellaneous Systems

- .1 Install identification on conductors at panels, remote devices and system connections. Identify in accordance with reviewed Shop Drawings.

3.5 Panelboard Identification

- .1 Install identification plates, using adhesive, on outside of panel.
- .2 Install directory.
- .3 Identify main bus as follows:
 - .1 Phase A - red
 - .2 Phase B - black
 - .3 Phase C - blue
 - .4 Neutral - white
 - .5 Ground - green

3.6 Switchboard Identification

- .1 Install identification plates for panel and branch feeders.

3.7 Motor Starter, Contactor and Disconnect Switch Identification

- .1 Install identification plates using self-tapping screws.

3.8 Equipment Warning Signs

- .1 When equipment is supplied from more than one source install red warning signs to this effect.

End of Section

1 General

1.1 Section Includes

- .1 Pre-test inspection, testing and cleaning requirements.

1.2 Reference Standards

- .1 Conform to latest issues, amendments and supplements of following standards:
 - .1 ASTM, American Society for Testing and Materials
 - .2 CSA C22.2 No. 41-81, Grounding and Bonding Equipment
 - .3 CAN/CSA-C22.3 No. 1-M, Overhead Systems
 - .4 CSA C22.3 No. 2, General Grounding Requirements and Grounding Requirements for Electrical Supply Stations
 - .5 NETA, International Electrical Testing Association Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems, 1987
 - .6 CEA, Commissioning Guide for Electrical Apparatus
 - .7 ICEA, Insulated Power Cable Engineer's Association
 - .8 IEEE, Institute of Electrical and Electronic Engineers Guide for Making High Voltage Tests on Power Cable Systems the Field Std. 400

1.3 Project Site Conditions

- .1 Prior to testing, concrete and masonry work in vicinity of equipment and enclosures, walls, doors, gates and fences shall be completely installed, loose dirt and debris removed, and area cleaned. Interior areas shall be broom cleaned and washed down to remove dust.

1.4 Safety

- .1 Conform to federal, provincial and municipal safety requirements.
- .2 Provide adequate protection for persons performing, assisting, or witnessing tests.

- .3 Guard test areas from persons not involved in test procedures.

1.5 Quality Assurance

- .1 Perform testing of the following:
 - .1 Ground system
 - .2 Motors
 - .3 Low voltage switchboard
 - .4 Motor control centres
 - .5 Automatic transfer switch
 - .6 Low voltage cables
 - .7 Panelboards
 - .8 Distribution transformers
 - .9 Thermographic scanning

2 Products

2.1 Materials

- .1 Furnish materials, instruments, and equipment required to execute specified pre-test inspection, testing and cleaning.
- .2 Furnish megger test instruments as follows:

System Voltage	Megger Voltage
less than 208 V	500 V
277 V to 1000 V	1000 V
over 1000 V	5000 V, motor driven

3 Execution

3.1 General

- .1 Remove dust, debris, surplus material and tools from equipment.

- .2 Check and tighten bus connections and terminations with a calibrated torque wrench. Refer to manufacturer's instruction for proper foot pound levels. Mark with adhesive tape or label when satisfactory.
- .3 Notify owner and commissioning agent when each equipment installation is completed, cleaned, safe and ready for testing.
- .4 Insulation resistance values:

System Voltage	Megger Voltage	Min. Acceptable Resistance, in Megohms
less than 208 V	500 V	25
277 to 1000 V	1000 V	100

3.2 Testing and Inspection

- .1 Perform all testing and inspection as required
- .2 Provide personnel as required to remedy defects and make adjustments.
- .3 Arrange for site attendance by representatives of Product manufacturer companies as requested by Owner.

3.3 Power Transformers - Dry Type

- .1 Install but do not terminate power conductors to transformer primary or secondary terminals.
- .2 Take precautions necessary to ensure that installed power conductors which have not been terminated are protected from damage.
- .3 Inspect for physical damage, cracked insulators, tightness of connections, defective wiring and general mechanical and electrical conditions.
- .4 Compare equipment nameplate information with latest single line diagram and report discrepancies.
- .5 Verify proper auxiliary device operation such as fans and indicators.
- .6 Check tightness of accessible bolted electrical joints.

- .7 Perform specific inspections and mechanical tests as recommended by manufacturer.
- .8 Make a close examination for shipping brackets or fixtures that may not have been removed during original installation. Ensure resilient mounts are free.
- .9 Verify proper core grounding.
- .10 Verify proper equipment grounding.
- .11 Clean equipment using manufacturer's approved methods and materials.
- .12 Terminate transformer primary and secondary conductors when instructed to do so by Consultant.

3.4 Low Voltage Cables (Less Than 1000 V)

- .1 Install low voltage feeder cables to switchgear, panelboards, MCC's and distribution transformers but do not terminate to equipment.
- .2 Take precautions necessary to ensure that installed cable runs which have not been terminated to their respective equipment and exposed terminals of equipment are protected from any damage.
- .3 Visually inspect and megger cables to ensure they are ready for testing by Testing and Inspection Company.
- .4 Terminate cable runs to equipment when instructed to do so by Consultant.

3.5 Panelboards

- .1 Inspect for physical, electrical, and mechanical condition.
- .2 Compare equipment nameplate information with latest single line diagram and report discrepancies.
- .3 Inspect for paint, dents, scratches, fit, and missing hardware.

- .4 Verify that fuse and/or circuit breaker sizes and types correspond to drawings.
- .5 Check tightness of bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper torque levels.
- .6 Clean panelboard.
- .7 Megger test.

3.6 Dry Type Transformers - Up To 600 V

- .1 Inspect for physical damage, broken insulation, tightness of connections, defective wiring and general condition.
- .2 Thoroughly clean unit prior to making any tests.
- .3 Verify taps if applicable and connect transformer to desired tap.
- .4 Check that connections are not mechanically stressed.

3.7 Low Voltage Motor Control Centres, Starters, Contactors Up To 1000 Volt Service

- .1 Visually inspect components and the complete assembly, check drawout and plug connections.
- .2 Clean equipment.
- .3 Check each contactor and starter for rating, contactor size and operation, auxiliary contact operation.
- .4 Check starter overloads and fuses with motor full load nameplate ratings.
- .5 Check controls, starters and contactors operation on load.
- .6 Check phasing.
- .7 Check tightness of bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper torque levels.

3.8 Fusible and Non-Fusible Disconnect Switches

- .1 Clean equipment.
- .2 Inspect for physical and mechanical condition.
- .3 Verify that fuse sizes and types correspond to Drawings.

3.9 Automatic Transfer Switch

- .1 Verify that the short circuit withstand rating exceeds the available short circuit duty.
- .2 Compare equipment nameplate information and connections with single line diagram and report any discrepancies.
- .3 Check switch to ensure positive interlock between normal and alternate sources (mechanical and electrical).
- .4 Check tightness of all control and power connections.
- .5 Perform manual transfer operation.
- .6 Ensure manual transfer warnings are attached and visible to operator.

3.10 Motors

- .1 Inspect for physical damage.
- .2 Inspect for proper anchorage, mounting, grounding, connection, and lubrication.
- .3 Inspect for unusual mechanical or electrical noise or signs of overheating during initial test run.

End of Section

1 General

1.1 Section Includes

- .1 Field testing and commissioning of low voltage electrical systems.

1.2 Reference Standards

- .1 Canadian Standards Association: CSA
 - .1 C22.3 No. 1
 - .2 C22.2 No. 0.3-M
 - .3 C22.3 No. 2
 - .4 C22.2 No. 04-M
 - .5 C22.2. No. 41

1.3 Submittals

- .1 Submit certified test reports in accordance with Section 26 05 01.

2 Products

2.1 Materials

- .1 Furnish all materials, instrumentation, etc. required to execute testing and commissioning as specified, including manufacturers testing and commissioning.
- .2 Calibrate test instruments and for each instrument record identifying numbers, date of calibration and percentage of error (if any) on appropriate test reports.
- .3 Furnish megger test instruments as follows:

Megger Voltage	System Voltage
500 V	up to 250 V (low voltage)
1000 V	277 V to 1000 V (low voltage)

3 Execution

3.1 Coordination of Electrical Protective Devices

- .1 Following receipt of Shop Drawings, obtain from manufacturer's time-current curves of all protective devices.
- .2 Co-ordinate setting of relays, rating of fuses and trip elements of circuit breakers, so that the protective device immediately ahead of any fault operates before any upstream protection and establish selective coordination throughout the system.
- .3 Prepare a complete set of curves showing time current characteristics for all breakers and fuses from main switchboard main circuit down to 208/120 V panels.

3.2 Pre-Test Inspection and Cleaning

- .1 Check that all dust, debris, surplus materials and tools, have been removed from equipment.
- .2 Inspect all parts of the power distribution systems at each voltage level for completeness, check and set circuit protective devices, fuses, breaker relays, trips, and all ancillary devices in accordance with the reviewed coordination studies, approved Drawings and manufacturers' instructions.
- .3 Check phase sequence throughout the systems and application of colour codes to equipment and cables.
- .4 Verify all cable sizes, equipment ratings, trip settings conform to Specifications and coordination study.

3.3 Testing General

- .1 Test the electrical installation including all safety devices as the Work progresses and on completion.
- .2 Without adjustment to the Contract Price:
 - .1 Repair, rework or replace any equipment, material or workmanship which fails specified tests.

- .2 Perform such additional tests and re-tests as may be directed by the Consultant and/or Owner's Representative.
- .3 Energize each voltage level of the system immediately after testing is complete.
- .4 In case this is not feasible verify all fuse sizes and trip settings and repeat megger tests of each feeder and equipment with circuit breakers and switches open, immediately before energization.
- .5 Distribution panels and panelboards
 - .1 Check bolted connections bus to bus, and bus to cable lug with torque wrench, to manufacturer's values. Mark with adhesive tape or label when satisfactory.
 - .2 Measure contact resistance on low voltage fusible and non-fusible switches, circuit breakers, contactors and auxiliary equipment.

Acceptable values:

	Microhms
Low voltage - up to 250 V	500
Low voltage - 277V to 1000V	500
 - .3 Megger test insulation resistance phase to phase and phase to ground of fusible switches, circuit breakers, contactors, buswork, auxiliary equipment. Acceptable values:

	Megohms
Low voltage, up to 250V	1
Low voltage, 277V to 1000 V	50

Duration of each test: one (1) minute
 - .4 Check ground bus and ground path for continuity, and connection to all non-current carrying metalwork. Maximum acceptable reading 0.1 ohms.
 - .5 Check for physical faults: damaged or dirty insulators, alignment of contacts, switchblades, operating mechanism, clearances, barriers, mounting.
 - .6 Operate circuit breakers, switches, and contactors three times.

- .7 Operate equipment through design functions, including remote control operation, actuation of alarm and indication devices, mechanical and electrical operation and operation from protective relays.
- .8 Check 600V circuit breakers for trip and target operation. Test long time, short time, instantaneous and ground fault trips. Trip settings shall conform to values selected in the coordination study. Verify pickup and time values. Compare actual trip time with manufacturer's specifications and present in tabular form.
- .9 Balance loads on all panelboards. Use shop drawing information for all equipment loads.

3.4 Low Voltage Switchboards up to 1000 Volt Service

- .1 Visually inspect components and complete assembly, check wiring and interconnections.

3.5 Low Voltage Starters, Contactors Up To 1000 Volt Service

- .1 Visually inspect components and the complete assembly.
- .2 Check each contactor and starter for switch or breaker operation, fuse or breaker rating, contactor size and operation, auxiliary contact operation.
- .3 Check starter overloads with motor nameplate ratings.
- .4 Check controls and starters and contactors operation on load.
- .5 Check motor rotation.
- .6 Correct three phase rotation where required.

3.6 Distribution Transformers Up To 1000 Volt Service

- .1 Set taps for nominal voltage output from secondary with initial loads applied.
- .2 Check for clear airflow through enclosure.
- .3 Check connections are not stressed.

3.7 Thermographic Survey

- .1 Perform thermographic surveys at end of construction, and 4 months and 10 months after process load is introduced on system in accordance with NETA ATS, Section 9, Thermographic Survey.
- .2 Provide photographs and thermographs of problems only for the end of construction and the four month survey.
- .3 Provide photographs and thermographs of each area as seen on the imaging system for ten month survey.

End of Section

1 General

1.1 Section Includes

- .1 Electrical service and distribution equipment.

1.2 Reference Standards

- .1 Conform to latest issues, amendments and supplements of following standards:
 - .1 CSA C9-M, Dry-Type Transformers
 - .2 CSA C22.2 No. 4-M, Enclosed Switches
 - .3 CSA C22.2 No. 5.1M, Moulded Case Circuit Breakers
 - .4 CSA C22.2 No. 31-M, Switchgear Assemblies
 - .5 CSA C22.2 No. 39, Fuseholder Assemblies
 - .6 CSA C22.2 No. 47, Air-Cooled Transformers (Dry Type)
 - .7 CSA C22.2 No. 106-M, HRC Fuses
 - .8 NEMA BU1.1, General Instructions for Proper Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less

2 Products

2.1 Panelboards - Circuit Breaker Type

- .1 Panelboards to be product of one manufacturer.
- .2 Enclosures: Steel, NEMA 1 to suit location.
- .3 Bus: Copper, half capacity ground bar and full capacity neutral bar, braced for interrupting capacity as indicated.
- .4 Circuit breakers: Bolt-on, quick-make, quick-break, thermal and magnetic trips, trip indicating, trip free handle. Common operating handle on multipole breaker.

- .5 Integral transient voltage surge suppressor, where indicated, with features as follows:
 - .1 Connection to panelboard bus via circuit breaker.
 - .2 Hybrid filter consisting of metal oxide varistors and a parallel filter circuit.
 - .3 High energy transient voltage suppression, surge current diversion and high frequency attenuation of wave shapes in category B environment as defined in ANSI/IEEE C62.41.
 - .4 Surge current rating, based on 8 x 20 μ s wave shape, as follows:
 - .1 Per mode: 60 kA minimum
 - .2 Per phase: 120 kA minimum
 - .5 Filter noise attenuation: 50 dB minimum, normal mode, at 100 kHz.
 - .6 Normal protection modes: line to line (and line to neutral for 4 wire system). Common protection modes: line to ground (and neutral to ground for 4 wire system)
 - .7 Fusing for each protection mode.
 - .8 Status LED indication of each phase.
 - .9 UL1449 and UL1283 listed, CSA or CUL approved.
- .6 Door: Hinged lockable door.
- .7 Keys: two keys per panelboard; key panelboards alike.
- .8 In addition to CSA requirements, manufacturer's nameplate to indicate panel withstand fault current.
- .9 Lock-on devices: For circuits supplying continuously operating equipment. Minimum quantity 10% of 15A, 20A and 30A rated breakers.
- .10 Spaces: Fully bussed for future breakers with removable filler plates.
- .11 Breaker arrangement: Locate breakers at specific circuit number locations shown on panelboard schedule sheet.

.12 Acceptable Manufacturers

- .1 Eaton
- .2 Schneider
- .3 Siemens

2.2 Dry Type Transformers - Up To 600V

- .1 Dry-type transformers: Type ANN, copper windings, insulation class H, 150°C rise.
- .2 Enclosure: Steel, ventilated, NEMA 1.
- .3 Taps: Full capacity 4 – 2½%, 2 above and 2 below normal.
- .4 Impedance: Minimum 3% and maximum 6%.
- .5 Vibration isolators: Internal noise and vibration isolating pads.
- .6 Mounting brackets: Floor and wall standard.
- .7 Acceptable manufacturers
 - .1 Eaton
 - .2 Schneider
 - .3 Siemens
 - .4 Hammond

2.3 Fusible and Non-Fusible Disconnect Switches

- .1 Enclosure: Steel, NEMA 1 to suit location.
- .2 Switches: Quick-make, quick-break, heavy duty, short circuit rating 100,000A rms sym. Provision for locking in off position with up to three padlocks.
- .3 Viewing window: For viewing blades.
- .4 Electrical interlock: Mechanically operated from switch mechanism, rated 120 VAC, 15A, 1 NO and 1 NC contact.

- .5 Acceptable manufacturers:
 - .1 Schneider, Square D
 - .2 Cutler-Hammer
 - .3 GE Canada
 - .4 Siemens
 - .5 Approved equivalent

2.4 Fuses

- .1 HRC fuses to CSA C22.2 No. 106-M.
- .2 Time delay fuses as follows:
 - .1 Fuses up to 600V, up to 600A HRCI-J, Form I: Class J Bussman JHC, Gould Shawmut AJT, or approved equivalent.
- .3 Provide spare fuses of each type and size in use as follows:
 - .1 600A and below: Six
- .4 Submit a list of spare fuses to Consultant for approval.

2.5 Photoelectric Relays

- .1 Weatherproof enclosure for conduit mounting, with adjustable light shield.
- .2 Temperature range -40°C to +70°C.
- .3 Switching time delay adjustable up to thirty seconds.
- .4 Acceptable Manufacturers
 - .1 Intermatic
 - .2 Tork
 - .3 Paragon
 - .4 Approved equivalent

2.6 Relays

- .1 Totally enclosed plug-in type relay with four form-C contacts, operating coil to suit required voltage. Complete with mounting socket.

- .2 Acceptable manufacturers
 - .1 Allen-Bradley
 - .2 Schneider Square D
 - .3 Eaton
 - .4 Approved equivalent

3 Execution

3.1 General

- .1 Protect equipment from dust, debris, moisture, and physical damage, with sealed envelope of plastic or other impervious material until building is enclosed and cleaned and equipment is energized.
- .2 Protect from condensation by maintaining at suitable temperature above 0 °C.
- .3 Finish equipment enclosures to ANSI 49 or ANSI 61, baked grey enamel.

3.2 Panelboards

- .1 Locate panelboards, secure, plumb true and square to structure.
- .2 Mounting Methods
 - .1 Exterior walls and interior combustible walls: mount on continuous slotted channel strut with 75 mm clear between back of panel and wall. Where practical, group panelboards on common frame.
 - .2 Interior non-combustible walls: mount against wall.
- .3 Where panelboards are flush mounted, provide three 25 mm empty conduits from each panelboard into ceiling space above.
- .4 Identify load circuits on panel directory complete with name and location.

3.3 Distribution Transformers

- .1 Support from building structure on trapezes or L brackets. Locate to provide free flow of cooling air.

- .2 Loosen isolation pads until no compression is visible.
- .3 Make final connection with flexible metal conduit.
- .4 Leave slack in cables and flexible conduit, to avoid stress on connections.

3.4 Contactors

- .1 Install contactors local to panelboard where practical.
- .2 Check operation of contactors.
- .3 Provide plastic covers to exclude dust and dirt until contactors are energized.

3.5 Disconnect Switches

- .1 Install local to equipment on adjacent wall, column, or other suitable mounting surface. Where necessary provide free standing rigid continuous slotted channel strut frame.
- .2 Where mounted on masonry walls, allow minimum of 6 mm clear space between enclosure and masonry wall.

3.6 Fuses

- .1 Store fuses in a moisture free location until ready to energize.
- .2 Install fuses immediately prior to energization.
- .3 Prior to acceptance of the Work, clearly mark manufacturer's labels on inside cover of each fusible unit, with ampere rating and catalogue symbol of replacement fuses to be used.

3.7 Photoelectric Relays

- .1 Install and adjust in accordance with manufacturer's instructions.
- .2 Check operation of relay and connected contactor.
- .3 Set to switch "on" at 100 Lx and below, "off" at 200 Lx and above.

3.8 Photoelectric Devices

- .1 Rigidly support devices and reflectors and provide for adjustment and alignment when screwed in place.
- .2 Ensure that operating distance does not exceed 50% of device rated operational distance.

End of Section

1 General

1.1 Section Includes

- .1 Lighting equipment as per the luminaire schedule and as specified herein.

1.2 Related Requirements

- .1 Refer to architectural reflected ceiling plans for exact location of luminaires.
- .2 Check latest ceiling finish schedule in areas where recessed luminaires are specified to ensure that luminaires have suitable ceiling trim for particular ceiling finish.

1.3 Reference Standards

- .1 CSA C22.2 No. 9-M1988, Luminaires
- .2 CSA C22.2 No. 34-M1987, Electrode Receptacles, Fittings, and Connectors for Gas Tubes
- .3 CSA C22.2 No. 43-M1984, Lampholders
- .4 CSA C22.2 No. 66-1988, Specialty Transformers
- .5 CSA C22.2 No. 74-92, Equipment for Use with Electric Discharge Lamps
- .6 CSA C22.2 No. 141-M1985, Unit Equipment for Emergency Lighting
- .7 ANSI/IEEE C62.41, Guide for Surge Voltages in Low Voltage AC Power Circuits

1.4 Codes and Standards

- .1 All wiring to be in accordance with the Ontario Electrical Safety Code.
- .2 Provide only equipment bearing a label acceptable to the Electrical Safety Authority (ESA) to indicate that the equipment has been tested to applicable CSA standards.

1.5 Submittals

- .1 Submit Shop Drawings in accordance with Section 01 33 00.
- .2 Submit certified copies of photometric test data, for each luminaire type, prepared by independent testing laboratory. Photometric data to include total input watts, candlepower summary, candlepower distribution, zonal lumen summary, luminaire efficiency, coefficient of utilization table, lamp type, ballast type and manufacturer, and lumen rating in accordance with IESNA testing procedures.

2 Products

2.1 Luminaires

- .1 General
 - .1 Furnish luminaires in accordance with CSA C22.2 No. 9.
 - .2 Furnish medium screw base lampholders of nickel or brass in accordance with CSA C22.2 No. 43.
 - .3 Furnish mogul screw base lampholders of porcelain and nickel in accordance with CSA C22.2 No. 43.
 - .4 Furnish lamp bases for gas tube lamps in accordance with CSA C22.2 No. 34.
 - .5 Luminaire finishes shall resist chipping, crazing, discolouration.
 - .6 Luminaires to contain no asbestos.
 - .7 Furnish luminaires with flanges and gaskets to eliminate light leaks.
 - .8 All luminaires are to be complete with mounting brackets, transformers, supports, trims, louvers, lenses and other accessories as required to make luminaire operational and allow it to be installed in the respective location.
- .2 LED Luminaires
 - .1 Cast aluminium with integral weathertight LED driver compartments and high performance heat sinks.
 - .2 Epoxy primer with powder topcoat, resistant to corrosion, ultraviolet degradation and abrasion.

- .3 Drivers rated for operation over a -30 °to 40 °C ambient temperature range.
- .3 Exit Light Luminaires
 - .1 Universal ceiling, end-to-wall, surface back-to-wall mounting or recessed mounting if indicated.
 - .2 LED type with diffusing lens.
 - .3 Refer to luminaire schedule for additional information.
- .4 Emergency Remote Luminaires
 - .1 Wall mounted or ceiling mounted as indicated on Drawings.
 - .2 Fire-retardant thermoplastic
 - .3 Three hundred degree rotation, MR16 LED lamps.
- .5 Acceptable Manufacturers
 - .1 As indicated in luminaire schedule.

2.2 LED Drivers

- .1 Electronic
 - .1 Voltage range: (120 - 277) +/- 10%
 - .2 Current: 525 mA secondary
 - .3 Frequency: 50/60 Hz
 - .4 Power factor: >90% at full load
 - .5 THD: <20% at full load
 - .6 Load regulation: +/- 1% from no load to full load
 - .7 Output ripple: < 10%
 - .8 Output shall be isolated
 - .9 Case temperature: rated for -40 °C through +80 °C
 - .10 Overhead protection, self-limited short circuit protection and overload protected
 - .11 Primary fused
 - .12 Life rating not less than 50,000 hours

2.3 Emergency Battery Units

- .1 Supply voltage 120 V ac as noted on luminaire schedule.
- .2 Output voltage 12 V DC.
- .3 Batteries: Sealed lead acid calcium alloy grid type sized to operate the lamp load to 91% of initial voltage for 120 minutes or 30 minutes as noted on luminaire schedule.
- .4 Battery charger: Solid state, multi-rate, voltage/current regulated, sized to restore battery to full charge in twelve hours.
- .5 Low voltage disconnect: Solid state, modular, operates at 80% battery voltage.
- .6 NEMA 1 code gauge steel housing.
- .7 Auxiliary Equipment
 - .1 "AC Power ON"
 - .2 "Fast charge" pilot light
 - .3 Voltmeter
 - .4 Test switch
 - .5 Cord and plug (120 V only)
- .8 Lamp heads: Mounted as indicated, 360 degree horizontal and 180 degree vertical adjustment, MR16 LED lamps.
- .9 Acceptable Manufacturers
 - .1 As indicated in luminaire schedule.

3 Execution

3.1 Installation - General

- .1 Provide supports for luminaires. Support single units from luminaire studs in outlet boxes. For continuous row fluorescent type, provide support for each end plus at least one for each channel section, or additional as required. Swivel-mount stems. Provide concrete inserts at points of

luminaire support in unfinished areas where a concrete slab serves as ceiling. Provide support from concrete floor and roof steel above ceiling as applicable.

- .2 Align luminaires in rows, maintain required heights, and install luminaires clear of other Work.
- .3 Keep luminaires covered and protected from construction dust and debris until building is broom clean and free of suspended dust clouds.
- .4 Do not lamp luminaires until ready for testing and use. Obtain Owner's approval before lamping. Install lamps in lampholders.
- .5 When installation is complete, demonstrate operation to satisfaction of Owner.
- .6 Standard octagonal boxes may be supplied where conduits feeding luminaires in finished areas are exposed on ceiling if hanger canopies entirely cover outlet boxes and are neatly notched for conduit. Otherwise, provide cast conduit outlet boxes with a diameter larger than canopies.
- .7 Attach boxes or hickeyes directly to poured concrete with 6 mm minimum diameter bolts and lead expansion anchors where luminaires are suspended directly from concrete slabs. Use 8 mm minimum bolts through precast slabs, welded to 100 mm x 100 mm minimum, 3.5 mm plate above slabs.
- .8 Do not mount luminaires above pipes, ducts or equipment. In event of unavoidable tight locations, provide hangers to clear obstructions. Check layouts of other trades on job and plan cooperatively. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown.
- .9 Provide continuous 12 mm x 38 mm channel above ceiling, where luminaires are suspended or mounted on furred ceilings. Fasten luminaires to channel with two 6 mm minimum diameter studs with minimum 1220 mm on centre.

- .10 Where two 1220 mm surface or suspended fluorescent luminaires occur in tandem, an 8 ft body may be used. Where two single lamp luminaires occur in tandem, a common lamp ballast may be used.
- .11 Verify catalogue number of luminaires with description prior to ordering, and check for final ceiling finish in areas where recessed luminaires are called for in order to provide ceiling trim, flanges and mounting brackets to suit particular construction used where luminaires are installed.
- .12 Support luminaires in an approved manner to comply with the Ontario Electrical Safety Code and the Ontario Building Code.
- .13 Provide steel luminaire studs, brackets and hangers. Where luminaires are hung on chain hangers, provide chain of closed link type capable of supporting ten times luminaire weight. Use U-bolts for chain ends; S-hooks are not acceptable.

3.2 Installation - Industrial

- .1 For industrial luminaires suspended from ceiling outlet boxes, provide 13 mm rigid combination conduit stems, luminaire stud, and self-aligning hangers. In other locations, except as otherwise detailed or required, provide ceiling or wall outlet boxes with 9.5 mm, no-bolt luminaire studs. Provide special hangers for support of any luminaire which weighs more than 50 pounds.
- .2 Where specified, provide safety restraint device (safety chain or safety cord) of minimum length as recommended by the manufacturer.
- .3 The manufacturer to certify that the safety restraint device has been drop tested for the actual luminaire and restraint length.

3.3 Installation - Emergency and Exit Lights

- .1 Exit sign installation shall meet all requirements of the authorities having jurisdiction.
- .2 Install emergency battery units where shown. Support on brackets supplied by manufacturer.

- .3 Aim heads to properly illuminate exit path.

End of Section

1 General

1.1 Section Includes

- .1 Low voltage lighting control systems.

1.2 Submittals

- .1 Submit Shop Drawings and product data in accordance with Section 01 33 00.
- .2 Shop Drawing
 - .1 Composite wiring and schematic diagram for overall control system and each control circuit as proposed to be installed (standard diagrams will not be accepted)
 - .2 Scale drawing for each area showing exact location of each sensor, room controller, digital switch, and interface modules.
- .3 Product data: Catalog sheets, specifications and installation instructions.
- .4 Include data for each device which:
 - .1 Indicates where sensor is proposed to be installed.
 - .2 Prove the sensor is suitable for the proposed application.

1.3 Reference Standards

- .1 American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
 - .1 C62.41-1991 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 Canadian Standards Association (CSA)
 - .1 CSA C22.2 #14 Industrial Control Equipment.
 - .2 CSA C22.2 #184 Solid-State Lighting Controls.
 - .3 CSA C22.22 #156 Solid-State Speed Controls
 - .4 CSA C22.2 #42.1-00 Cover Plates for Flush Mounted Wiring Devices
 - .5 CSA C22.2 #74 Electronic Ballast Standard

- .3 Underwriters Laboratories Canada (ULC)
 - .1 508 (1999) - Standard for Industrial Control Equipment.
 - .2 924 (2003) - Emergency Lighting and Power Equipment (requires LUT-ELI).

1.4 System Description

- .1 Provide a complete and operative digital low voltage lighting control system as specified herein and as indicated on the Drawings.
- .2 New control system to match existing main building lighting control system.
- .3 All lighting zones and levels to be automatically or manually controlled via digital room controllers, local digital switches, digital sensors, or central controller from integrator control relay panel as indicated. Refer to lighting layout drawings, low voltage control panel schedules and lighting control sequence of operation schedule.
- .4 All local relays to be addressed by local switches without limitation.
- .5 Local and central switching of relays to be fully memory and status changes continuously updated by local interface.
- .6 Centralized preset lighting control software, processor and keyboard to automatically program entire system by zones, levels or relays.
- .7 Relays, zones or levels to be assigned individual digit codes. Any code or combination of codes to be manually addressed by keyboard or included into clock program for automatic operation.
- .8 Automatic clock and restart memory functions to remain operational by standby battery in the event of power failure.
- .9 Status for remote relay panels to be indicated at central monitor, and status of each relay constantly available for display on monitor. Relay status to be indicated by colour coded system.

- .10 System to be capable of producing status and utilization reports, and to provide lamp usage information for each relay circuit to establish relamping criteria.
- .11 Advance indication of lights being turned off to be by flashing lights on and off. Acknowledgement in any particular zone shall leave lights on for a preset period after which the flashing and off cycle to be repeated.

1.5 Operation and Maintenance Data

- .1 Provide data incorporated into maintenance manual as specified including the following:
 - .1 Dimensioned drawings and data of all lighting system components
 - .2 Operating system manual and software.
 - .3 Manufacturer's "Guide to Operations" and "Installation and Setup".
 - .4 Operation, setup and maintenance of auxiliary components and interface.
 - .5 Lighting control system operating instructions, maintenance and troubleshooting instructions.
 - .6 Relay panel schedules including circuits and codes assigned.

1.6 Quality Assurance

- .1 Manufacturer Qualifications
 - .1 Minimum 10 years' experience in manufacture of lighting control systems.
 - .2 Quality system: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.

1.7 Maintenance Material Submittals

- .1 Make ordering of new equipment for expansions, replacements, and spare parts available to end-user, qualified dealer or installer.
- .2 Make new replacement parts available for minimum of ten years from date of manufacture.

1.8 Training

- .1 Conduct training of Owner's operating and maintenance staff upon completion of system.
- .2 Fully demonstrate the complete operation of the system to the Owner.

2 Products

2.1 General

- .1 All control system devices to be completely preassembled and prewired, and contain all components to provide a complete system.
- .2 Low voltage lighting control system to consist of the following components, but not limited to:
 - .1 Integrator control relay panels w/ time clock package,
 - .2 Control transformers and rectifiers,
 - .3 Configuration tools
 - .4 Digital room controllers
 - .5 Digital occupancy sensors, digital photosensors, digital on/off or dimming switches.
 - .6 Interface modules,
 - .7 Network link devices.

2.2 Integrator Control Relay Panels

- .1 Enclosure to be surface mounted NEMA 1 with hinged doors finished to manufacturer's standard paint finish.
- .2 Panels to contain the following components, but not limited to:
 - .1 Control transformer and rectifiers,
 - .2 Interface modules where required
 - .3 Relays
 - .4 Sectionalized wiring compartments with barriers between different voltage levels

- .3 Relay contacts rated at 120 volts, 20 amps (inductive).
- .4 Mechanical "ON-OFF" indicator clearly visible from front of panel.
- .5 Relays for HID loads to be extra heavy duty designed for type of load.
- .6 Relay coils shall not be continuously energized. Eliminator contacts to automatically condition the input control circuit to reverse coil polarity immediately after "ON" or "OFF" pulse received.
- .7 Panel mounted switches to manually override programmed operation for each relay.
- .8 Panel includes user interface and circuit boards.

2.3 Low Voltage Digital Wall Switches

- .1 Switches to be digital wall switches with pushbutton ON/OFF operation. Each button can control individual or multiple loads or one scene.
- .2 Each switch to include a LED pilot light for the individual buttons to indicate ON or OFF status.
- .3 Switches to be mounted in groups as indicated on drawings.
- .4 Refer to electrical lighting drawings for detail device requirement.

2.4 Low Voltage Momentary Toggle Wall Switches

- .1 Single pole, double-throw with center position rest. Fits conventional toggle switch openings.
- .2 Switches to connect to low voltage control panel for 3-way low voltage control use.
- .3 Refer to electrical lighting drawings for detail device requirement.

2.5 Exterior Photocell

- .1 Exterior wall mounted photocell for switching all exterior lighting, 0 - 200 fc.

- .2 Completely weather proof with a hooded lens.
- .3 Photocell shall have separate trip point setting. Sensitivity is to be adjustable.
- .4 Refer to electrical lighting drawings for detail device requirement.

2.6 Digital Room Controller

- .1 Room controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room controllers shall be provided to match the room lighting load and control requirements. The control units will include the following features:
 - .1 Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 - .2 Device status LEDs to indicate:
 - .1 Data transmission
 - .2 Device has power
 - .3 Status for each load
 - .4 Configuration status
 - .3 Quick installation features including:
 - .1 Standard junction box mounting
 - .2 Quick low voltage connections using standard RJ-45 patch cable
- .2 On/Off room controllers shall include:
 - .1 One or two relay configuration
 - .2 RJ-45 DLM local network ports
- .3 On/Off/Dimming enhanced room controllers shall include:
 - .1 Real time current monitoring
 - .2 Multiple relay configurations
 - .3 RJ-45 DLM local network ports.

- .4 One dimming output per relay
 - .1 Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers.
- .4 Plug load room controllers shall include:
 - .1 One relay configuration
 - .2 Automatic-ON/OFF configuration
 - .3 RJ-45 DLM local network ports
- .5 Refer to electrical lighting drawings for more information.

2.7 Occupancy Sensors

- .1 C5 Ceiling mounted passive infrared (PIR), extreme temperature sensor UL listed for damper locations. Temperature compensating circuitry stabilizes sensitivity at temperature -40 °C to +52 °C. Working height up to 7620 mm (25'). Power pack as required.
 - .1 Eaton Cooper Greengate OXC-P-2MH0-R

2.8 Enclosure

- .1 Wall mount enclosure for control delay panel and/or room controller
- .2 Enclosure to be NEMA 4 type, c/w heater and thermostat, size to accommodate required control components installed inside.
- .3 Enclosure: Hammond HWHK series 48"x36"x12" or equal
- .4 Heater: Genesis DIN Rail 50W heater c/w thermostat, or equal

2.9 Wiring

- .1 LMRJ series cables for digital device connection. Refer to low voltage lighting control schematic diagram.
- .2 LM-MSTP series wire for digital segment network connection. Refer to low voltage lighting control schematic diagram.
- .3 4 wire interconnecting bus where required, #20 AWG twisted shielded pairs.

- .4 Switch wiring #20 where required, twisted shielded pair.

2.10 Software and Programming

- .1 Provide necessary software and programming as required for the functions described herein.

2.11 Acceptable Manufacturers

- .1 Eaton Cooper Lighting Greengate
 - .1 Existing main building lighting control system is Eaton Cooper Greengate.

3 Execution

3.1 General

- .1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.
- .2 Install wiring in conduit in accordance with manufacturer's recommendations and as indicated. Conduit installation to be in accordance with Section 26 05 02.
- .3 Wiring to be colour coded and each wire termination to be identified with circuit and corresponding relay number.
- .4 Refer to Drawings and Section 26 50 00 for luminaire types, relay circuiting and panel locations.
- .5 Refer to lighting layout drawings, low voltage control panel schedules and lighting control sequence of operation schedule for more information.

3.2 Installation

- .1 Install equipment in accordance with manufacturer's installation instructions.
- .2 Provide complete installation of system in accordance with Contract Documents.

- .3 Provide dedicated network between control panels where required.
- .4 Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- .5 Define each dimmer's/relay's load type, assign each load to a zone, and set control functions.
- .6 Mount exterior daylight sensors to point due north with constant view of daylight.
- .7 Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of luminaries.
- .8 Season lamps at full intensity according to lamp manufacturer's recommendation.

3.3 Integrator Control Relay Panels

- .1 Install relay panels adjacent to associated lighting panelboards as indicated on Drawings.

3.4 Switches

- .1 Refer to and comply with Section 26 05 02.

3.5 Testing

- .1 Test entire system for operation from the sensors, switches, telephones and relay panels including all functions and photocell control.

3.6 Training

- .1 Provide training to Owner's personnel, two sessions, four hours each.

3.7 Close Out Activities

.1 On-site Walkthrough

- .1** Lighting control system manufacturer to provide a factory certified field service engineer to demonstrate system functionality to the commissioning agent.

End Of Section

1 General

1.1 Section Includes

- .1 This section includes common requirements for all communication systems.

1.2 Submittals

- .1 Refer to Section 01 33 00 – Submittal Procedures. Submit the following:
 - .1 Shop Drawings:
 - .1 All component types prior to their use on site.
 - .2 Drawing illustrating front elevation of rack layouts prior to assembling said equipment.
 - .3 Drawing illustrating equipment room layouts where different from contract drawings. Identify dimensions of clearances to front, rear and sides of floor mounted components.
 - .4 Drawings illustrating cabling identification scheme prior to use on site.
 - .2 Test reports, submit within three days of testing.
 - .3 Site maintained working progress Drawings for Consultant's review when requested. Site maintained copy of site instructions, change orders, change directives, minutes of site and trades coordination meetings for Consultant's review when requested.
 - .4 Operating and Maintenance Manuals for all communications systems to be combine din master manual as specified in Section 01 78 00.

1.3 Quality Assurance

- .1 These Specifications supplement the Electrical and Electronic Manufacturers Association of Canada, Canadian Standards Association Standards, Electronic Industries Association, Telecommunications Industries Association standards and recommendations. Conditions of the EEMAC, CSA, EIA, TIA and ISO/IEC standards and recommendations apply unless superseded or modified by this Specification.

- .2 Where requirements of the Specifications exceed referenced standards, the Specifications apply. Where standards differ between authorities, the most stringent applies.
- .3 Requirements of the Specifications that are substandard to referenced standards should be brought to the attention of Consultant during bidding period in sufficient time to allow suitable action to be taken and addenda issued as necessary.
- .4 Equipment must be acceptable to electrical inspection authorities.
- .5 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
- .6 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.

1.4 Area Classification

- .1 Garage area: Class 1 Zone 2 within 50 mm above the floor and any pit or depression below floor level.

1.5 Working Drawings and Documents

- .1 Where the word "HOLD" appears on Drawings and other Contract Documents, the Work is included in the Contract. Execute such Work only after verification of dimensions and materials and obtaining Consultant's written permission to proceed.

2 Products

2.1 Manufacturers

- .1 All components comprising the structured cabling channel as defined by TIA 568 by one manufacturer only and under the protection of a single installation and performance warranty.

2.2 Pathways – Hangers and Supports

- .1 Supports for structured cabling to segregate cabling from electrical and mechanical sources of interference or sources of potential damage.

2.3 Open Hook Hangers

- .1 Open hook hangers (J hooks) permitted only in T-bar ceiling area.

2.4 Cable Retention Wraps

- .1 Cable retention wraps not permitted.
- .2 Hard nylon cable retention wraps (tiewrap™) or like products not permitted as communications cable retainers nor permitted to be in direct contact with cable jacket.

2.5 Pathways – Conduits

- .1 Metallic and non-metallic conduit and cable tray per Section 26 05 01 and to TIA 569.
- .2 Flexible conduits at building expansion joints, connections from overhead pull-boxes to furniture access poles, and between wall pass-through boxes and modular systems furniture assemblies.
- .3 Flexible liquid-tight metallic conduit for isolation and protection of communications cables between outlet boxes and enclosed raceways installed below access floors in areas not designated as a computer room.

2.6 Pathways – Conduit Device Boxes

- .1 Metallic and non-metallic device boxes per Section 26 05 01 and to TIA 569.
- .2 Device boxes of sufficient depth and width to prevent cable curvature in breach of manufacturer's specification for bending radius.
- .3 Device boxes of sufficient capacity to permit storage of cable working allowance without interference to outlets and terminations.

2.7 Pathways – Cable Tray and Cable Runway

- .1 Overhead cable runway in telecommunications rooms and computer rooms.
- .2 Overhead cable tray in finished and unfinished areas.

2.8 Pathways – Ducts

- .1 Underground and buried duct conduit and services per Section 26 05 53 and to TIA 569.
- .2 Ducts installed complete with flexible inner-duct sleeving and marked mule tape.

2.9 Grounding and Bonding

- .1 Comply with grounding and bonding as indicated in the Contract Electrical Drawings.
- .2 Provide technical single point ground as telecommunications systems ground reference.
 - .1 Grounding and bonding system for telecommunications to achieve an independent electrical grounding and bonding scheme separate and isolated from other grounds including building ground, lightning ground, process and controls ground or grounds, with exception that technical ground and electrical safety ground bonded at single point only, being closest to the source of incoming electrical power or as indicated.
 - .2 Technical grounding bus bars in telecommunications rooms, computer equipment rooms, telecommunications carrier building entrance and service rooms.
 - .3 Main technical grounding bus bar(s).
 - .4 Bonding conductors between technical grounding bus bars and main technical grounding bus bar as indicated using conductor of size whichever is greater of #6 AWG or as required by electrical safety code or as indicated on the Contract Drawings.
 - .5 Bonding between main technical grounding bus bar and electrical safety ground.
 - .6 Computer and communications equipment cabinets bonded to technical ground.
- .3 Common Electrical Ground
 - .1 Overvoltage protection building entrance devices bonded to electrical power safety ground.

- .2 Communications metallic conduits, cable trays, cable runways, electrical enclosures, raceways bonded to electrical power safety ground.
- .3 Grounding conductors in buried telecommunications ducts bonded to electrical safety ground.
- .4 Pathways
 - .1 Communications cable tray, cable runway, bonded to electrical safety ground through continuous minimum 10 AWG copper conductor. Bonding at intervals of 2440 mm or less.

2.10 Communications Grounding and Bonding

- .1 Use products that comply with Ontario Electrical Safety Code.
- .2 Pre-Drilled Copper Bus Bar
 - .1 Components complying with BICSI/J-STD-607A and TIA/EIA 607A
 - .2 Telecommunications Grounding Busbar (TGB)
 - .1 Type T-300
 - .1 300 mm TGB -Telecommunications grounding bus bar, 6.5 x 50 x 305 mm, tin plated; six sets holes 6 mm diameter, spaced 16 mm; three sets of 10 mm holes spaced 25 mm, standoff insulators and mounting brackets.
 - .2 Manufacturer:
 - .1 Panduit: GB2B0306TPI-1
 - .2 Hubbell: HBBB14210A
 - .3 Or approved equivalent
- .3 Two-Hole Long Barrel Lug
 - .1 Components complying with BICSI/J-STD-607A.
 - .2 Tin plated long barrel with inspection window to confirm cable insertion; two holes according to NEMA size and spacing.
 - .3 Manufacturer:
 - .1 Panduit.
 - .2 Hubbell

.3 Or approved equivalent

2.11 Pathways for Communications Systems

.1 General

- .1 Refer also to Section 27 11 00 – Communications Equipment Room Fittings.
- .2 Refer also to Section 26 05 01 for rigid overhead cable tray.
- .3 Use approved electrical raceways described elsewhere in this Specification with the addition of items described herein.

.2 Cable Hangers and Supports

- .1 For use only where expressly indicated as permitted.
- .2 Cable supports of open hook construction (J hooks) with 54 mm wide cable bearing surface curved with radius greater than minimum required by supported cable.
- .3 Listed manufacturers and products:
 - .1 Panduit: JMH2-X
 - .2 Erico
 - .3 Or approved equivalent
- .4 Cable retention wraps, soft, reusable hook-and-loop tie, coloured to match colour code indicated. Plenum rated.
 - .1 Panduit: HLTP and HLSP series
 - .2 Or approved equivalent
- .5 Nylon cable retention wraps (Tiewraps™) not permitted.

.3 Conduit Guard

- .1 Plastic protection press-on bushings to suit EMT and rigid galvanized steel conduit; size to suit conduit to maximum 103 mm diameter. Suitable for use in air supply or return plenum spaces.
- .4 Flexible corrugated non-metallic conduit of nominal inside diameters 25 mm, 32 mm in fire ratings FT4, FT6.
 - .1 Manufacturers:
 - .1 A-D technologies
 - .2 Premier

- .3 Or approved equivalent
- .5 Flexible fabric thin wall inner duct sleeve white with colour identification stripe including pull tape in 1-, 2-, 3-cell on micro-cell format. Fire ratings of normal, riser and plenum with optional copper 18 gauge tracing strips.
 - .1 Listed manufacturer and products:
 - .1 Max cell
 - .1 3-cell: 103 mm MXC4003XX series
 - .2 3-cell: 78 mm MXC3456XX series
 - .3 2-cell: 53 mm MXC2002XX series
 - .4 Micro 2-cell: 27 mm MXCM3302XX series
 - .2 Or approved equivalent
- .6 Flexible Liquid-Tight Metallic Conduit
 - .1 Corrugated heavy gauge electro galvanized flexible steel strip helically wound conduit with integral copper bonding wire and PVC jacket, colour blue or grey in nominal inside diameter sizes 21 mm, 25 mm, 32 mm , with fire ratings FT4, FT6, to CSA C22.2 No. 0.3.
 - .2 Manufacturers:
 - .1 Delikon, Type YF-604
 - .2 Or approved equivalent
- .7 Flexible Metallic Conduit
 - .1 Corrugated heavy gauge electro galvanized flexible steel strip helically wound conduit with integral copper bonding wire in nominal inside diameter sizes 21 mm, 25 mm, 32 mm.
 - .2 Manufacturers:
 - .1 Delikon, Type YF-504
 - .2 Or approved equivalent

2.12 Underground Ducts and Raceways For Communications

- .1 Comply with Section 26 05 53.
- .2 Rigid PVC Conduit
 - .1 Rigid PVC conduit manufactured to CSA C22.2 No. 211.2
 - .1 Rigid PVC fittings, long sweep bend

- .3 Rigid Ferrous Metal Conduit With PVC Coating
 - .1 Rigid ferrous metal conduit to CSA C22.2 No. 45-M with PVC coating to nominal thickness of 1.02 mm conforming to NEMA publication RN1-1998
 - .1 Matching rigid ferrous metal PVC coated fittings and couplings; matching long sweep bends
- .4 Underground Enclosure
 - .1 Precast polymer concrete underground enclosure
 - .1 Precast polymer concrete enclosure reinforced with glass fibre, to 20,000 pound loading application, open base, tamperproof cover locks
 - .2 Width: 305 m square; depth: 457 mm, 609 mm, 913 mm
 - .3 Manufacturers:
 - .1 Synertech
 - .2 Or approved equivalent

3 Execution

3.1 Dimensions and Quantities

- .1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to Shop Drawings and field measurement.
- .2 Quantities or lengths indicated in any of the Contract Documents are approximate only.
- .3 Make necessary changes to routing of cables and the like to accommodate structural, mechanical, electrical and architectural conditions. Coordinate with other trades and make allowance for conditions that will arise from work in progress under separate contract.
- .4 Plan cable pathway routing to ensure compliance with cable performance specifications, reference standards, and to avoid electromagnetic interference effects.
- .5 Report to the Consultant immediately upon identification of any condition that may result in the performance criteria of the cabling being compromised.

- .6 Install measuring tape for full length of communications pathways in those pathways approaching cable performance distance limits. Measure length and confirm that distance limits are not exceeded.
- .7 Mark up areas on communications rooms backboards to indicate locations for installation and mounting of communications terminal blocks, security, related devices and electronic equipment, public address and paging, related equipment and terminal blocks and areas allocated for public carrier for over voltage protection devices, demarcation terminal blocks and CATV distribution and amplification devices. Use removable tape to prepare proposed layout for Consultant's review. Overlay with black permanent marker after review by Engineer.

3.2 Communications Grounding and Bonding

.1 General

- .1 Install grounding and bonding to comply with Ontario Electrical Safety Code and all applicable codes.
- .2 Install inside grounding cables and conductors in electrical raceways, cable trays, cable runways, or in rigid PVC conduits as indicated. Install outside grounding cables and conductors in PVC rigid conduit or direct buried as indicated.
- .3 Install inside grounding to comply with BICSI/JSTD-607-A, TIA-607 and BICSI published Telecommunications Design Methods Manual.
- .4 Install outside grounding to comply with BICSI published Customer Owned Outside Plant Manual (latest edition).

.2 Bus Bars

- .1 Mount bus bars insulated from building ground and in locations and at elevations indicated.
- .2 Mount horizontally with fasteners able to resist axial pull of 50 kgf.
- .3 Ensure clearance of 50 mm from other metallic objects including components of dissimilar grounding systems.

.3 Enclosures

- .1 Bond communications enclosures only to telecommunications ground bus bar. Do not bond directly to electrical safety ground.

- .2 For arrays of four or fewer communications cabinets, connect individual #6 grounding cables between technical grounding bus bar and individual communications cabinets.
- .3 For arrays of five or more communications cabinets, connect individual #6 grounding cables between individual cabinets and a common #2 AWG insulated aisle ground cable using crimp taps. Connect aisle ground cable to technical ground bus bar using two-hole long barrel lug with window.
- .4 Communications Shields
 - .1 Bond communication shields to technical ground at both terminations when sharing a common single point ground system. Bond communications shield to technical ground at termination distant from work area outlets when terminations do not share a common ground system.
 - .2 Make grounding connections to telecommunications cable conductive shields as indicated, using components designed for purpose and following manufacturer's instructions.
 - .3 Protect finished communications grounding against making unwanted connections to dissimilar grounding systems.
- .5 Flexible Conduits
 - .1 Bond armour and bonding wire to ground through manufactured conduit accessories.

3.3 Electrical Safety Ground

- .1 Bond electrical conduit for telecommunications, cable trays for telecommunications, cable runways directly to electrical safety ground. Do not bond directly to technical ground.
- .2 Bond main technical ground bus bar to electrical safety ground.

3.4 Pathways for Communications Systems

- .1 General
 - .1 Pathways laid out and installed to comply with latest release of ANSI/TIA 569.

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- .2 Pathways run lengths to comply with latest release of ANSI/TIA 568. Notify Engineer in event of any inside path length exceeding 90 m.
 - .3 Inside pathways installed parallel or perpendicular to building lines.
 - .4 Submit drawings of proposed installation, and indicating deviation from cable routing shown on drawings to the Engineer for review prior to commencing installation.
 - .5 Maintain minimum clearances measured from any point of the communications system to any point on the outer container of electrical and heat sources.
 - .1 Unit substations 10 m
 - .2 Power transformers enclosure (greater than 30 kVA) 10 m
 - .3 Transformers enclosures (up to 30 kVA) 1.2 m
 - .4 Motors casings (greater than 1 HP) 10 m
 - .5 Motors casings (up to 1 HP) 1.2 m
 - .6 Switch gear enclosures (greater than 600V) 10 m
 - .7 Feeder cable / conduit (600V and above) 1 m
 - .8 Distribution cable / conduit (less than 600V) 750 mm
 - .9 EMT conduit (enclosing 30A branch circuits) 300 mm
 - .10 ENT conduit (enclosing 30A branch circuits) 450 mm
 - .11 AC90 cable (enclosing 30A branch circuits) 450 mm
 - .12 EMT conduit (enclosing 20A branch circuits) 75 mm
 - .13 ENT conduit (enclosing 20A branch circuits) 150 mm
 - .14 AC90 cable (enclosing 20A branch circuits) 150 mm
 - .15 EMT conduit (enclosing 15A branch circuits) 65 mm
 - .16 ENT conduit (enclosing 15A branch circuits) 100 mm
 - .17 AC90 cable (enclosing 15A branch circuits) 100 mm
 - .18 Control cabling (in separate conduit) zero
 - .19 Control cabling (exposed) 100 mm
 - .20 Class 2 wiring (in separate conduit) zero
 - .21 Class 2 wiring (exposed) 100 mm
 - .22 Conduit (all others) 75 mm

- | | | | |
|--|-----|-------------------------------|--------|
| | .23 | Fluorescent luminaires | 600 mm |
| | .24 | Pipes (gas, oil, water, etc.) | 300 mm |
| | .25 | HVAC (equipment, ducts, etc.) | 150 mm |
- .2 Cable Protection
- .1 Provide protective cable sleeving to prevent damage to cables at transition from cable tray, conduit, pull box, junction box, maintenance hole, pull point. Provide sleeve to reduce friction, bending and crushing forces. Install split sleeve where impracticable to install solid.
- .3 Cable Hangers and Supports
- .1 Where expressly indicated, support cables by use of cable hangers. Space hangers at maximum 1 m separation.
- .2 Limit cables to twenty-four per hanger.
- .3 Apply cable retention wraps without causing tension, pressure or other deformation of cable and cable bundles. Complete wrap with 100 mm overlap. Spacing between wraps not more than 1.2 m except for cables in horizontal cable tray. Avoid wrapping cables in bundles in horizontal sections of cable tray. Secure cables in bundles in vertical portion of cables tray with supports at spacing of not more than 600 mm. Place and secure cables in tray to prevent edges pressing against cable jacket.
- .4 Do not use nylon cable retention wraps (Tiewraps™) for cable retention.
- .4 Conduit
- .1 Extend distribution and backbone conduit to cable tray.
- .2 Form field-formed raceway to comply to TIA 569 specifications.
- .3 Fit conduit guard bushings on each exposed entrance to conduit raceway.
- .4 Field form 'gooseneck' bends in conduit where surface run conduit changes direction to penetrate a wall or partition at 90 degrees. Assume the gooseneck bend includes 180 degrees of bending.
- .5 Innerduct Sleeving

- .1 Provide and install flexible corrugated non-metallic conduit for protection against abrasion and bending, and as protection of optical fibre cables in open cable tray. Colour: orange except black or grey where indicated; inside diameter: 25 mm except 32 mm where indicated; fire ratings: FT6 except FT4 where indicated.
- .2 Provide and install flexible fabric low friction pre-lubricated inner duct sleeve in all backbone conduits, and in conduits intended to carry backbone cabling, and in all conduits below grade and also where indicated. Colour coded, with pre-installed pulling tape; electrically traceable where indicated.
 - .1 3-cell construction for installation in 103 conduits
 - .2 3-cell construction for installation in 78 conduits
 - .3 2-cell construction for installation in 54 conduits
 - .4 Micro 2-cell construction for installation in 27 conduits
- .6 Flexible Conduit
 - .1 Install flexible non-combustible metallic liquid-tight conduit below access flooring as pathway between communications raceways and individual outlet device boxes.
 - .2 Install conduit of trade size as indicated on the Drawings or described in the Specification or 21 mm diameter whichever is the greatest.

3.5 Underground Ducts and Raceways

- .1 General
 - .1 Clean out each section of duct by pulling a steel wire brush and mandrel of the correct size through the duct before pulling cables.
 - .2 Notify the Engineer if immovable obstructions are encountered when cleaning existing ducts.
 - .3 Protect cable at entry and exit from ducts by flexible corrugated non-metallic conduit.
 - .4 Install pull string with length markers ("mule tape") in each duct and in each inner-duct where applicable.
- .2 Cable Placement in Underground Ducts

- .1 Pull cables in underground ducts in continuous length, without splicing.
- .2 Install cables in lower ducts first, leaving upper ducts for future; install cables in inner-ducts where provided.
- .3 Apply only manufacturer recommended or approved lubricant to cables to reduce friction between the cable and the duct.
- .4 Apply cable grips with ball bearing swivel to the cable sheath or strength members to avoid applying tensile force directly to conductors or fibres when pulling cables.
- .5 Station personnel at each access point to observe and lubricate the cables during pull.
- .6 Provide cable slack at manholes for expansion and contraction; mount with clips to prevent sagging.
- .7 Submit tension pulling calculation prior to installation of cables to Consultant for review.
- .8 Monitor cable pull tension during installation. Do not exceed maximum tensile rating of cables.
- .9 Avoid bending cables to a radius less than manufacturer's recommendation, or 10 times the cable outside diameter, whichever is the greater.
- .10 Where cable is pulled through a distance of greater than 30 m or through a pathway containing more than one ninety degree bend, use a dynamometer to record installation tension and a tension limiting device to prevent exceeding the maximum pulling tension specification during installation. Set the tension limit at or below the manufacturer's maximum limit. Take up the cable at intermediate pulling points with an intermediate cable take-up device reviewed by the Consultant.
- .11 Make cable pulls continuous and steady between pull points. Avoid interruptions to the pull unless necessitated by excessive tension on the cable.
- .12 Seal duct entrance into buildings with duct sealing compound to prevent the ingress of moisture, foreign materials and rodents.

End Of Section

1 General

1.1 Section Includes

- .1 Identification requirements for communications system equipment.

2 Products

2.1 Manufacturers

- .1 Furnish or install Products manufactured by stipulated manufactures where so indicated on the Contract Documents.
- .2 Avoid use of Products by manufacturers not stipulated on the Contract Documents.
- .3 Occurrence of Products in these Specifications other than those stipulated for use is not to be interpreted as authorization to use such Products.

2.2 Wrap-Around Colour Identification Markers

- .1 Coloured Metallic Cable Ties
 - .1 Coloured aluminum cables ties
 - .1 Width: 8 mm
 - .2 Lengths 140 mm, 201 mm, 362 mm to suit cable or conduit diameters of 25 mm, 51 mm, 102 mm
 - .3 Colours: Blue, green, red, yellow, black, clear aluminum
 - .2 Listed manufacturers and representative products:
 - .1 Panduit: MLT1H-LPAL, MLT2H-LPAL, MLT4H-LPAL etc.
 - .2 Accepted equal
- .2 Coloured Hook and Loop Non-Metallic Cable Ties
 - .1 Coloured non-metallic cables ties, adjustable and reusable, hook-and-loop material, -18C to 104C
 - .1 Widths 8.4 mm, 13 mm, 19 mm
 - .2 Lengths 150 mm, 300 mm, 457 mm

- .3 Colours: Black, red, orange, yellow, green, blue, grey, white
 - .2 Listed manufacturers and representative products:
 - .1 Panduit: HLT2I-X0 etc.
 - .2 Accepted equal
- .3 Electrical Colour Coding Tape
 - .1 PVC backing, 0.178 mm thick indoor outdoor suitable, pressure sensitive rubber adhesive, coloured, fade resistant, abrasion and weather resistant, to CSA C22.2 No 197-M1983
 - .1 Widths: 13 mm, 19 mm
 - .2 Colours: Black, brown, red, orange, yellow, green, blue, grey, white, violet
 - .2 Listed manufacturers and representative products:
 - .1 Scotch 35 vinyl electrical colour coding tape
 - .2 Accepted equal

2.3 Labels

- .1 General
 - .1 Use products that comply with TIA-606A and CSA-T528.
 - .2 Prepare labels by use machine printing. Avoid use of handwritten labels.
 - .3 Manufacturer: same as original equipment supplier otherwise Panduit.
- .2 Cable Labels
 - .1 Self-adhesive, self-laminating material, white engrave area.
 - .2 Minimum two times full wrap-around cable.
- .3 Faceplate Labels
 - .1 Labels to suit selected faceplate.
- .4 Grounding Bus Bars
 - .1 Self-adhesive, white engraved areas, minimum size 25 x 50 mm, characters minimum height 12 mm.

.5 Patch Panels

- .1 Self-adhesive, white engraved areas to suit selected patch panel or termination strip.

.6 Rack and Cabinets

- .1 Self-adhesive, white engraved areas, minimum size 50 x 75 mm, characters minimum height 12 mm.

2.4 Standard Marking Colours

- .1 Coloured marking using standardized colours consisting of the following Pantone reference colours or the indicated commercial equivalent:

- .1 Red: Pantone 186C or 184C
 - .3 Benjamin Moore: 133-20
 - .4 Armour coat: Fire Red 98-4748-6
- .1 Blue: Pantone 300C or 291C
 - .1 Benjamin Moore: 133-33
 - .2 Armour coat: Commodore Blue 98-4745-2
- .2 White: Pantone White C
 - .1 Benjamin Moore: 133-01
 - .2 Armour coat: Gloss White
- .3 Orange: Pantone 166C or 150C
 - .1 Benjamin Moore: 007
 - .2 Armour coat: Zesty orange
- .4 Yellow: Pantone Yellow C or 101C
 - .1 Benjamin Moore: 133-12
 - .2 Armour coat: Holland Yellow
- .5 Green: Pantone 336 or 353C
 - .1 Benjamin Moore: 133-40
 - .2 Armour coat: Shutter Green
- .6 Brown: Pantone 478C or 465C
 - .1 Benjamin Moore: 133-60
 - .2 Armour coat: Havana Brown

- .7 Black: Pantone Black C
 - .1 Benjamin Moore: 133-80
 - .2 Armour coat: Gloss Black
- .8 Purple: Pantone 257C or 264C
 - .1 Benjamin Moore: 1396
 - .2 Armour coat: N/A
- .9 Grey: Pantone 422C
 - .1 Benjamin Moore: not specified
 - .2 Armour coat: not specified

2.5 Paint

- .1 Treat as shop primed ferrous metal - alkyd finish.
 - .1 One coat alkyd, paint code 48, gloss enamel
 - .2 Paint code: 48 - interior alkyd gloss enamel: Conforming to CAN/CGSB-1.60-M; Benjamin Moore 133, ICI Devoe 4308 Series, Para 400, PPG 6-282, Sherwin Williams B35-200 Series or Sico 888-111.

3 Execution

3.1 Installation – General

- .1 Label cables, cords, power strips, cabinets, electrical raceways, grounding conductors, outlets, faceplates, firestops in accordance with latest revision of TIA-606 and as described on the Contract Drawings and herein.
- .2 Identify conduits, electrical raceways, pullboxes, junction boxes, for communications according to the colour scheme indicated on the Contract Drawings and herein.
- .3 Identify cables, outputs, faceplates, jacks, grounding components and cabinets for communications according to the labelling and identification scheme indicated in the Contract Drawings and herein.
- .4 Use cables, jacks, cords, icons, manufactured in the colours identified in the Contract Drawings and herein.

- .5 Use the identification scheme as indicated.
- .6 Prepare a sample printed copy of the identification labels and submit to the Consultant for review.

3.2 Colours

- .1 Use components in the colour as indicated.

3.3 Labeling

- .1 General
 - .1 Apply labels so that the printed information may be read without the need to disturb the cables.
 - .2 Apply labels on cables as close to the end of the cable jacket as practicable and no closer than 10 mm and not concealed by obstructions.
 - .3 Apply labels on jacks, faceplates and patch panels in the manner prescribed by the original equipment manufacturer.
 - .4 Apply more than one label where immediate obstructions may prevent ease of reading the prescribed label.
 - .5 Apply a label on the inside of the electrical device outlet box corresponding to each cable terminated on the face plate mounted on the device box.
 - .6 Use only approved cable marking materials.
 - .7 Clearly identify all outlets, patch-panels, patch-cords, cables, racks enclosures, spaces, closets, conduit, and raceways according to the administration system shown on the Contract Drawings.
 - .8 Use only machine printed labeling for outlets.
 - .9 Use only engraved plastic plates for the labeling of enclosures and racks.
- .2 Horizontal Distribution Cabling
 - .1 Use the identification scheme as stipulated in the Contract Documents.

- .2 Scheme:
 - .1 Generic horizontal cabling
 - .1 Where an outlet is tagged on the Contract Drawings as "V/D", designate one jack as Voice, the other jack as Data.
 - .2 Identifier scheme template: V-nnn or D-nnn
 - .1 Where an outlet is tagged on the Contract Drawings as "V", designate the jack for Voice (telephone) service.
 - .2 Where an outlet is tagged on the Contract Drawings as "D", designate the jack for Data service.
 - .3 nnn – consecutive cable ordinals to identify each cable with a unique identifier. Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification within new or with existing cabling.
 - .3 Telecommunications room horizontal cable patch panel termination.
 - .1 Label the data termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally left to right, and progressing vertically as each row of jacks is completed.
 - .2 Label the cable at the patch panel with the same identification as the jack to which the cable is connected.
 - .4 Cable count ordinals
 - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling, padded left to three characters using zero and the pad character.

.5 Work area outlet

- .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.

.3 Connecting Cords

- .1 Do not label connecting cords.

3.4 Communications Pathway Identification

.1 General

- .1 Identify only those communications conduits used for backbone cabling.
- .2 Identify communications ducts.
- .2 Mark surface mounted metallic or non-metallic conduit raceways by use of combination of coloured couplers and painted stripes, electrical identification plastic tape, or wrap-around markers.
- .3 Do not identify surface raceways mounted below ceiling line in finished areas. Do not apply colour code identifier markings to outlet faceplates.
- .4 Identify raceways at termination of raceway and transition to other raceways or enclosures. Apply markings on each side of transit through architectural partitions or floors or ceilings.
- .5 Employ system colours as indicated in table below.
- .6 Apply a small area of paint to inside of outlet, junction and pull boxes.
- .7 Apply identifying mark as paint to full surface of junction box and pull box cover panels for boxes of 150 x 150 mm or smaller.
- .8 Apply identifying mark as stripe for junction and pull boxes greater than 150 x 150 mm.
- .9 Use wrap around identification bands to identify conduit where painting is impracticable or prohibited or has potential to damage cabling or adjacent materials. Avoid obscuring labels. Avoid obscuring inspection windows.

- .10 Use wraparound identification bands to identify exposed communications cabling according to system where indicated on the Drawings.
- .11 Apply one or more markings per the table below as indicated in the Contract Drawings.
- .12 Apply a base mark of minimum 19 mm wide. Where indicated, apply stripes of minimum 8 mm maximum 12 mm each. Apply marking with separation of 12 mm to 20 mm between adjacent bands. Apply the base marking band nearest to the junction of the conduit with the junction box, outlet box or pull box.
- .13 Use the following system colours

System	Base colour	1 st stripe	2 nd stripe
Communications	blue		
Communications – backbone	blue	blue	
Communications – backbone – copper (public)	blue	blue	green
Communications – backbone – copper (private)	blue	blue	blue
Communications – backbone – fibre (public)	blue	blue	orange
Communications – backbone – fibre (private)	blue	blue	yellow
Communications – distribution	blue	green	
Communications – distribution – copper	blue	green	green

Communications – distribution – fibre	blue	green	orange
Security	green		
Security – access control	green	yellow	
Security – intrusion detection	green	yellow	green
Security – CCTV	green	blue	
Security – magnetic locks	green	red	
Security – duress alarms	green	red	green
Fire alarm	red		
Fire alarm – speakers	red	white	
Fire alarm – telephone	red	blue	
Distributed communications	white		
Distributed communications – intercom	white	brown	
Distributed communications – PA	white	white	
Distributed communications – AV	white	white	green
Distributed communications – radio	white	green	
Distributed communications – CATV	white	blue	

End Of Section

1 General

1.1 Section Includes

- .1 Requirements for commissioning and testing of communication systems..

1.2 Related Sections

- .1 Section 01 33 00 Submittal Procedures

1.3 Submittals

- .1 Submit test reports for review by Consultant. Include in Operating and Maintenance Manual. Comply with Section 01 33 00.
- .2 Submit test data in a machine readable format approved by the Consultant. Submit a "reader" program designed and as required for use with the test data file.
- .3 Submit a hard copy version of each test report. Use two-sided printing where practicable.
- .4 Submit a PDF (portable document format) version of each test report.
- .5 Submit a summary report for each copper cable indicating pass/fail and length for each cable tabulating each result by cable number.
- .6 Submit a summary report for each optical fibre strand indicating insertion loss for each strand tabulating each result by cable sheath and strand number.
- .7 Submit detail test results for all copper and optical fibre cables including backbone and distribution communications cables.
- .8 Deliver reports on a CD/DVD or USB flash drive.

1.4 Test Reports

- .1 For each check and test performed prepare and submit a test report, signed by the test engineer, and where witnessed, by the Consultant.
- .2 Test reports to include a record of all tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test engineer, witnesses, also calibration record of all test

instruments used together with manufacturers name, serial number and model number.

- .3 Calibration record to include performance level of test equipment.
- .4 Tests performed with instruments that have not been calibrated or certified as fit for purpose within twelve months preceding the date of use may be rejected at sole discretion of the Owner.
- .5 Undertake either full or sample testing daily and have reports available for review by the Consultant as an assurance that standards of working practices are being maintained.
- .6 Complete test records and certification of such records prior to project cutover or beneficial use of the facility by Owner.
- .7 Configure the test equipment according to the cable under test. Install Product specific parameters.

1.5 Manufacturer's Attendance

- .1 Provide manufacturer's representatives to verify installation practices for each part of the Work as may be relevant to all components including wiring and terminations.

1.6 Field Inspection

- .1 Provide field engineer for inspection and certification of facilities during installation, testing and commissioning as required.
- .2 Concurrent with testing, perform visual inspection of all exposed cable to verify compliance with bend radius protection, sheath protection and protection against harsh environment.
- .3 Perform visual verification that all cables, outlets, jacks and patch cords are labelled according to this Specification. Confirm that cable numbers and jack numbers align.
- .4 Prepare and submit to the Consultant, summary report attesting to the findings of the field inspection.

1.7 Quality Assurance

- .1 These Specifications supplement the Electrical and Electronic Manufacturers Association of Canada, Canadian Standards Association

Standards, Electronic Industries Association, Telecommunications Industries Association standards and recommendations. Conditions of the EEMAC, CSA, EIA, TIA and ISO/IEC standards and recommendations apply unless superseded or modified by this Specification.

- .2 Where requirements of the Specifications exceed referenced standards, the Specifications apply. Where standards differ between authorities, the most rigid applies.
- .3 Requirements of the specifications that are substandard to referenced standards should be brought to the attention of Consultant during bidding period.
- .4 Where any part of the Work fails tests or fails visual inspection, replace the defective material.
- .5 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.
- .6 Identify and indicate in the test results, the type/style/category/product number of cables under test.
- .7 At the reasonable discretion of the Consultant, replace cable or cabling components that fail performance tests, or fail to comply with work practices described in TIA and BICSI published standards and with practices published by the vendor of cabling used on the Project. Make these replacements at no cost to the Project, not in material cost, nor labour charges nor in delays incurred to make such replacements.

2 Products

2.1 Test Instruments

- .1 Use only one style of test instrument for all measurements; use instruments of only one manufacturer for all measurements.
- .2 Use instruments manufactured by one of the following:
 - .1 Agilent
 - .2 Fluke

3 Execution

3.1 Material Acceptance

- .1 Perform OTDR and flux loss measurements on optical fibre cable after delivery to Site and before installation. Prepare summary report and submit as a Shop Drawing to the Consultant for review. Reject material which fails performance tests or appears physically damaged.
- .2 Perform visual inspection tests on communications cables after delivery to Site and before installation. Reject material which fails performance tests or appears physically damaged.
- .3 Perform full performance testing on samples removed from each spool of communications cable after delivery to site and before installation. Submit the test results to the Consultant for review as a Shop Drawing. Record the manufacturer's production data as imprinted on the cable sheath. Use a cable sample of physical length 50 meters \pm 500 mm. Retain sample for further testing until after Shop Drawings are returned as "Reviewed as Submitted".

3.2 Testing and Repairing

- .1 Test horizontal and backbone copper cables according to the following criteria:
 - .1 For cables up to and including category 3, test all pairs of each horizontal and backbone cables for continuity, short circuits, open circuits, continuity to ground, correct polarity, length, attenuation and near end crosstalk to a minimum of 16 MHz. Perform tests in accordance with TIA 568B.
 - .2 For category 5, and 5e cabling, test all pairs for continuity, short circuits, open circuits, continuity to ground and correct polarity. Test each cable for length, attenuation, near end crosstalk, far end cross talk, delay, delay skew to a minimum of 350 MHz. Perform tests in accordance with TIA 568B.
 - .3 For category 6 cabling, test all pairs for continuity, short circuits, open circuits, continuity to ground and correct polarity. Test each cable for length, attenuation, near end crosstalk, far end cross talk,

- delay, delay skew to a minimum of 650 MHz. Perform tests in accordance with TIA 568B.
- .4 For category 6A cabling, test all pairs for continuity, short circuits, open circuits, continuity to ground and correct polarity. Test each cable for length, attenuation, near end crosstalk, far end cross talk, delay, delay skew to a minimum of 1000 MHz. Perform tests in accordance with TIA 568B.
 - .5 For category 6A cabling, and on request of the Consultant, conduct tests to 1000 MHz for alien cross talk measurements on an audit basis as per TIA 568 B2-10 on two samples of 6-around-one cable sets selected by the Consultant.
 - .6 Test coax cabling for center conductor continuity, shield continuity, impedance (75 ohms), and attenuation to limits dependent on the application as described in TIA 942-1.
- .2 Test optical fibre cable according to the following:
- .1 Test every fibre of each cable with an Optical Time Domain Reflectometer (OTDR) for length and attenuation. Include a hard copy chart recording with the test documentation.
 - .2 Test every fibre of each cable with a power meter/light source combination in both directions. Tabulate and include test results with the test documentation.
 - .3 Multi-mode fiber
 - .1 Perform factory tests for loss measurements at 850 nm and 1300 nm in both directions using a source and power meter calibrated at these wavelengths. Perform the tests using an LED source. Comply with procedures described in FOTP-171 methods A1 or D1, or FOTP-34 method A2. Archive measurement results electronically showing pass/fail results measured using limits provided in TIA 568-C.3 and deliver with viewer/reporting software.
 - .2 Perform testing with an OTDR using a launch fiber at both ends. Submit OTDR trace data along with a viewer program. Submit OTDR event table showing reflective events with an absolute value less than 50 dB return loss

and non-reflective events with a loss value greater than 0.1 dB.

.4 Single mode fiber

- .1 Perform tests for loss measurements at 1310 nm and 1550 nm in both directions using a source and power meter calibrated at these wavelengths. Comply with procedures described in FOTP-171 methods A3 or D3, or FOTP-34 method B. Measure against limits provided in TIA-568-C.3. Archive measurement results electronically and show pass/fail results delivered with viewer/reporting software.
- .2 Perform testing with an OTDR using a launch fiber at both ends. Submit OTDR trace data along with a viewer program. Submit OTDR event table showing reflective events with an absolute value less than 50 dB return loss and non-reflective events with a loss value larger than 0.1 dB.
- .3 For single mode fiber runs longer than 5 km deployed for 10 Gbps or higher rates, measure chromatic dispersion showing absolute dispersion at 1550 nm and polarization mode dispersion. Record and submit results for these fibers in addition to the tests above.

End Of Section

1 General

1.1 Section Includes

- .1 Fittings for communications equipment room.

1.2 Related Requirements

- .1 Section 27 05 00, Common Work Results for Communications

1.3 Quality Assurance

- .1 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
- .2 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.
- .3 Manufacturer's Attendance
 - .1 Provide manufacturer's representatives to verify installation practices for each part of the Work as may be relevant to all components including wiring and terminations.
- .4 Field Inspection
 - .1 Provide field engineer for inspection and certification of equipment during installation, testing and commissioning as required.

1.4 Area Classification

- .1 No area in the Work is classified as hazardous.
- .2 Refer to all related Drawings and Specifications in the Contract Documents.

1.5 System Description

- .1 Fittings to effect fully functional telecommunications equipment room(s).

- .2 Cabinets, racks, frames and enclosures as secure and managed spaces for communications equipment, computer equipment, communication cabling terminations and power distribution strips, bars and accessories, seismic restraints in accordance with the National Building Code, part 4.1.8.17.
- .3 Miscellaneous structural supports, braces, rods and brackets necessary for suspension, attachment or support of communications cabinets, racks, frames and enclosures except as indicated otherwise.
- .4 Free standing cabinets and frames to sustain seismic action to seismic classification of installed location.
- .5 Equipment cabinets and frames to accommodate equipment by class or type.
- .6 Cabling terminations and patch panels.
- .7 Supports for networking and systems electronic equipment.
- .8 Supports for server and storage equipment.
- .9 Cabling termination blocks, patch panels, as components of a complete structured cabling installation:
 - .1 Termination blocks for multi-pair copper backbone cables.
 - .2 Termination blocks for 4-pair backbone cross-over tie lines.
 - .3 Termination panels for backbone optical fibre cabling.
 - .4 Patch panels for horizontal distribution cables and optical fibre cables.
 - .5 Rack mounted cable management systems.
- .10 Overhead ladder racking cable runway support. Provide seismic restraints in accordance with the National Building Code, part 4.1.8.17.
- .11 Rack mounted power distribution and power protection strips for in-rack power distribution, monitoring and control. Mounted vertically and horizontally.

2 Products

2.1 Structured Cabling Systems Vendor

- .1 Termination blocks, patch panels, cables, patch cords, outlet jacks for structured COPPER cabling systems shall be manufactured by Belden furnished under a single manufacturer's warranty.

2.2 Service Entrance Protection Device

- .1 Single Channel
 - .1 Surface mount, discrete, 4-pair format, solid state, 5ns maximum response time, comply with TIA568 performance by indicated category
 - .1 Type P63, Category 6 – 16V and POE
 - .1 16V peak clamping voltage, category 6A specification for use with data channels carrying power over Ethernet
 - .2 Products
 - .1 Systimax CommScope OSP Protection Units
 - .2 Raychem Tyco
 - .3 Or approved equivalent

2.3 Communications Cabinets Racks Frames and Enclosures

- .1 Cabinets are existing.

2.4 Communications Cabinets Racks Accessories

- .1 Cabinets accessories are existing.

2.5 Copper Medium Termination Patch Panels

- .1 Patch panel is existing, with spare room for installation of future jacks.

2.6 Copper Medium Jacks

- .1 UTP 4-pair 8P8C (RJ45) Modular Jack – Keyed
 - .1 Modular plastic formed telecommunications 8-pin 8-conductor ("RJ45") outlet jack, keyed, comply with ANSI/TIA/EIA 568 specification and CSA T529, compatible with rack mount angled

modular patch panels, with colour coded removable identification icon, compatible with shielded panel and shielded cable options; built in modular cable strain relief.

- .2 Pair wiring comply with ANSI/TIA/EIA 568 Specification TIA 568A convention.
 - .1 Pair 1 Pins 4-5 Blue pair
 - .2 Pair 2 Pins 3-6 Orange pair
 - .3 Pair 3 Pins 1-2 Green pair
 - .4 Pair 4 Pins 7-8 Brown pair
- .3 Jack body colour:
 - .1 Voice: White
- .4 Colour-coded icon colour
 - .1 Voice: White
- .5 Jack type
 - .1 U/UTP, Category 6, keyed
 - .1 Belden KeyConnect Modular Jack

3 Execution

3.1 Service Entrance Protection Device

- .1 Install OVP over voltage protection device on backboard within 1 m distance to where the cable come out of the underground conduit

3.2 Termination Panels

- .1 Install jacks and connectors in existing panels.
- .2 Mount wall mounted components on walls as indicated, and following manufacturer's recommendations.

End Of Section

1 General

1.1 Section Includes

- .1 Requirements for communications horizontal cabling.

1.2 Related Requirements

- .1 Section 27 05 00, Common Work Results for Communications

1.3 Reference Standards

- .1 Performance to ANSI/EIA/TIA 568.

1.4 System Description

- .1 Horizontal cabling and connectivity components to effect a fully functional horizontal distribution cabling information transport system.

1.5 Quality Assurance

- .1 Manufacturer's Attendance
 - .1 Comply with Section 27 05 00.
- .2 Field Inspection
 - .2 Comply with Section 27 05 00.

2 Products

2.1 Horizontal Copper Cables

- .1 Unshielded twisted copper 24 AWG 4-paired cables of characteristic impedance 100Ω, EIA/TIA compliant
- .2 Indoor type: 4-pair U/UTP, Category 6, CSA CMR (FT4) rated.
 - .3 Belden GigaFlex Belden 4813LX
 - .1 Cable Jacket color
 - .1 Voice: White
- .3 Outdoor type: 4-pair U/UTP, Category 6, OSP rated.
 - .1 Belden OSP6U

2.2 Jacks

- .1 Modular Jack (8p8c) - 8 Position, - Non-Keyed
 - .1 Modular plastic formed telecommunications 8-pin 8-conductor ("RJ45") outlet jack non-keyed, compatible with flush- and surface-mount telecommunications outlet faceplates, modular furniture faceplate adapters, utility service pole adapter plates, floor box adapter plates, conduit poke-through adapter plates, rack mount modular patch panels, with colour coded removable identification icon, compatible with shielded panel and shielded cable options
 - .2 Jack face parallel with face of faceplate
 - .3 Modular cable strain relief
 - .4 Pair wiring / pinning convention. (TIA-568A)
 - .1 Pair 1 Pins 4-5 Blue pair
 - .2 Pair 2 Pins 3-6 Orange pair
 - .3 Pair 3 Pins 1-2 Green pair
 - .4 Pair 4 Pins 7-8 Brown pair
 - .5 Jack body colour:
 - .1 Voice: White
 - .6 Colour-coded icon colour
 - .1 Voice: White
 - .7 Jack type
 - .1 U/UTP, Category 6, one port
 - .1 Belden GigaFlex PS6+ Module jack

2.3 Telephone Wall Plate

- .1 Stainless steel wall plate with double lug for wall mount telephone instrument attachment.
- .2 Keystone cutout to suit single 8p8c jack.

3 Execution

3.1 General

- .1 Place cable only in conduits and cable tray and other designated cabling pathways. Do not place cable in crevices, cracks or other gaps in the building infrastructure not expressly intended for cabling. Do not run cables on the outside of conduits, or piping, or building supports or anything not intended expressly for communications cables. Use only protected cable pathways such as formed slots, formed sleeves, conduits, cable trays, ducts, raceways and furniture system channels.
- .2 Terminate cables at connectors in work areas and in telecommunications rooms.
- .3 Apply channel identification labels at each end of cable. Comply with Section 27 05 53.
- .4 Record deviation of cabling shown on Drawings in as-constructed Drawings.
- .5 Avoid scraping, denting, crushing, twisting, kinking or otherwise damaging cables, before, during or after installation. Replace damaged cables without cost to the Contract.
- .6 Pull cables in a continuous run. Do not splice horizontal cables.
- .7 Install cables in accordance with manufacturer's specifications. Ensure proper installation techniques are observed and cable maximum pull-force and minimum bend radius specifications are adhered to.
- .8 Protect cables against risk of damage at edges of furniture, cable tray, raceway etc. Install cable in flexible plastic conduit.
- .9 Protect cable at pathway transitions by use of flexible plastic conduit or manufactured "waterfall" elements.
- .10 Neatly bundle, secure cables. Use light pressure soft wraps.
- .11 Bundle and dress cables in groups of twelve or twenty-four, at patch panels and within cabinets. Dress cables neatly and orderly within cabinets. Follow manufacturer's recommended practices to ensure performance compliance.

- .12 Support cables within cabinets at rear of patch panel and at intervals of 450 mm.
- .13 Support vertically placed cables by attaching to a support, firmly attached to the building fabric, at intervals of 600 mm.
- .14 Separate voice and data cables. Separate copper and optical fibre cables.
- .15 Maintain cable clearances as described in Section 27 05 00.
- .16 Do not maintain bundles for distances greater than 1 m in cable trays.
- .17 Pass cables at backboard terminations through holes positioned in the centre of the termination mount.
- .18 Do not exceed manufacturer's recommended bending of cable. Maintain a radius of four times cable diameter or 25 mm for copper UTP or FTP or STP, whichever is the greater. Maintain a radius of ten times cable diameter or 30 mm for optical fibre cables.
- .19 Do not untwisted exposed pairs at terminations for more than 13 mm.
- .20 Bond to ground all metallic cable strength members and metallic sheaths to manufacturer's specifications.
- .21 Where practicable and where the maximum allowable cable length is not exceeded, provide of slack UTP cable and 3 m of slack optical fibre cable at the workstation end of each distribution cable. Neatly coil and store slack in cable tray.
- .22 Where the telecommunications outlet is mounted on a wall box or floor box or system furniture, provide working slack allowance for UTP cable of 3 m. Coil neatly and secure in the outlet box.
- .23 Select least obstructed pathway through modular or system furniture. Where available, use eye-level pathways in preference to base-level pathways.
- .24 Install blank filler plates for all unused modular jack positions on faceplates.
- .25 Install blank cover plates for all unused or abandoned outlet boxes.
- .26 Inform Consultant immediately of any horizontal cable runs exceeding 90 m in length.

3.2 Testing

- .1 Perform pre-installation and post-installation testing.
- .2 Comply with Section 27 08 00.

End Of Section

1 General

1.1 Section Includes

- .1 Communications Connecting Cords and Adapters.
- .2 Cross-connect cables, interconnect cables, and patch-cords.
- .3 Work-area cables.

2 Products

2.1 Manufacturers

- .1 Supply Products only by same manufacturer of selected horizontal cabling systems. Refer to Section 27 15 00.

2.2 Copper Patch-Cords and Cross-Connect Jumpers

- .1 Cross-connect cable 24 AWG solid copper twisted and to performance to match horizontal or backbone cables.
- .2 Patch cords, equipment cables and work area cables 24 AWG stranded conductors and performance to match horizontal cabling.
- .3 Patch-cords factory assembled and tested, not Site prepared.
- .4 Patch-cords of snagless type using either a moulded connector or rubber housing for connector pin.
- .5 Patch-cords in the following colours:
 - .1 White: Voice
- .6 Patch-cords in the following quantities:
 - .1 100% count of total voice outlet jacks at work area (for VoIP phones)
- .7 Patch cord length as follows.
 - .1 1 m (3'-0") at work area

- .8 Type
 - .1 4-pair Cat.6 RJ45-RJ45
 - .2 Products
 - .1 Belden GigaFlex PS6+

3 Execution

3.1 General

- .1 Supply patch cords. Examine factory prepared test report. Verify patch cord complies with performance specification.
- .2 Submit test report to Consultant for review as Shop Drawing.
- .3 Turnover patch cords to owner with transmittal notice. Submit copy of transmittal notice to Consultant for review.

End Of Section

1 General

1.1 Section Includes

- .1 Public address and mass notification system.
- .2 Provide PA horns in the new material storage facility as an expansion of existing public address system
- .3 Provide any other equipment, labour or material necessary to fulfil the functional and performance criteria of the system whether shown in the Specification or Contract Drawings or not.

1.2 Standards and Codes

- .1 Components and system to comply with:
 - .1 Applicable EIA standards
 - .2 CSA C22.1
 - .3 Ontario Electrical Safety Code
 - .4 Ontario Building Code
- .2 Bring to the attention of the Engineer any occurrence where this Specification disagrees with any of the cited or otherwise applicable codes or standards.

1.3 Product Data and Shop Drawings

- .1 Submit product data and Shop Drawings in accordance with Section 01 33 00.
- .2 Submit a riser diagram and block diagram of the complete P.A. and sound system to the Consultant for review prior to commencing installation Work.
- .3 Submit system design criteria to the Consultant for review prior to commencing installation Work.
- .4 Provide functional and wiring diagrams showing all interconnections, within the systems and between this system and other auxiliary systems specified herein.
- .5 Include internal and external component layouts including terminal block locations and numbering, cable numbering and equipment identification.

- .6 Prior to commencement of any work, supply rack layouts, and a detailed block functional diagram of the cable routing to the Consultant for review. No Work shall be done until the Client Representative has reviewed the Contractor's Shop Drawings and review is given.
- .7 The review of the Shop Drawings by the Owner's Representative does not relieve the Contractor of the responsibility to provide a complete and working system, based on the intent outlined in these documents.

1.4 Maintenance and Operation Data

- .1 Provide maintenance manual.
- .2 Include description of system operation.
- .3 Include parts list, using component identification numbers standard to electronics industry.
- .4 Include a priced spare parts list noting address, telephone number and contact name of available Suppliers.

2 Products

2.1 System Criteria

- .1 Public address system to operate on 120 V nominal, 60 Hz input voltage.
- .2 Continuous duty cycle.
- .3 Modular system design.
- .4 Components: solid state, and suitable for 19" rack mounting.
- .5 Maximum operating temperature: 65 °C.
- .6 Maximum rise above ambient: 15 °C.
- .7 Fan cooling of components.

2.2 Performance and Design Criteria

- .1 Use only electronic and electro-mechanical equipment produced by a manufacturer with a minimum five year period of experience producing similar products and who can refer to similar installations now rendering satisfactory service.

- .2 Provide equipment of modular design and solid state devices except for electro-mechanical components.
- .3 Reference to model numbers and other information is intended to establish the standards of performance, quality, and appearance which must be met.

2.3 Equipment Cabinet

- .1 Cabinet is existing.

2.4 IP Paging Unit

- .1 IP paging unit is existing TOA SP-11N.

2.5 Power Amplifiers

- .1 Power amplifier is existing TOA-DA-250FH.
- .2 Provide report on updated channel loading.
- .3 Install horns using not less than #12 AWG conductor cable.
- .4 Install speakers using not less than #16 AWG conductor cable.

2.6 Stereo Preamplifier and Mixer

- .1 Stereo preamplifier and mixer is existing TOA M9000M2.

2.7 Sound Reproducers

- .1 Horn type loudspeakers of medium power capacity with the following features:
 - .1 High efficiency re-entrant horn with minimum 130 degree x 60 degree coverage measured @ 2 kHz centre frequency octave band.
 - .2 Nominal frequency response of 400 Hz to 14 kHz.
 - .3 Maximum low frequency roll off of 200 Hz.
 - .4 Weatherproof horn, non-resonant construction, moulded ABS plastic and structural aluminum, colour grey.
 - .5 Mounting bracket with 180 degree vertical and horizontal range of adjustment. Suitable for box or steel strap mounting.
 - .6 Complete with 70V matching transformer.

- .7 Sensitivity of 116 dBA measured at 1 m on axis at 15W power input.
- .8 Adjustable taps of 1, 2, 3.8, 7.5, 15 watts.
- .9 Maximum power rating 15W RMS.
- .10 Nominal weight 1.8 kg.
- .11 Nominal size of 200 x 220 x 240 mm.
- .12 Nominal size of mounting bracket 75 mm x 75 mm.
- .2 Representative unit and manufacturer for horn type, medium power loudspeakers:
 - .1 TOA SC-615T
 - .2 Approved equivalent

2.8 Microphone and Line Level

- .1 Belden 8451 cable (balanced wire).

2.9 Labels

- .1 Provide labels on cables at each end and where indicated on the Contract Drawings.
 - .1 Label material self-adhesive, self-laminating
 - .2 Marking by machine generated copy, not handwritten
 - .3 Grounding cables labelled to comply with Electrical Safety Code and CSA-T528 or ANSI/TIA/EIA-606
- .2 Provide labels on equipment, junction boxes, panels and enclosures:
 - .1 Laminated plastic
 - .2 Engraved text
 - .3 Minimum character height: 6 mm

3 Execution

3.1 Examination

- .1 Verify site conditions before commencing Work.

- .2 Examine location conditions and submit, in writing to the Consultant prior to proceeding with the Work, justification for deviating from the installation parameters shown on the Drawings, including: mounting height, orientation, power setting, and speaker or horn type, or any other parameter that may be indicated. Make these adjustments only after receipt of approval in writing from the Consultant and at no additional cost to the Owner.
- .3 Confirm that the system specified herein has the capability to meet the design intent, or propose an alternative system, either fully or in part.
- .4 Ambient noise levels are:
 - .1 Office areas: 60 - 65 dBA
 - .2 Light industrial: 80 - 85 dB
 - .3 Heavy industrial: 85 - 88 dB
- .5 Acceptable P.A. system output sound pressure levels are 15 dB above ambient.
- .6 Make adjustments to the design of the system to ensure that the acceptable sound pressure levels are met.

3.2 Installation

- .1 Install equipment in accordance with manufacturer's instructions.
- .2 Install cable in conduit. Provide conduit necessary to install the system to locations required for satisfactory system operation.
- .3 Provide final connection to equipment with wiring installed in flexible conduit, make splices using insulated crimp type sleeves. Make connections to devices having screw terminals with suitable lugs crimped to ends of conductors.
- .4 Provide identification for wiring at outlet boxes and at accessible locations.
- .5 Make final connections under direct supervision of equipment supplier's engineer.
- .6 Use wire marker clearly and permanently marked in a numerical fashion at each end. The numbering scheme shall be carried to the wiring diagrams which are part of the As-Built Drawings.

- .7 Care shall be exercised by the Contractor during installation to avoid damage to cables and equipment. Soldered connections shall be made with rosin multi-core solder. Mechanical crimp connectors may be used in loudspeaker wiring only. Wiring shall be executed in strict adherence to professional practice and standards.
- .8 Install loudspeakers, amplifiers, etc., with suitable fastenings or supports adequately sized to support their loads with a safety factor of at least 3x. Equipment shall be held firmly in place. This includes cable and wire harnesses. No equipment shall be left sitting loose unless so designated.
- .9 Control connectors and custom panels shall be clearly, logically and permanently marked before installation. Suitable means are direct engraving or Brother laminated self-adhesive labels.
- .10 Permanently and clearly mark in a descriptive manner all switches, connectors, jacks, receptacles, outlets, terminal blocks and cable terminals if not already required by other parts of this specification.
- .11 Take the necessary precautions to prevent and guard against electro-magnetic and electrostatic hum, to supply adequate ventilation and to install equipment so as to provide reasonable safety for the operator.
- .12 Exercise care in wiring so as to avoid damage to the cables and to the equipment during and after installation.
- .13 Execute wiring in strict adherence to standard EIA practices. The Contractor shall observe current standards for connecting the shield drain wire of shielded audio cables. Cable shields shall be insulated at their terminated ends with sleeves or heat shrinkable tubing, and shield drain wires shall be protected by a piece of PVC or Teflon tubing from where they exit the jacket of the cable.
- .14 Run microphone and line level circuits up to +10 dBm in one conduit. Install loudspeaker circuits (or those above +10 dBm) in separate conduit(s).
- .15 Space conduits used for sound reinforcement system away from power conduits by 2 m for circuits less than 10 dBm and 1 m for circuits greater than 10 dBm.

- .16 Connect all audio grounds in the equipment rack to a common point on the rack. Connect the rack to a ground point electrically as close as possible to ground.

3.3 Field Tests and Inspection

- .1 Completely test the system upon completion of the installation. The criteria of this section shall be followed. Document test results and submit to the Consultant.
- .2 Identify rattles, buzzes and other noises produced due to improper mounting by connecting a sine wave generator to the sound system and adjusting the output to produce a sound pressure level of 85 dB SPL (average). Slowly sweep a sine wave signal from 300 Hz to 4 kHz to check for resonances and vibrations. Any defects must be corrected.
- .3 The gain structure of the completed sound system must be optimized for maximum signal to noise, and minimum distortion. Any residual noise in the completed system shall be of a random nature. The residual noise in the system shall be below audibility when the served area is unoccupied.
- .4 Using a one octave bandwidth of pink noise centred at 500 Hz and then 4 kHz, the sound pressure shall be adjusted to a level at least 6 dB above the ambient noise level in the room. Using the pink noise as a source, adjust the system for an average of 90 dB SPL throughout the room. Measure and record reading at ten locations to verify a deviation throughout the coverage area of no greater than ± 2 dB, band limited to 400 to 4 kHz.
- .5 Subjective listening tests shall be conducted and shall verify a uniformity of system performance through the room, with clear intelligibility in the spoken word.
- .6 Establish and record the normal settings for all level controls on rack and box mounted equipment for optimum signal-to-noise ratios and signal balance.
- .7 Perform tests and demonstrate the communication system.
- .8 Verify that all equipment is properly installed and secured in place, ensure that all warning labels, covers, etc. are in place. Verify that all wiring is

complete and free of all hazards and unintentional shorts. Ensure that all grounding is complete.

- .9 Test all components of the system individually as per suppliers recommendations. Test each individual zone and demonstrate that the features specified are satisfactorily performed. Conduct intelligibility tests and record sound levels obtained. Make adjustments to sound source equipment and properly align and adjust sound signalling appliances for optimum clarity and audibility of messages and music. After each zone is tested and found acceptable conduct an all-call and confirm the same quality of intelligibility is provided to all areas.
- .10 Tests shall be conducted while the facility is vacant and repeated when occupied.
- .11 Repeat testing at 90 days after satisfactory acceptance. Make any additional adjustments, re-alignment of horns, etc. at no extra cost to Owner.

3.4 Operation and Maintenance Manual

- .1 Include the following in the Operation and Maintenance Manual provide according to Section 01 78 00:
 - .1 System block diagrams and functions.
 - .2 Schematic diagrams of all equipment and devices.
 - .3 Complete "as built" wiring diagram showing all device wiring and the connections, including colour codes, cable numbering and terminal numbering.
 - .4 Operating instructions for all supplied equipment.
 - .5 Service manuals for all supplied equipment.

3.5 Demonstration and Training

- .1 Provide training to the Owner's personnel. Training shall acquaint Owner's personnel with operation of added P.A. equipment located in the facility.
- .2 Furnish four sets of instruction material requisite for proper operation of the equipment by Owner's personnel.

End Of Section

1 General

1.1 Summary

- .1 Section Includes
 - .1 Install new door contacts and keypads to new security panel as shown on drawing and connect them to the existing security system.
 - .2 Install new card readers, door contacts, and electric strikes to new door controllers as shown on Drawing and connect them to the existing security system.
 - .3 Install new IP video surveillance recording equipment complete with new fixed outdoor IP cameras.
 - .4 All required wiring, new conduits and mounting equipment for cameras and access control be new unless specified otherwise in this document.
 - .5 All security cameras, access control system, glass detectors and motion detectors, tied to the existing UPS.
 - .6 Install two new data line for CCTV network and access control system and connect access control system and CCTV to Owner's security system.
 - .7 All security devices, installed in new conduits and junction box as per Ontario Electrical Safety Code.
 - .8 All new wires and new cables, run in new conduits.
- .2 Provide services to undertake the following:
 - .1 Supply, install, set up and commission system according to the outline of requirements shown on the Contract Documents.
 - .2 Integrate the security and CCTV system of the facility expansion into the Owner's existing facility security and CCTV system. Coordination with Region security and existing facility security and CCTV system supplier/installer for system integration.
 - .3 Existing facility security and CCTV system supplier/installer is:
 - T.C. Security Corporation
 - Dondi Keough

313 Albert Street
Oshawa, ON L1H 4R9
Phone: 905-432-5008
Cell: 416-529-7180
E-mail: Dondi@tcsecure.ca

1.2 Submittals

- .1 Operation and Maintenance Manual
 - .1 Operation and Maintenance Manual to include:
 - .1 Approved Shop Drawings for complete system including component interconnecting Drawings, electrical schematics and wiring diagrams.
 - .2 Parts catalogue listing name of suppliers with telephone numbers.
 - .3 Description of operation of each and every component and of the total system.
 - .4 Test reports of the operation of each device.
 - .5 Theory of operation of the system.
 - .6 Data base preparation and management for entering, modifying, deleting personnel credentials; hard copy forms for preparation of database information.
 - .7 System manager operations and technical assistance guide; procedures for setting, modifying and deleting supervisory accounts; guide to trouble shooting and preventive maintenance, backup, reset, restart and system recovery in event of failure.
- .2 Shop Drawings
 - .1 Submit Shop Drawings for review by the Engineer; obtain returned reviewed copies before proceeding with the affected portion of the Work.
 - .2 Comply with submittal procedures described in Section 01 33 00 where that section is included with this section.

- .3 Justification of contemplated use of alternative products
 - .1 Voluntarily propose alternative Products to substitute for indicated Products.
 - .2 Submit justification for contemplated substitution of systems manufactured by other manufacturers where substitutes are deemed functionally equivalent to those manufactured by the named manufacturer.
 - .3 Demonstrate benefits available to the Owner by preparing a point by point comparison between the named manufacturer's Products and proposed alternative Products indicating inventory of system features, performance comparison and cost benefit.
 - .4 Assume liability for all system design changes and adjustments to documentation consequential in event that proposed substitutes are accepted by Owner.

1.3 Supplier/Installer Qualifications

- .1 Installation, system integration and set up by forces as an authorized dealer with the proposed manufacturer with minimum of two years of related experience on work of similar scale and scope. Submit evidence of qualification within five days of award of Contract or as requested by the Owner.
- .2 The Contractor's installers and technicians shall be manufacturer trained and certified integrator of the Verex/Guardall Director platform.

1.4 Warranty

- .1 System Warranty
 - .1 Warranty equivalent to or better than Contract Warranty as indicated elsewhere in this Specification.
 - .2 Removal, repair or replacement, transportation, reinstallation and testing without charge to Owner, all or any parts of the system found to be defective due to faulty materials or workmanship for a period of two (2) years.

- .3 Upgrades supplied and installed to Product firmware and software, excluding custom or applications programming, available from the original equipment manufacturer until the expiry of the warranty period.

2 Products

2.1 Components

- .1 Provide components to effect a complete and fully working and operative system using products as referenced on or required by the Drawings.

2.2 Security Control Panel

- .1 Product
 - .1 SM/xL control panels, IP/HSC-IP modules, world-wide-modems, GSM, RAM.

2.3 Access Control Panel

- .1 Unit shall be installed and mounted at the security room as per Drawing.
- .2 Each controller for any combination of eight readers or keypads
- .3 Provide separate power supply input for proximity readers.
- .4 Product
 - .1 Guardall AFx door controller (latest version)

2.4 Door Contact (Door Monitor Switch)

- .1 Door contact for overhead door shall be overhead door contact.
- .2 All door contact switches shall be concealed type switch.
- .3 Door contact switch (concealed mount)
 - .1 The door contact switch shall be a concealed type switch, which shall operate with up to a 13 mm gap between the switch and magnet when mounted in a steel or wooden door and frame. The contact configuration shall be normally closed when the door is closed. The switch and magnet shall mount into a 25 mm or smaller diameter hole.

- .2 Product:
 - .1 Sentrol # 1076D series
 - .2 GRI # 184-12W series
 - .3 Honeywell # 947 series
 - .4 Or approved equal

2.5 Electric Strikes (Fail Secure)

- .1 The units shall have the following features:
 - .1 The fail secure electric strikes provided shall be 12 V DC. Provide all power and control components for a complete operating system.
 - .2 The electric strikes shall be UL listed, having a holding strength of greater than 907 kg (2,000 lbs). Latch bolts, switches and strike locked switches shall be monitored. Coordinate exact unit with door and frame style and configuration as required.
 - .3 Utilized where required ULC classified units designed for rated doors and frames.
 - .4 Product:
 - .1 Von Duprin
 - .2 HES Electric Strike
 - .3 RCI Electric Strike
 - .4 Or approved equal
- .2 Provide the electric strike power supplies, consisting of a ULC listed transformer with 120 VAC input and regulated and filtered 12 VDC output. The power supply shall have individual zoned outputs to each lock or set of locks. The power supply shall be complete with manual reset capability and low voltage ground fault circuitry. The power supply shall be rated to deliver 150 percent of the actual connected load.

2.6 Proximity Card Readers

- .1 All card readers for exterior door must be arming station (card reader with key pad).
- .2 Physical and Performance Characteristics
 - .1 Cable distance: as required

- .2 305 mm wire pigtail standard
- .3 Indoor/outdoor design: Secured in a rugged, tamper-resistant epoxy potting designed to withstand extreme weather conditions.
- .4 Product
 - .1 G-Prox II Proximity Reader

2.7 CCTV Recording Equipment (NVR)

- .1 Recording equipment is existing, digital watchdog blackjack P-rack NVR

2.8 CCTV Cameras

- .1 Exterior/Interior Fixed
 - .1 Super dynamic vandal resistant fixed dome cameras
 - .1 Locate and mount cameras as shown on Drawings. Cameras to be located at the highest point possible at the shown locations or as instructed by the client, but shall not be lower than 3 m in height at any given location.
 - .2 Fixed dome network cameras shall provide day/night function.
 - .3 The surface mount dome shall be all metal, vandal resistant housing for fixed camera application. The housing is suitable for interior and exterior applications, IP66 rated and able to withstand 1000 kg of pressure. The camera gimbal bracket allows for easy position and adjustment of the lens assembly. Die cast aluminum body – withstands severe shocks.
 - .4 IP66 Standard – protection against rain and wind.
 - .5 Exterior cameras shall come supplied complete with heater. Heater unit: WV-CW3H (optional) – ideal for varying temperature. Ambient operating temperatures shall be - 10 °C ~ +50 °C for interior and -30 °C ~ +50 °C (with heater) for exterior.
 - .6 Built-in dehumidification device to prevent moisture build-up inside the camera.
 - .7 Super Dynamic 5 (Super D + Adaptive Black Stretch + i-VMD) technology to provide the best image quality.

- .8 650 horizontal lines of resolution for clear detailed images.
3.8 ~ 8 mm auto iris lens built-in (2x vari-focal with 2x digital zoom).
- .9 Conforms to IP66 rating for outdoor conditions.
- .10 High sensitivity with day/night functionality (1.0 lux colour / 0.08 lux B/W). True day/night switching with I/R cut filter removal.
- .11 24/7 in focus operation with built-in Automatic Back Focus (ABF) capability.
- .12 Built-in dehumidification device to prevent moisture build-up inside the camera.
- .13 Alarm input and output terminal for flexible system integration.

.2 Camera type:

- .1 Vivotek 2MP

.2 Camera List and Locations

.1 Orono Depot

Camera #	Interior / Exterior	Type of Camera	View Area of Cameras	Location	Lens / Other Info
1~17	Existing	Existing	Existing	Existing	Existing
18	Exterior	Fixed IP	North west of shed	South west corner of storage shed	Corner/wall mounted
19	Exterior	Fixed IP	South west of shed	North west corner of storage shed	Corner/wall mounted
20	Exterior	Fixed IP	South east of shed	South west corner of storage shed	Corner/wall mounted

2.9 CCTV POE Switch

- .1 Existing CCTV switch is Vivotek 24 Port POE switch.
- .2 New CCTV switch: Vivotek ViviCam 8 Port POE switch or approved equivalent

2.10 Enclosure

- .1 Wall mount enclosure for security devices (alarm and access control panels, power supply, etc.).
- .2 Enclosure to be NEMA 4 type, c/w heater and thermostat, size to accommodate required security device installed inside.
- .3 Enclosure: Hammond HWHK series 48"x36"x12" or equal.
- .4 Heater: Genesis DIN Rail 50W heater c/w thermostat, or equal.

2.11 Ethernet POE Extender

- .1 LONGSPAN long range Ethernet and POE.
- .2 Approved equivalent.

2.12 Cabling

- .1 All CCTV cabling to Cat.6 U/UTP data cable.
- .2 All cabling installed in underground conduit shall be outdoor waterproof type.
- .3 All cabling shall be labeled at both ends for identification purposes.
- .4 All new cable must be installed in conduit.
- .5 All wiring shall be installed to conform to the requirements of the Canadian Electrical Code, Part I and applicable provincial codes. Wiring shall be sized in accordance with Class 2 requirements, but shall be protected from mechanical injury or other injurious conditions such as moisture, excessive heat or corrosive action in accordance with Class I requirements. Conductors shall be solid copper. The minimum size of any conductor shall be per manufacturer's requirements.

2.13 Secure Cabinet for CCTV Recording Equipment

- .1 Secure cabinet is existing, located inside main building Comm/Security Room.

2.14 Uninterrupted Power Supply (UPS)

- .1 UPS is existing, located inside main building Comm/Security Room.

2.15 Fixed Pipe Bollards and Safety Barriers

- .1 Bollards and safety barriers to be as shown on the Drawings.
- .2 Paint:
 - .1 Primer:
 - .1 Sherwin Williams KEM Bond HS Universal Metal Primer
 - .2 PPG Fast Dry 35 Inhibitive Primer 95-908
 - .3 Approved equivalent
 - .2 Finish Coat
 - .1 Sherwin Williams Steel Spec Fast Dry Alkyd Topcoat B55-800
 - .2 PPG Fast Dry 35 Gloss Alkyd Enamels 95-912
 - .3 Approved equivalent.
 - .3 Thinner
 - .1 Sherwin Williams R2K4 Aromatic Thinner
 - .2 PPG97-727 Porter Thinner
 - .3 Approved equivalent

3 Execution

3.1 Examination

- .1 Carefully examine the Drawings and the Place of the Work.

3.2 Preparation

- .1 Order all required parts and equipment upon notification of award of the Work.
- .2 Bench test all equipment prior to delivery to the job site.
- .3 Verify the availability of power where required. If a new source of power is required, a licensed electrician shall be used to install it.
- .4 Arrange for obtaining all programming information including access times, free access times, door groups, operator levels, etc.

3.3 Installation

- .1 General
 - .1 Comply with the latest edition of the Ontario Building Code, including the supply and installation of all warning signs at exit doors.
 - .2 Install all components in accordance with the manufacturer's instructions.
- .2 Conduct a site review with the system Suppliers and/or manufacturers immediately following installation of the system to verify installation practices and compliance with the Specifications.
- .3 Verify that the supervised wiring is correctly installed; simulate fault conditions and observe the system response to such; perform such testing in the presence of the manufacturer and obtain a manufacturer's witness statement to attest to satisfactory performance.
- .4 Security Management System
 - .1 Install server; install application software suite; configure to Owners Specification.
 - .2 Install client work stations, install client application suite, configure to Owners Specification.
- .5 Door Access Control Panel
 - .1 Install control panel in locations as indicated.
 - .2 Install controllers.
 - .3 Make connecting of wiring to controllers to effect a fully operational system.
 - .4 Turn keys over to Owner.
- .6 Intrusion Detection System Panel
 - .1 Install control panel in location indicated.
 - .2 Install controllers.
 - .3 Make connecting of wiring to controllers to effect a fully operational system.
 - .4 Turn keys over to Owner.

.7 Wiring Methods

- .1 Connect access control distributed controllers through a separate and exclusive wiring system not shared by any other system.

.8 Cabling

- .1 Install cables in conduits or in cable tray; conceal cable and conduits. Avoid use of exposed cables.
- .2 Install wiring to conform to the requirements of the Canadian Electrical Code, Part 1 and applicable provincial codes. Size wiring in accordance with Class 2 requirements; protect wiring against mechanical injury or other injurious conditions such as moisture, excessive heat or corrosive action in accordance with Class 1 requirements.
- .3 Use wire with copper conductors.

.9 Door Strikes

- .1 Comply with Specifications included with architectural Drawings, Specifications and door hardware schedule otherwise the following:
 - .1 Modify frame for door to accept suitable door strike.
 - .2 Install door strike and align with bolt to achieve reliable and consistent operation.
 - .3 Set strike to required voltage.
 - .4 Set strike to fail – secure mode.

.10 Card Readers - Normal

- .1 Install card readers on the public side of separation between public and secure spaces in a location as indicated.
- .2 Adjust the location to suit site conditions with preference given to locating the reader near to the handle of the door.
- .3 Clearly identify the proposed location for each card reader and request the Owner to review each location for confirmation of acceptability before completing the installation. Relocate the reader position before installation by a horizontal distance of 2 m without additional cost.
- .4 Install card reader signal repeaters where distance limitations are exceeded.

.11 Camera Enclosures

- .1 Install camera enclosures by securing to back boxes or direct mounting to building fabric or manufactured brackets.
- .2 Secure against movement resulting from unassisted human interference.
- .3 Align to permit camera to view in direction indicated or as directed by the Owner.
- .4 Make electrical connections of control, power and signaling cables.
- .5 Make connections for control wiring to PTZ device.

.12 Camera Support Brackets

- .1 Position camera supports according to positions indicated observing indicated sight lines.
- .2 Secure brackets to wall where so indicated; align vertically; set length of pendant to position enclosure at mounting elevation as indicated.
- .3 Secure pendant support pipe to building fabric to place camera in position and height indicated.
- .4 In locations where fine lateral adjustment is required, suspend pendant pipe from custom bracket arrangement providing +/- 300 mm east-west, north-south adjustment or equivalent.
- .5 Where pendant pipes penetrate solid or tiled ceiling, provide pipe in sections with threaded 50 mm coupler at 50 mm above elevation of ceiling; finish ceiling penetration with plastic grommet of matching colour.

.13 Cameras

- .1 Locate and install the following:
 - .1 CCTV camera exterior mounting brackets
 - .2 CCTV camera interior support brackets
 - .3 CCTV camera pan and tilt drives
 - .4 CCTV cameras
 - .5 CCTV exterior cameras in their environmental enclosures
 - .6 Aim fixed cameras in direction indicated or as directed by the Owner, observing indicated sight lines

- .7 Make connections for signal wiring to cameras
- .14 Camera Lenses
 - .1 Install lenses and adjust to viewing criteria
 - .1 Varifocal lens: Adjustment range of 3:1 with image of human face occupying 10-15% of vertical field of view of target at centre of adjustment range.
 - .2 Zoom lens: Adjustment range 22:1 with image of human face occupying 15-20% of vertical field of view of target at tightest extreme of adjustment range.
 - .3 Adjust view angle to produce field of view as indicated or as directed by the Owner or Engineer on site.
 - .2 Change the fixed focal length lens with any other fixed focal length lens as directed by the Engineer without additional cost to the Project.
 - .3 Set focus of fixed lenses.
 - .4 Set focus on zoom lenses to track from wide through tight views.
 - .5 Connect auto iris.
 - .6 Optimize auto iris settings.
- .15 Ethernet POE Extender
 - .1 Provide Ethernet POE extenders for CCTV cameras with cable length more than 100 meters if required to meet CCTV camera performance requirement.
- .16 Grounding
 - .1 Bond metallic non-current bearing components to ground.
 - .2 Bond the CCTV and security equipment to ground by use of a #6 AWG insulated grounding conductor connected to the grounding bus
- .17 Other Installation Requirements
 - .1 Use PVC conduits where required (pump rooms, areas with high humidity, underground connections, etc.). Limit the use of liquid tight conduits to where necessary.
 - .2 All cabling shall be labeled at both ends for identification purposes.

- .3 Contractor to connect power for security hardware from power outlet. Contractor shall verify existing outlet before quoting. Contractor shall need to install 24 V power output for camera and 12 V for access control system.
- .4 The Contractor is responsible for scanning or x-raying of concrete prior to performing any drilling or coring through. Contractor shall avoid penetration through areas of concrete identified to have embedded components by means of scanning or x-raying (conduits, wires, re-bar, etc.).
- .5 Provide all labour, material, equipment and services specified to install new ISM panel in security room in the Depot. New ISM panel shall be ISM/xL control panels, IP/HSC-IP modules, world-wide-modems, GSM, RAM.
- .6 The Contractor shall confirm required door hardware replacement as required for new card readers. Provide all labour, material, equipment and services specified to replace or install new hardware as required for new card reader.

3.4 Programming

- .1 Set up and configure all systems including CCTV devices to interoperate as a single unified system.
- .2 Access to existing credential verification relational data base made available by the Owner, share existing data base maintained by Owner.
- .3 Programme the performance of the overall system to the Owner's Specification.
- .4 Customize the identification of each system message identifying each field device to suit local nomenclature; custom programme system messages to the Owner's Specification.
- .5 Program one hundred personal profiles including person's name, address, contact information and twenty other data fields to be defined by Owner. Personnel data supplied by Owner.

3.5 Cabling

- .1 Install wiring for CCTV video equipment system:

- .1 Where cable is outside equipment room, install cable in electrical raceway, including conduit or cable tray. Avoid suspending cable in free air
- .2 Run signal cable in continuous lengths; avoid splicing signal cables
- .3 Run power cables in continuous lengths using splicing only where necessary. Make wiring splices only in junction boxes using pressure type terminal blocks
- .4 Identify all terminal blocks
- .5 Use only copper conductors
- .6 For IP CCTV camera system, Cat.6 U/UTP fitted with RJ45 connectors at each end.
- .7 For CCTV camera controls as indicated by the system manufacturer
- .8 For CCTV extra-low voltage power supply, as indicated by the system manufacturer
- .9 Wiring for 120 V circuits installed in separate conduits from the wiring for extra low voltage, control and signal applications if required
- .2 Complete the connection of each Cat.6 U/UTP cable terminated on the patch panel to the POE switch by use of Cat.6 U/UTP patch cords
- .3 Connect the extra-low voltage power wiring to each camera respectively and to the power supply panel using a separately fused circuit for each camera if required.
- .4 Connect the control wiring to each remotely controlled camera respectively and the main panel if required.

3.6 Electrical Services

- .1 Power Distribution Units
 - .1 Install in locations indicated, or where not indicated then in telecommunications room immediately adjacent to and on the same level as the camera location. Coordinate location with Consultant.
 - .2 Connect power input to dedicated 120 V 15A branch circuit on emergency fed power breaker panel (Class III power type) using locked off breaker.

- .3 Connect cables to individual cameras.
- .2 Cabling
 - .1 Install signal, power and control cabling to effect a complete and operational system.
 - .2 Install cabling inside electrical conduits or raceways.
 - .3 Observe cable clearances from other electrical services as indicated in the Specifications.
 - .4 Splice power cable only where unavoidable.
 - .5 Splice signal cable by use of two signal connectors and bulkhead connector.
 - .6 Splice controls cable by use of male-female connector pair.
 - .7 Accommodate splices in junction box of minimum size 120 x 120 x 53 mm.
 - .8 Surge/transient protection.
- .3 Device Boxes
 - .1 Install electrical device boxes as back supports for camera mounting brackets or for camera enclosures.
 - .2 Firmly secure device box back box able to resist without rupture a shear force of 500 kg force applied parallel with the camera mounting plane and a tensile force of 500 kg when applied axial and concentric to the support plane.
 - .3 Eliminate exposure of wiring where practicable by fully concealing cables and connections within manufactured enclosures, device boxes and conduits.
 - .4 Device box of minimum size 120 x 120 x 53 mm.
- .4 Conduits
 - .1 Use conduits or cable tray for support and protection of cabling.
 - .2 Do not strap cabling to the exterior of conduits.
 - .3 Use low profile raceway where cables would otherwise be exposed below finished ceiling.
 - .4 Use flexible conduit where use of rigid conduit is not practicable.

3.7 Workmanship

- .1 Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship. In all cases, comply with the manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions, and datasheets as applicable.
- .2 Perform Work with persons experienced and qualified to produce workmanship specified.
- .3 Maintain quality control over Suppliers and Subcontractors.
- .4 Owner and Consultant will have the authority to reject Work which does not conform to the Drawings and Specifications.

3.8 Testing, Commissioning and Training

- .1 The Contractor shall make an inspection of the digital CCTV camera equipment, including those components necessary to the direct operation of the system. The inspection shall comprise an examination of such equipment for the following:
 - .1 That the wiring connections to all equipment components show that the installer observed ULC and CSA requirements.
 - .2 That equipment of the manufacturer's manufacture has been installed in accordance with the manufacturer's recommendations, and that all digital CCTV camera equipment of whatever manufacture have been operated or tested to verify their operation; and
 - .3 That the supervisory wiring of those items of equipment connected to a supervised circuit is operating.
 - .4 That the field of view of the camera and set-ups are acceptable to the Owner.
- .2 Testing, commissioning and training of all equipment shall be done by the Contractor.
- .3 Cost for testing, commissioning and training shall be included in this Contract.
- .4 The Contractor shall verify the following:

- .1 Full operation of the CCTV surveillance system. Regional headquarters shall be able to connect remote site (Scugog Depot) CCTV surveillance system and access control system.
 - .2 Final network and electrical tie-ins are installed as per Specifications and in accordance with all governing codes and regulations;
 - .3 All installed equipment are installed in accordance with the manufacturer's recommendations, and that all equipment of whatever manufacturer have been operated or tested to verify their operation
- .5 The Owner reserves the right to invite the component manufacturers to inspect the installed equipment, including those components necessary for the direct operation of the system, whether or not manufactured by that manufacturer. Such inspection will be conducted, at the Owner's cost, within thirty days of completion of the work of this Section. Any deficiencies found shall be corrected by the Contractor. The inspection shall comprise an examination of such equipment for the following:
- .1 The type of equipment installed is that designated by the Specifications.
 - .2 That the wiring connections to all equipment components show that the installer observed ULC and CSA requirements.
 - .3 That equipment of the manufacturer has been installed in accordance with the manufacturer's recommendations, and that all equipment of whatever manufacture have been operated or tested to verify their operation; and
 - .4 That the supervisory wiring of those items of equipment connected to a supervised circuit is operating.
 - .5 A copy of the inspection technician's report, showing location of each device and certifying the test results of each device.
- .6 The field of view of the camera and set-ups are acceptable to the Owner.
- .7 A copy of the inspection technician's report, showing location of device and certifying the test results.
- .8 The Contractor shall label and clearly identify all panels, conduits and wiring on Drawings as well as panels.

- .9 Testing and commissioning must be verified in the presence of the Consultant and/or third party representative of the Owner.

3.9 Fixed Pipe Bollards and Safety Barriers

- .1 Construct fixed pipe bollards and safety barriers in accordance with details on the Drawings and at locations shown on the Drawings.
- .2 Apply primer at spread rate of 350 ft²/Imperial gallon, to a thickness of 3-5 mm thick when wet, or as per paint manufacturers specification.
- .3 Allow thirty minutes drying time (to touch) of the primer coat prior to applying a single finish coat
- .4 Apply finish coat at a spread rate of 300 s ft²/Imperial gallon to a thickness of 3-5 mm thick when wet, or as per paint manufacturers specification.
- .5 Apply a finish coat within 3 hours of applying the primer coat, otherwise Contractor shall wait 30 hours prior to the application of the final coat or as per the paint manufacturer's specifications.

End of Section

1 General

1.1 Section Includes

- .1 Preparation of the site and clearing and grubbing.

1.2 References

- .1 Canadian Council of Ministers of the Environment (CCME).
 - .1 CCME PN1055, Environmental Code of Practice for Underground Storage Tank Systems Containing Petroleum Products and Allied Petroleum Products.
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1992, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations.
 - .4 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .3 Underwriters' Laboratories of Canada (ULC).
 - .1 ULC/ORD-C107.19, Secondary Containment of Underground Piping.
 - .2 ULC/ORD-C58.15, Overfill Protection Devices for Underground Tanks.
 - .3 ULC/ORD-C58.19, Spill Containment Devices for Underground Tanks.
- .4 MOECC, Ministry of the Environment and Climate Change
- .5 Occupational Safety and Health Act; Ministry of Labour of Ontario
- .6 Local municipal by-laws

1.3 Submittals

- .1 Hazardous materials: Provide description of Hazardous Materials and Notification of Filing with proper authorities prior to beginning of Work as required.

- .2 Certificates: Submit copies of weigh bills receipts from authorized disposal sites and reuse and recycling facilities for material removed from site upon request of Consultant.

1.4 Site Conditions

- .1 Site Environmental Requirements
 - .1 Ensure that the work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
 - .2 Do not dispose of waste of volatile materials including but not limited to, mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
 - .1 Ensure proper disposal procedures are maintained throughout the project.
 - .3 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.
 - .4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with as directed by Consultant.
 - .5 Protect trees, plants and foliage on site and adjacent properties where indicated.

2 Products – Not Used

3 Execution

3.1 Examination

- .1 Visit the Site and determine the work extent and nature of existing conditions. In no circumstances will any claims against the Owner be allowed resulting from failure to ascertain the work herein described or implied.

- .2 Report to Consultant in writing any conditions which will prejudice the proper completion of the work. Commencement of work constitutes acceptance of existing conditions.
- .3 Soil conditions between boreholes may be at variance with the information shown on borehole data. Borehole data is issued for information only.

3.2 Preparation

- .1 Establish locations of service installations existing in the areas of work and obtain service Owners' approval to work in such areas. Provide adequate markers or take protective measures to ensure that no damage is caused under the work of this section. Repair damaged work as required without cost to Owner.
- .2 Notify Consultant and obtain clearance to proceed prior to commencement of work.
- .3 Temporarily cover existing catchbasins and manholes exposed to construction traffic to prevent entry of earth or debris.
- .4 Provide all necessary hoardings, guardrails, markers, including temporary warning lights, or other means required to ensure that no damage, injury or death is caused to persons or damage to property resulting from this work.
- .5 Protect existing trees, shrubs and plants to remain.
- .6 Protect the work of other Contracts in progress or completed and protect the Owner's properties, stored products, services and utilities from damage.
- .7 Environmental Requirements
 - .1 Dust control: Provide and maintain to the Consultant's satisfaction, adequate system to avoid any nuisance caused by dust and dirt rising throughout the area of operations.
 - .2 Silt control: Provide and maintain to Consultant's satisfaction, control systems to prevent silt from entering any storm drainage system.

3.3 Access Roads

- .1 Maintain and clean all access roads used for hauling operations as may be required by municipal authorities.

3.4 Clearing and Grubbing

- .1 Clear and grub as necessary to remove trees, farm crops, brush, roots, weeds, vegetation from area designated on Drawings. Tag and adequately protect trees to be preserved.

3.5 Site Demolition and Removals

- .1 Where a section of asphalt or concrete is to remain, saw cut cut-off point prior to breaking out to avoid damage to remaining work.

3.6 Restoration

- .1 Restore areas and existing works outside areas of demolition to match condition of adjacent, undisturbed areas at no extra cost to the Contract.
- .2 Use soil treatments and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent watercourses or ground water.

3.7 Cleaning

- .1 Remove debris, trim surfaces and leave Work Site clean upon completion of work.
- .2 Use cleaning solutions and procedures that are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent watercourses or ground water.

3.8 Disposal of Waste and Surplus Materials

- .1 Except where specified or indicated on Drawings to be retained on site for reuse, remove from the site and legally dispose of all waste and surplus materials resulting from Site preparation work on a daily basis.
- .2 Divert excess materials from landfill to site approved by Consultant.

- .3 Source separate for recycling materials that cannot be salvaged for reuse including wood, metal, concrete and asphalt, and gypsum.
- .4 Remove materials that cannot be salvaged for reuse or recycling and dispose of in accordance with applicable codes at licensed facilities.

End of Section

1 General

1.1 Summary

.1 Section Includes

- .1 Earthwork, grading and fill for areas to be paved as shown on the Drawings.

1.2 References

.1 Reference Standards

- .1 ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
- .2 CSA-A23.1, Concrete Materials and Methods of Concrete Construction
- .3 MOECC, Ministry of the Environment and Climate Change
- .4 OPSS.MUNI 1004, November 2013 - Ontario Provincial Standard Specification, Material Specification for Aggregates - Miscellaneous
- .5 OPSS.MUNI 1010, November 2013 - Ontario Provincial Standard Specification, Material Specification for Aggregates - Granular A, B, M and Select Subgrade Material

.2 Geotechnical Investigation

- .1 Geotechnical investigation of the site was carried out for the Owner as a guide in design and construction. A report and borehole logs on the investigation were prepared and are bound into the Specifications.
- .2 Soil conditions between boreholes may be at variance with the information shown on the soil investigation report.
- .3 Be responsible for including in the Work, costs for all conditions identified or inferred in the report.

1.3 Submittals

- .1 Submit a certificate issued by fill supplier to substantiate that fill materials are free of contaminants.

1.4 Quality Assurance

.1 Testing and Inspection

- .1 Be responsible for compaction throughout the work of this Contract, as it progresses and on completion to ensure required densities are obtained.
- .2 Owner may appoint an independent testing company at its own expense for checking or approval of the placing and compaction work. Pay charges for re-testing after making good defective areas. Coordinate construction schedule with Consultant so that testing company can be notified in advance.
- .3 Provide the following and pay for all associated costs as part of the Contract:
 - .1 Have sampling and testing of soil and aggregate materials and of compaction done by an independent, well established and qualified commercial testing agency. The personnel shall be qualified and have had experience on projects equal to the complexity of this project. Upon request from the Owner submit qualifications of the testing agency and include their personnel for approval prior to retaining either one of the agencies.
 - .2 Retain a testing agency to perform material testing and to prepare test reports and other submittals, and a separate testing agency to maintain field quality control of operations. The Owner reserves the right to request change in personnel or firms at any time.
 - .3 Submit proposed material, including off-site borrow material, to the testing agency for its analysis and report, in sufficient time so as not to delay the progress of the work. The testing agency shall approve all fill material prior to placement and shall observe placement to ensure lift thickness is as specified.
 - .4 Each testing agency shall submit, in duplicate, test report which includes tests, investigations, findings and recommendations to the Contractor and to the Owner, within 24 hours of the tests.

- .5 The testing agency for field quality control of operations shall determine the compaction of material placed and shall conduct the following minimum number of in-place density tests after monitoring the placing and compacting of each lift.
 - .1 For mass filling: one test per lift of fill for each 100 square metres.
 - .2 Pavement subgrade: one test per final lift (subgrade) of fill or backfill for each 500 square metres, both after compaction and before base construction.
 - .3 Floor subgrade: One test per final lift (subgrade) or fill or backfill within building wall lines, for each 500 square metres, both after compaction and before slab construction.
 - .4 For trenches: three tests per lift of trench backfill for each 150 linear metres.
- .6 If compaction tests indicate that a layer has not been brought to the required compaction, re-compact the area, prior to placement of additional material, until the required compaction is obtained. If the layer has been covered by a subsequent operation, remove such material before re-compacting the defective layer.
- .4 Submit a testing and inspection program to account for all the items specified above. Submit to the Consultant at pre-construction meeting or prior to start of construction.

1.5 Site Conditions

- .1 Existing Buried Utilities and Structures
 - .1 Prior to commencing excavation, establish locations of existing buried service installations in the construction area. Notify service owners and obtain their approval to work in such areas. Place adequate markers and take protective measures to ensure that no damage is caused under the work of this Section. Repair damaged work as required at no change in Contract Price.
 - .2 Temporarily cover local existing catchbasins and manholes exposed to construction traffic to prevent entry of earth or debris.

.2 Excavations

.1 Erect necessary hoardings, guardrails, markers; place temporary warning lights; take all other measures required to ensure that no damage or injury is caused to persons, or damage to property resulting from this work.

.2 Protect excavations and maintain warning devices during construction and during time when work is closed down for any cause.

.3 Other Contracts, Existing Buildings and Surface Features

.1 Protect Work of other trades or of other Contracts in progress or completed and protect Owner's existing properties, stored products, services and utilities from damage.

.4 Environmental Requirements

.1 Dust control: Prevent any nuisance caused by dust and dirt rising throughout the area of operations with an adequate dust control system acceptable to the Consultant. Maintain system for the duration of the Work.

.2 Silt control: Prevent silt from entering any storm drainage system with an adequate silt control system acceptable to the Consultant. For the duration of the work, maintain system on a regular basis and after rainfall by removing trapped silt and re-aligning and re-staking control system as required.

.5 New and Existing Drainage

.1 Maintain new and existing drainage during construction. Manage the overland flows so as not to impact the existing flows from adjoining properties during construction.

2 Products

2.1 Materials

.1 Granular materials - general: New materials conforming to OPSS.MUNI 1010, imported from off-site, and sourced from a member of the Aggregate Producers Association of Ontario.

- .2 The use of slag and recycled aggregates is prohibited.
- .3 Granular Fill Materials
 - .1 Base course: Granular A
 - .2 Sub-base course: Granular B Type 1 or Type II (crushed stone only)
- .4 Select fill: Native excavated site material approved by Consultant and capable of being compacted to required density and free of all:
 - .1 Vegetable or organic matter and roots
 - .2 Cinders or ashes
 - .3 Building debris
 - .4 Rocks and stones larger than 75 mm

2.2 Stockpiling of Granular Materials

- .1 Stockpile materials in a manner to prevent segregation.
- .2 Protect materials from contamination.
- .3 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
- .4 Do not use intermixed or contaminated materials. Remove and dispose of materials rejected by Consultant within 48 hours of rejection.
- .5 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

3 Execution

3.1 Lines and Levels

- .1 Establish lines and elevations from existing lines and elevations shown on Drawings.

- .2 Have lines and levels established by a Registered Ontario Land Surveyor or a qualified Registered Civil Engineer.
- .3 Indicate location of building walls in relationship to property lines on plan.
- .4 Protect and maintain lines and bench marks as long as they are required and leave in place at completion of the work.

3.2 Topsoil Stripping

- .1 Strip topsoil from working area in locations shown. Load, haul and dump in stockpiles of sufficient quantity to provide for 100 mm (topsoil depth over areas to be seeded or sodded.
- .2 Strip to prevent intermixing with, or removal of, underlying soil or objectionable materials.
- .3 Dish topsoil surface to retain moisture in the stockpile. Crown top of subsoil stockpile to facilitate drainage.

3.3 Ditching

- .1 Maintain positive drainage at all times.
- .2 Provide whatever temporary ditches or culverts required to expedite and facilitate construction activities of this section. Backfill such temporary ditches. Remove culvert and backfill excavated area upon completion of Work.

3.4 Grading

- .1 Grade to levels, profiles and contours indicated on Drawings, allowing for topsoil fill or required depth of granular fill to be added to provide new finish elevations.
- .2 Supply additional material required to obtain new grade levels. Place and compact as specified.

- .3 Graded areas shall be smooth to profile, free of debris, with local excavations and depressions filled and compacted as specified hereunder.
- .4 Remove surface debris, roots, vegetation, branches and stones in excess of 50 mm in size.
- .5 Provide roundings at top and bottom of banks and at other breaks in grades.
- .6 Do not disturb soil within branch spread of trees and shrubs remaining.

3.5 Dewatering

- .1 Build temporary ditches to prevent surface water flowing into excavations or damaging adjoining property.
- .2 Keep excavated areas free from standing water using power operated mechanical equipment. Drain water away from excavations, buildings, walls, and paved areas, to disposal areas approved by Consultant.
- .3 Protect open excavations against flooding and damage due to surface run-off.

3.6 Excavation

- .1 Excavate to depths indicated with proper allowance for subsequent construction. Excavation shall be clean and clear of loose material and true to size.
- .2 Perform excavation at or adjacent to existing structures or foundations in such a way that structures and foundations are not weakened or endangered in any way.
- .3 If undisturbed soil having the required bearing capacity is not encountered at depths indicated, determine possible additional volume of excavation that will be required and obtain Consultant's instructions in writing to excavate to additional required depth.

3.7 Fill

- .1 Compact exposed sub-grade prior to placing any fill. Compact areas inaccessible to roller with portable mechanical tampers. Have Soils Consultant accept compacted sub-grade. Remove any soft spots prior to placing any fill material.
- .2 Remove loose materials, debris, etc., from areas to receive fill.
- .3 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow and ice. Ensure no frozen material is used in placing.
- .4 Fill areas receiving pavement with compacted courses of granular base and granular sub-base.
- .5 Place granular fill in loose layers not exceeding 200 mm (, with each layer thoroughly compacted.
- .6 Grade materials using methods which do not lead to segregation or degradation of aggregate.
- .7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .8 Remove and replace that portion of layer in which material becomes segregated during spreading.

3.8 Compaction

- .1 Use compaction equipment capable of obtaining required material densities.
- .2 Compaction Densities
 - .1 Granular materials: to 100% Modified Proctor Maximum Dry Density in accordance with ASTM D1557.
 - .2 Earth subgrade and select fill: to 98% Standard Proctor Maximum Dry Density in accordance with ASTM D698.
- .3 Shape and roll alternately to obtain smooth, even and uniform compaction.

- .4 Apply water as necessary during compaction to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with power operated portable plate compactors.
- .6 Depth and layers specified are minimum dimensions of fill after compaction, except where loose layer is specified.
- .7 Ensure compaction operations do not cause vibration and noise levels exceeding acceptable limits established by authorities having jurisdiction.

3.9 Site Access Cleaning

- .1 Keep site access clear of mud, debris and dirt resulting from Work of this section.

3.10 Surplus Materials

- .1 Remove from the site and legally dispose of, excess excavated material, waste material, trash, debris and rubble resulting from earthwork operations.
- .2 Be responsible for obtaining all necessary regulatory approvals, consents and permits at own cost.

End of Section

1 General

1.1 Section Includes

- .1 Excavation and backfilling for structures.

1.2 References

.1 Reference Standards

- .1 ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
- .2 ASTM E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
- .3 ASTM E1745, Specification for Plastic Vapor Retarders Used in Contact With Soil or Granular Fill Under Concrete Slabs
- .4 CSA-A23.1, Concrete Materials and Methods of Concrete Construction
- .5 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering
- .6 OPSS.MUNI 1010, November 2013 - Ontario Provincial Standard Specification, Material Specification for Aggregates - Granular A, B, M and Select Subgrade Material
- .7 MOECC, Ministry of the Environment and Climate Change

.2 Geotechnical Investigation

- .1 Geotechnical investigation of the site was carried out for the Owner as a guide in design and construction. A report and borehole logs on the investigation were prepared and are available.
- .2 No responsibility is assumed by the Owner or Consultant for the scope, accuracy, or interpretation of the geotechnical investigation report. Soil conditions between boreholes may be at variance with the information shown on the geotechnical investigation report.
- .3 Be responsible for including in the Work, costs for all conditions identified or inferred in the report.

1.3 Submittals

- .1 Submit a certificate issued by fill supplier to substantiate that fill materials are free of contaminants.

1.4 Quality Assurance

- .1 Testing and Inspection
 - .1 Refer to Section 01 45 00 - Quality Control.
 - .2 Be responsible for compaction throughout the work of this Section, as it progresses and on completion to ensure the required densities are obtained.
 - .3 Owner may appoint an independent inspection/testing company at its own expense for checking or approval of the placing and compaction work. Pay charges for re-testing after making good defective areas. Coordinate construction schedule with Consultant so that testing company can be notified in advance.
 - .4 Provide the following and pay for all associated costs as part of the Contract:
 - .1 Have sampling and testing of soil and aggregate materials and of compaction done by an independent, well established and qualified commercial testing firm. The personnel shall be qualified and have had experience on projects equal to the complexity of this project. Upon request from the Owner submit qualifications of the testing firm and include their personnel for approval prior to retaining either one of the firms.
 - .2 Retain a testing firm to perform material testing and to prepare test reports and other submittals, and a separate testing firm to maintain field quality control of operations. The Owner reserves the right to request change in personnel or firms at any time.
 - .3 Submit proposed material, including off-site borrow material, to the testing firm for its analysis and report, in sufficient time so as not to delay the progress of the work. The testing firm

- shall approve all fill material prior to placement and shall observe placement to ensure lift thickness is as specified.
- .4 Each testing firm shall submit, in duplicate, test report which includes tests, investigations, findings and recommendations to the Contractor and to the Owner, within twenty-four hours of the tests.
 - .5 The testing firm for field quality control of operations shall determine the compaction of material placed and shall conduct the following minimum number of in-place density tests after monitoring the placing and compacting of each lift.
 - .1 For mass filling: One test per lift of fill for each 100 square metres.
 - .2 Floor subgrade: One test per final lift (subgrade) or fill or backfill within building wall lines, for each 500 square metres, both after compaction and before slab construction.
 - .3 For trenches: Three tests per lift of trench backfill for each 150 linear metres.
 - .6 If compaction tests indicate that a layer has not been brought to the required compaction, re-compact the area, prior to placement of additional material, until the required compaction is obtained. If the layer has been covered by a subsequent operation, remove such material before re-compacting the defective layer.
 - .5 Submit a testing/inspection program to account for all the items specified above. Submit to the Consultant at pre-construction meeting or prior to start of construction.
 - .2 Cementitious backfill materials will be tested for conformance to the Specifications by an independent inspection company selected and paid for by Owner. Tests include the following:
 - .1 Obtaining certification of cements.
 - .2 Cylinder test. Three test cylinders will be taken from initial pour.
 - .3 Cooperate with and assist Owner's inspection/testing company's personnel during inspections and tests.

- .4 Remove defective materials and completed work which fails tests and replace as directed by Consultant.
- .5 Where work or materials fail to meet strength requirements as indicated by test results, pay costs of additional inspection and testing required for new replacement work or materials.

2 Products

2.1 Materials

- .1 Granular materials - general: New materials conforming to OPSS.MUNI 1010, free of organic matter, imported from off-site, and sourced from a member of the Aggregate Producers Association of Ontario. Note: The use of slag and recycled aggregates is prohibited.
 - .1 Backfill: OPSS Granular B Type I
 - .2 Sub-base: OPSS Granular B Type I
 - .3 Underfloor base: OPSS Granular A
- .2 Select fill: Native excavated site material approved by Consultant and capable of being compacted to required density and free of:
 - .1 Any vegetable or organic matter and roots
 - .2 Cinders or ashes
 - .3 Building debris
 - .4 Rocks and stones larger than 75 mm
- .3 Perimeter foundation insulation: Styrofoam "SM" by Dow Chemical Co. or "Celfort 300" by Owens Corning conforming to CAN/ULC-S701. Use Lepage "PL Premium" adhesive for use in conjunction with installation of perimeter insulation.
- .4 Vapour retarder: One layer of minimum 0.25 mm (thick sheet membrane conforming to ASTM E1745.
 - .1 Lap tape: Double sided, asphaltic, pressure sensitive mastic tape Viper Vapor Tape by Insulation Solutions 866-698-6562, or accepted equal.

2.2 Stockpiling of Granular Materials

- .1 Stockpile materials in a manner to prevent segregation.
- .2 Protect materials from contamination.
- .3 Separate different aggregates by strong, full-depth bulkheads, or stockpile far enough apart to prevent intermixing.
- .4 Do not use intermixed or contaminated materials. Remove and dispose of materials rejected by Consultant within forty-eight hours of rejection.
- .5 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

3 Execution

3.1 Preparation

- .1 Protection
 - .1 Existing buried utilities and structures:
 - .1 Prior to commencing excavation, establish locations of existing buried service installations in the construction area. Notify service owners and obtain their approval to work in such areas. Place adequate markers and take protective measures to ensure that no damage is caused under the Work of this Section. Repair damaged Work as required at no change in Contract Price.
 - .2 Temporarily cover local existing catchbasins and manholes exposed to construction traffic to prevent entry of earth or debris.
 - .2 Excavations:
 - .1 Erect necessary hoardings, guardrails, markers; place temporary warning lights; take all other measures required to ensure that no damage or injury, is caused to persons or damage to property resulting from this Work.

- .2 Protect excavations and maintain warning devices during construction and during time when Work is closed down for any cause.
- .3 Other contracts, existing buildings and surface features:
 - .1 Protect work of other trades or of other Contracts in progress or completed and protect Owner's existing properties, stored products, services and utilities from damage.

3.2 Lines and Levels

- .1 Establish lines and elevations from existing lines and elevations shown on Drawings.
- .2 Have necessary lines and levels established by a Registered Ontario Land Surveyor or a qualified Registered Civil Engineer.
- .3 Indicate location of building walls relative to property lines on survey plan.
- .4 Protect and maintain the lines and benchmarks as long as they are required.

3.3 Excavation

- .1 Remove obstructions (ice and snow) from surfaces to be excavated.
- .2 Perform excavation with proper allowance for subsequent work including shoring, bracing and formwork (sheet piling and underpinning). Excavation shall be clean and clear of loose material and true to size. Underpin as shown on Drawings. Also, refer to geotechnical report.
- .3 Securely shore and brace sides of trenches and excavation exceeding 1.2 m in depth with shoring and bracing extending at least 300 mm above the top of trenches or excavation.
- .4 Do not obstruct flow of surface drainage or natural watercourses.
- .5 Excavate to undisturbed soil, level, free from loose, soft or organic matter and of design bearing strength.

- .6 Perform excavation at or adjacent to existing structures or foundations in such a way that structures and foundations are not weakened or endangered in any way. Where it is required to excavate adjacent to an existing building, all fill under existing floor slabs must be contained.
- .7 If undisturbed soil or bedrock having the required bearing capacity is not encountered at footing depths indicated, determine the possible additional volume of excavation that will be required and obtain Consultant's instructions in writing to excavate to additional required depth.
- .8 Do not expose shale to weather in excavations and in any case, following inspection, cover with 50 mm of 15 MPa concrete within twelve hours after exposure.
- .9 Fill excavations for building foundations which are, through error, carried below the elevation shown or approved depth, with 15 MPa concrete, or as directed by Consultant, at no increase in Contract Price.
- .10 Notify geotechnical engineer when bottom of excavation is reached, and have same inspect excavation prior to resumption of work.

3.4 Dewatering

- .1 Keep excavated areas free from standing water using power operated mechanical equipment. Drain water away from excavations, buildings, walls, and paved areas, to disposal areas approved by Consultant.
- .2 Protect open excavations against flooding and damage due to surface run-off.

3.5 Perimeter Insulation

- .1 Install insulation with spot daub application of adhesive to ensure tight contact to substrate and to prevent displacement during backfilling. Butt joints tight between boards.

3.6 Backfilling

- .1 Prior to backfilling, remove loose materials, debris, etc., from excavated areas. Do not place backfill on contaminated or frozen ground.

- .2 Do not use backfill material which is frozen or which contains ice, snow or debris.
- .3 Place granular material, grade and compact to levels which provide for superimposed work at levels shown.
- .4 Notify Consultant for inspection when backfill is complete to compacted levels indicated on Drawings.
- .5 Place granular backfill in layers not exceeding 200 mm in depth and thoroughly compact. Each layer shall be compacted and accepted before next layer is placed.
- .6 Backfill simultaneously on both sides of walls. Do not backfill until walls have reached their design strength.
- .7 Take necessary precautionary measures during compaction of fill adjacent to foundations, walls, drains, etc., that such items are not displaced from their proper location or damaged by compacting equipment. In the event damage or displacement occurs during filling or resulting from compaction of fill, correct same, to approval of Consultant and at no increase in Contract Price.
- .8 Place select fill for backfill where shown in layers not exceeding 200 mm, with each layer thoroughly compacted.

3.7 Underfloor Granular Sub-Base

- .1 Prior to filling, remove loose materials, debris, etc., from areas to be filled. Do not place fill on contaminated or frozen ground.
- .2 Do not use fill material which is frozen or contains ice, snow or debris.
- .3 Proof roll existing earth sub-grade in order to identify inconsistencies or soft areas.
 - .1 If a soft area is encountered, promptly notify the Consultant and obtain his instructions in writing to rectify the soft area.
 - .2 Proceed with filling operations only after inconsistencies or soft areas have been rectified.

- .4 Place Granular B sub-base in loose layers not exceeding 200 mm to a compacted depth of 150 mm terminating as follows except where shown otherwise:
 - .1 For facilities with permanent, watertight enclosure installed prior to placing concrete:
 - .1 Terminate compacted granular sub-base 200 mm below underside of slab. This allows for 150 mm granular base plus 50 mm cushion to absorb bleed water from concrete allowing concrete to dry evenly on both sides.
 - .2 For facilities that are not permanently enclosed with a watertight enclosure prior to pouring concrete:
 - .1 Terminate compacted granular sub-base 150 mm below underside of floor slab.

3.8 Underfloor Granular Base

- .1 Prior to filling, remove loose materials, debris, etc. from areas to be filled. Do not place fill on contaminated or frozen ground.
- .2 Do not use fill material which is frozen or contains ice, snow or debris.
- .3 Proof roll granular sub-base in order to identify inconsistencies or soft areas.
 - .1 If a soft area is encountered, promptly notify the Consultant and obtain his instructions in writing to rectify the soft area.
 - .2 Proceed with filling operations only after inconsistencies or soft areas have been rectified.
 - .3 Place Granular A crushed limestone base to a compacted thickness of 150 mm in loose layers not exceeding 200 mm.

3.9 Vapour Retarder

- .1 Ensure that granular surface is smooth and free of sharp projections that will puncture vapour retarder.

- .2 Place vapour retarder under floor slabs to receive epoxy, urethane and floor finishes installed with adhesive and thin set mortar:
 - .1 Install vapour retarder in accordance with ASTM E1643 and as specified.
 - .2 Ensure there are no discontinuities in vapour retarder at seams and penetrations.
 - .3 Unroll with the longest dimensions parallel with the direction of concrete placement.
 - .4 Join sections of vapour retarder and seal penetrations in vapour retarder with mastic tape. Ensure vapour retarder surfaces to receive mastic tape are clean and dry.
 - .5 Ensure there is no moisture entrapment by vapour retarder due to rainfall or ground water intrusion.
 - .6 Immediately repair holes in vapour retarder with self-adhesive repair tape.
 - .7 Seal around pipes and other penetrations in vapour retarder with pipe boots in accordance with manufacturer's instructions.
 - .8 Protect vapour retarder from damage during installation of reinforcing steel and utilities and during placement of concrete slab or granular materials.
 - .9 Immediately repair damaged vapour retarder in accordance with manufacturer's instructions.
- .3 Vapour Retarder Location
 - .1 If the structure is enclosed with a permanent, watertight enclosure prior to concrete placing, place a 50 mm compacted thickness of granular limestone screenings cushion on top of vapour retarder to underside of floor slab.
 - .2 If the structure is not enclosed with a permanent, watertight enclosure prior to concrete placing, place the vapour retarder directly under the floor slab. Do not use cushion method.
 - .3 In any case, extend vapour retarder 1000 mm into areas without vapour retarder.

3.10 Compaction

- .1 Use compaction equipment capable of obtaining required material densities.
- .2 Compaction Densities
 - .1 Granular materials: to 98% Standard Proctor Maximum Dry Density (SPMDD) in accordance with ASTM D698.
 - .2 Earth fill and earth subgrade: to 95% Standard Proctor Maximum Dry Density (SPMDD) in accordance with ASTM D698.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with power operated portable plate compactors.
- .6 Depth and layers specified are minimum dimensions of fill after compaction, except where loose layer is specified.
- .7 Ensure compaction operations do not cause vibration and noise levels exceeding acceptable limits established by authorities having jurisdiction.

3.11 Protection of Fill and Backfill

- .1 Protect filled and backfilled areas against damage from any cause.

3.12 Access Road Cleaning

- .1 Keep access roads clear of mud, debris and dirt resulting from work of this section.

3.13 Disposal of Surplus Materials

- .1 Remove from the site and legally dispose of, excess excavated material, waste material, trash, debris and rubble from the site.
- .2 Obtain and pay for all necessary regulatory approvals, consents and permits for disposal of surplus material.

End of Section

1 General

1.1 Section Includes

- .1 Trenching, bedding and backfilling to within 1.5 m of building face.

1.2 References

- .1 Conform to the latest edition of the following:
 - .1 MOECC, Ministry of the Environment and Climate Change
 - .2 OPSS.MUNI 1010, November 2013 - Material Specification for Aggregates - Granular A, B, M and Select Subgrade Material
- .2 Geotechnical Investigation
 - .1 Soil investigation of the site was carried out for the Owner as a guide in design and construction. A report and borehole logs on the investigation were prepared and are bound into the Specifications.
 - .2 No responsibility is assumed by the Owner or Consultant for the scope, accuracy, or interpretation of the geotechnical investigation report. Soil conditions between boreholes may be at variance with the information shown on the soil investigation report.
 - .3 Be responsible for including in the Work, costs for all conditions identified or inferred in the report.

1.3 Submittals

- .1 Prior to purchasing, submit to Consultant at jobsite, handcarry samples of granular bedding and backfill materials in clear, heavy duty plastic bags. Consultant will accept or reject material delivered to job site. Remove from the site any material considered unsuitable.

1.4 Quality Assurance

- .1 Testing and Inspection
 - .1 Be responsible for compaction throughout the work of this section, as it progresses and on completion to ensure the required densities are obtained.
 - .2 The Owner may appoint an independent testing company at his own expense for checking or approval of the placing and

compaction work. Pay all charges for retesting after making good defective areas. Coordinate construction schedule with Consultant so that testing company can be notified in advance.

- .3 Provide the following and pay for all associated costs as part of the Contract:
 - .1 Have sampling and testing of soil and aggregate materials and of compaction done by an independent, well established and qualified commercial Testing Agency. The personnel shall be qualified and have had experience on projects equal to the complexity of this project. Upon request from the Owner submit qualifications of the Testing Agency and include their personnel for approval prior to retaining either one of the agencies.
 - .2 Retain a Testing Agency to perform material testing and to prepare test reports and other submittals, and a separate Testing Agency to maintain field quality control of operations. The Owner reserves the right to request change in personnel or firms at any time.
 - .3 Submit proposed material, including off-site borrow material, to the Testing Agency for its analysis and report, in sufficient time so as not to delay the progress of the work. The Testing Agency shall approve all fill material prior to placement and shall observe placement to ensure lift thickness is as specified.
 - .4 Each Testing Agency shall submit, in duplicate, test report which includes tests, investigations, findings and recommendations to the Contractor and to the Owner, within 24 hours of the tests.
 - .5 The Testing Agency for field quality control of operations shall determine the compaction of material placed and shall conduct the following minimum number of in-place density tests after monitoring the placing and compacting of each lift.
 - .1 For mass filling: one test per lift of fill for each 100 square metres.
 - .2 For trenches: three tests per lift of trench backfill for each 150 linear metre

- .6 If compaction tests indicate that a layer has not been brought to the required compaction, re-compact the area, prior to placement of additional material, until the required compaction is obtained. If the layer has been covered by a subsequent operation, remove such material before re-compacting the defective layer.
- .4 Submit a testing and inspection program to account for all the items specified above. Submit to the Consultant at pre-construction meeting or prior to start of construction.

2 Products

2.1 Materials

- .1 Granular materials - general: New materials conforming to OPSS.MUNI 1010, free of organic content, imported from off-site, and sourced from a member of the Aggregate Producers Association of Ontario. Note: The use of slag and recycled aggregates is prohibited.
 - .1 Pipe bedding: New Granular A material conforming to OPSS.MUNI 1010, of crushed rock, or a mixture of crushed gravel, sand and fines.
 - .2 Conduit bedding: New mortar sand conforming to OPSS.MUNI 1010.
 - .3 Granular backfill: New material conforming to OPSS.MUNI 1010; Granular A and Granular B.
- .2 Select fill: Native excavated site material approved by Consultant and capable of being compacted to required density and free of:
 - .1 Any vegetable or organic matter and roots
 - .2 Cinders or ashes
 - .3 Foreign or building debris
 - .4 Rocks and stones larger than 75 mm
- .3 Identification Tapes: Brady "Identoline" or approved equivalent 75 mm minimum wide polyethylene underground line location tape, colour and legend to suit service.

2.2 Stockpiling of Granular Materials

- .1 Stockpile materials in a manner to prevent segregation.
- .2 Protect materials from contamination.
- .3 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
- .4 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Consultant within 48 hours of rejection.
- .5 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

3 Execution

3.1 Preparation

- .1 Protection
 - .1 Existing buried utilities and structures:
 - .1 Prior to commencing excavation, establish locations of existing buried service installations in the construction area. Notify service owners and obtain their approval to work in such areas. Place adequate markers and take protective measures to ensure that no damage is caused under the work of this Section. Repair damaged work as required at no change in Contract Price.
 - .2 Temporarily cover local existing catchbasins and manholes exposed to construction traffic to prevent entry of earth or debris.
 - .2 Trenches:
 - .1 Erect necessary hoardings, guardrails, markers; place temporary warning lights; take all other measures required to ensure that no damage or injury is caused to persons or damage to property resulting from this work.

- .2 Protect trenches and maintain warning devices during construction and during time when work is closed down for any cause.
- .3 Other contracts, existing buildings and surface features:
 - .1 Protect work of other trades or of other Contracts in progress or completed and protect Owner's existing properties, stored products, services and utilities from damage.

3.2 Excavation

- .1 Excavate trenches to lines and grades indicated and to 75 mm below bottom of pipe for bedding of same.
- .2 Unless otherwise authorized by Consultant in writing, do not excavate trenches more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation. Remove unsuitable material from trench bottom to extent at depth as directed by Consultant.
- .3 Build adequate shoring, bracing, sheeting, barriers and temporary crossings as necessary to ensure support of trenches, and safety and protection of workers.
- .4 Advise Consultant if unstable soil conditions are encountered at proposed design elevations. When approved by Consultant, excavate to revised depth and replace with compacted granular bedding material.
- .5 Backfill any "over-excavations" with granular bedding material and compact.
- .6 Remove loose material from bottom of trenches to ensure bedding material is placed against undisturbed soil.
- .7 Use pumps, hoses or other means as required to maintain trenches free of standing water.
- .8 Prevent inflow of groundwater or soil into trenches and excavations.
- .9 Where excavating is required adjacent to and parallel with and below any footing bearing, backfill with 15 MPa concrete to top of highest adjacent footing.
- .10 Keep width of trenches to a minimum to ensure minimum loading on pipe.

3.3 Granular Bedding

- .1 Place bedding in unfrozen condition.
- .2 Use specified bedding material from bottom of trench to 300 mm above top of pipe or 150 mm above top of electrical conduits. Hand place bedding in 150 mm layers and compact carefully to ensure proper backfilling and compaction around bottom quadrants and sides of pipe.
- .3 Place 150 mm bedding material for precast structures, compact to specified density.
- .4 Shape bed to grade and to provide continuous, uniform bearing surface for pipe or precast structure.
- .5 Shape transverse depressions to suit pipe joints.

3.4 Backfill

- .1 Place backfill in unfrozen condition.
- .2 Do not backfill trenches until piping, conduits and cables therein have been inspected, tested, and approved by inspection authorities having jurisdiction and Consultant.
- .3 Prior to backfilling, remove wood blocks or wedges used to prevent movement of piping during tests.
- .4 Backfill from 300 mm above top of pipe or 150 mm above electrical conduits to subgrade level, with Select Fill placed in 150 mm layers. Compact either by hand or by machine.
- .5 Where backfilling trenches through paved areas, allow for compacted granular material under paving specified in a separate section.
- .6 Place backfill uniformly and simultaneously on each side of pipe.

3.5 Compaction

- .1 Use compaction equipment capable of obtaining required material densities.
- .2 Compaction Densities
 - .1 Granular materials: to 100% Standard Proctor Maximum Dry Density (SPMDD) in accordance with ASTM D698.

- .2 Earth subgrade and select fill: to 98% Standard Proctor Maximum Dry Density (SPMDD) in accordance with ASTM D698.
- .3 In areas not accessible to rolling equipment, compact to specified density with power operated portable plate compactors.
- .4 Depth and layers specified are minimum dimensions of fill after compaction.
- .5 Protect backfilled areas against damage from any cause.

3.6 Pipe Identification

- .1 In each trench, install identification tape over route of pipe for full length of trench and approximately 300 mm below finished grade.

3.7 Access Road Cleaning

- .1 Keep access roads clear of mud, debris and dirt resulting from work of this section.

3.8 Disposal of Surplus Material

- .1 Remove from the site and legally dispose of, excess excavated material, waste material, trash, debris and rubble from the site.
- .2 Obtain and pay for all necessary regulatory approvals, consents and permits for disposal of surplus material.

End Of Section

1 General

1.1 Section Includes

- .1 Asphalt paving.

1.2 Related Requirements

- .1 Section 31 10 00, Site Preparation
- .2 Section 31 23 00, Excavation and Fill

1.3 Reference Standards

- .1 Conform to the latest edition of the following:
 - .1 OPSS.MUNI 310, November 2017 - Ontario Provincial Standard Specification, Construction Specification for Hot Mix Asphalt
 - .2 OPSS.MUNI 1101, November 2016 - Ontario Provincial Standard Specification, Material Specification for Performance Graded Asphalt Cement
 - .3 OPSS 1150, November 2010 - Ontario Provincial Standard Specification, Material Specification for Hot Mix Asphalt

1.4 Submittals

- .1 Submit Shop Drawings in accordance with Section 01 33 00. Submit the following:
 - .1 Asphalt mix designs.

1.5 Quality Assurance

- .1 Implement a quality control program which includes testing and inspection to comply with the intent of these Specifications.
- .2 Owner may employ an independent testing and inspection company to perform additional testing and inspection, and costs of such tests and inspections will be paid for by Owner.
- .3 Consultant may have cores taken from finished pavement by an independent testing firm to ensure that paving has been placed to required thickness as shown and to specified degree of compaction. Testing will be

at the expense of the Owner. Patch core holes resulting from the removal of samples, with asphaltic concrete material as specified herein.

- .4 Remove and replace areas of asphalt work proven defective by the tests or contrary to requirements shown and specified, as directed by Consultant and at no cost to Owner.

2 Products

2.1 Materials

- .1 Hot mix asphaltic concrete: Conforming to OPSS 1150, composed of a base course and a surface course, of types as shown.
 - .1 Asphalt cement: Conforming to requirements of OPSS.MUNI 1101, PGAC 64-28 for heavy duty traffic.
 - .2 Asphalt primer: Liquid asphalt emulsion, slow drying for spray or brush application.
 - .3 Recycled content: Use recycled asphalt product (RAP) in binder/base course mixes only. Do not use for wearing course.

3 Execution

3.1 Examination

- .1 Inspect state of paving base preparation and other existing conditions upon which Work of this section is dependent.
- .2 Report to Consultant in writing any defects or discrepancies.
Commencement of Work implies acceptance of existing conditions.

3.2 Preparation

- .1 Protection
 - .1 Protect buildings and work of other trades from damage caused by Work of this section. Correct damage caused by work of this section at no cost to Owner.
 - .2 Protect Work of this section from damage or deformation during period of construction. Remove and replace precast bumper curb

that are cracked, chipped, broken or otherwise damaged with new units acceptable to Consultant at no cost to Owner.

- .3 Erect temporary barriers, signs, protective covers, and rain protection as required. Remove protection when pavement is ready for traffic.
- .4 Do not apply pavement during wet weather, or unless granular base is dry in terms of asphaltic concrete paving.
- .2 Shape bases as necessary to correspond with finish elevations of pavement, providing for slope as shown. Compact granular bases to densities and methods specified in Section 31 23 00.
- .3 Correct irregularities or depressions that develop under rolling by loosening granular material at such locations and adding or replacing material and re-compacting until the surface is smooth and uniform. Dig out and replace soft spots which develop in granular base during or after compaction operations.
- .4 To aid in compaction work or to reduce dust nuisance or both, sprinkle granular base with water during rolling, tamping and blading. Where water is added for improvement of compaction, apply immediately ahead of the compacting unit pass.
- .5 Maximum allowable tolerance in cross-sectional and longitudinal profile is 6 mm at any place measured with a 3000 mm straight edge.

3.3 Priming

- .1 Prior to application of paving, prime paint vertical contact surfaces with SS-1 liquid asphalt emulsion.
- .2 Where paving of a course of asphalt has been delayed and/or will not be completed immediately after the underlying course of asphalt has been placed, thoroughly clean surfaces to be paved and apply one full coverage tack coat of asphalt primer immediately before paving.

3.4 Tack Coat

- .1 This work consists of the application tack coat of SS-1 emulsion to existing asphalt surfaces which will be covered with hot mix asphalt.

- .2 Power broom clean and air blast surfaces to remove debris and dust prior to tack coat.
- .3 Apply tack coat of SS-1 asphalt emulsion diluted with an equal part of water. Apply tack coat to continuous uniform thickness in accordance with manufacturer's recommended rate of application, to bonding surfaces and allow to dry to manufacturer's recommended tackiness before placing hot mix.

3.5 Application

- .1 Install asphaltic concrete paving to lines and compacted thicknesses shown conforming to methods of application and compaction requirements of OPSS.MUNI 310.
- .2 Clean prepared base of all foreign matter prior to application of the mixture to substrate.
- .3 Form well bonded joints. Cut back bituminous course to full depth in straight line as required to expose fresh vertical surfaces. Remove broken or loose material. Paint exposed vertical edge of asphaltic joints with asphalt primer prior to placing asphalt courses.
- .4 Form joints between new and existing work in same manner as specified herein for new work, and in such a manner as to ensure continuous bond at interface.
- .5 Finish surface of pavement free from depressions exceeding 6 mm when measured with a 3000 mm straight edge. Remedy any low or defective areas by cutting out the course and replacing it with fresh hot mixture, and re-compact.

3.6 Protection of Paving

- .1 After completion of surface course, prevent vehicular parking on pavement until surface has cured and hardened.

End of Section

2 Appendix D, D-2 Material Disclosures

2.1 Pending Approvals

- .1 At the time of tendering the following agency approvals are pending:
 - .1 Building Permit.

2.2 Subcontracting

- .1 Using the Appendix – List of Proposed Subcontractor form, the lowest compliant bidder must provide and submit with the bid a list of all proposed subcontractors to be used if awarded this tender.

2.3 Drawings

- .1 Sheets 1 to 40 (Cover Page to Drawing 01-S40-00-04) inclusive are provided with this Tender.
- .2 Some Drawings indicate some work completed previously under a separate contract known as “T-610-2014”. Where this is the case, the work of this Contract will be denoted as “T-1023-2018”.

2.4 Geotechnical Investigation Report

- .1 Report Number 1783303 prepared by Golder Associates dated September 1, 2017.