

The following professional seals and signatures are provided as required by the current Ontario Building Code, including amendments thereto, for the above noted project and apply only to those specification sections listed in the table of contents for this Project. The Architectural, Structural, Mechanical, Electrical consultants of record are consistent with those identified on the permit drawings and Commitment to General Review submitted with the Building Permit Application.

Architectural	Structural
	
Mechanical	Electrical
	

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DR KEY:

A = ARCHITECTURAL	S = STRUCTURAL	M = MECHANICAL
E = ELECTRICAL	LC = LEED CONSULTANT	EC = ENERGY CONSULTANT
C = CIVIL	L = LANDSCAPE CONSULTANT	O = OWNER

END OF SECTION

APPLICATION FOR PAYMENT FORM

To: <Enter Contractor's Name & Address>

Certificate
No. 001

Date:

Project
Name:

Attn:

Project No.:

Under the terms of the contract, by and between

<Enter Owner's Name>

(Owner), and

<Enter Contractor's Name>

(Contractor)

By law, the amount certified is subject to reduction by the amount of any lien of which you have received written notice. This certificate is not negotiable and is payable to the payee named in it; issuance, payment and acceptance are without prejudice to any rights of the Owner or Contractor under their contract. The issuance of this certificate for payment shall not be taken as a representation that the Consultant has made the contract price or that the Contractor has discharged the obligations imposed on him by law under the Workers' Compensation Act, or other applicable statutes, non compliance with which may render the Owner personally liable for the Contractor's default.

This is to certify that the value of *Workperformed* and *Products* delivered to the *Place of the Work* as of
(exclusive of Value Added Taxes).

<enter month
end date> is \$

Statement of Account

1	Original Contract Amount	\$	
2a	Authorized Change Orders to Date	\$	
2b	Authorized Change Orders That Affect Contract Value	\$	
3	Contract Amount to Date (1 + 2b)	\$	\$
4	Total Certified (Including this Certificate)	\$	
5a	Statutory Holdback of 10%	\$	
5b	Deficiency Holdback of 2% <if applicable>	\$	
6	Holdback Previously Released	\$	
7	Holdback Released this Draw	\$	
8	Balance of Holdback ((5a+5b)-(6 + 7))	\$	
9	Total Certified Less Balance of Holdback (4 - 8)	\$	\$
10	Less Previously Approved (Item 9 from previous Certificate)	\$	
11	Total Payment Recommended This Certificate (9-10)	\$	\$
12	Value Added Tax at 13% (13% of line 11)		\$
13	TOTAL AMOUNT PAYABLE CURRENT PERIOD INCLUDING VALUE ADDED TAX		\$
14	Unpaid Balance Under Contract including Holdback (3 - 9) EXCLUDING VALUE ADDED TAX		\$

1 GENERAL

1.1 GENERAL CONDITIONS

- .1 CCDC2 - 2020 The General Conditions of the Stipulated Price Contract are the General Conditions between the Owner and Contractor.

1.2 SUPPLEMENTARY CONDITIONS

- .1 Refer to Appendix B - Supplementary Conditions – Stipulated Sum for amendments and supplements to the General Conditions.

END OF SECTION

1 GENERAL

1.1 SECTION INCLUDES

- .1 Provide for all requirements related to setting out, co-ordination, administration, general construction, safety and protection of the work, workmen, Owner's personnel and the public, the ongoing and final cleaning, and any other work specified or indicated on the drawings.

1.2 BUILDING LAYOUT AND COMPLIANCE SURVEY

- .1 Arrange and pay for services of an Ontario Land Surveyor to establish property lines, erect a benchmark relating to nearest geodetic bench mark and stake principal corners of the new building.
- .2 Foundation Verification: Arrange and pay for services of an Ontario Land Surveyor to certify that building foundations are located in accordance with the Contract Documents. File certification with the Building Department and the Consultant immediately after the foundations are completed.
- .3 Site Compliance Survey: Arrange and pay for the services of an Ontario Land Surveyor to verify all final site elevations of all graded areas, landscaped areas and asphalt areas. The results of this survey must be submitted to the Consultant for review before any topsoil or asphalt surfaces are applied.

1.3 GRADES, LINES AND LEVELS

- .1 Verify grades, lines and levels indicated on the Drawings, particularly with relation to road and sidewalk elevations, with the Consultant at the time of laying out the building.
- .2 Make spot checks of grades shown and report any variation from the Contract Documents.

1.4 BATTER BOARDS

- .1 Erect, maintain and protect against damage strongly constructed batter boards, with adequate and uniform off-set, to determine precisely all main walls of the building.
- .2 Construct batter boards of new lumber with rigid supports.
- .3 Erect and maintain additional lines and elevation stakes at correct locations for the guidance of various trades.

1.5 PROJECT MEETINGS

- .1 Schedule and hold pre-construction, progress and pre-installation meetings throughout construction of work.
- .2 Pre-Construction Meeting
 - .1 Attend pre-construction meeting, to be held prior to commencement of work at place and time to be announced by Consultant.
 - .2 Agenda: Project co-ordination, administrative procedures, scheduling and other related subjects.

.3 Progress Meetings

- .1 Schedule and administer bi-weekly progress meetings until Substantial Performance of the Work.
- .2 Make physical arrangements, prepare agenda, and distribute notice of each meeting to participants, and to Consultant three days in advance of meeting date.
- .3 The Contractor shall preside at meetings, record minutes, and distribute copies to participants and to entities affected by decisions at meetings within 5 working days.
- .4 Locations of meetings: Project site office or other acceptable location.
- .5 Minimum Agenda:
 - .1 Approval of minutes of previous meetings.
 - .2 Review of work progress.
 - .3 Field observations, problems and decisions.
 - .4 Identification of problems which impede planned progress.
 - .5 Review of Submittal Schedule and status of submittals.
 - .6 Review of off-site fabrication and delivery schedules.
 - .7 Maintenance of Progress Schedule.
 - .8 Corrective measures to regain projected schedules.
 - .9 Planned progress during succeeding work period.
 - .10 Co-ordination of projected progress.
 - .11 Maintenance of quality and work standards.
 - .12 Effect of proposed changes on Progress Schedule and co-ordination.
 - .13 Other business relating to the work.

.4 Pre-installation Meetings

- .1 Where required by the specifications or when deemed appropriate by the Contractor, hold pre-installation meetings with members of relevant trades involved to discuss installation of specific building products or elements.

.5 Coordination Meetings with Other Contractors

- .1 From time to time, and as directed by Owner, attend and participate in coordination meetings dealing with interfacing between other contractors and Contractor.

.6 Attendance at Meetings

- .1 Contractor, job superintendent, Subcontractors, and Suppliers as appropriate to agenda, and authorized to act on behalf of the entity each represents; Owner, Consultant, professional consultants and others may attend as appropriate.

1.6 PARKING

- .1 Comply with local parking regulations.
- .2 No parking will be allowed at the Place of the Work unless approved by Owner.

1.7 SITE ACCESS AND TRAFFIC CONTROL

- .1 Reference Section 01 55 26.

- .2 Consult with authority having jurisdiction in establishing public thoroughfares to be used for site access haul routes.
- .3 Coordinate and comply with local authorities regarding necessary diversion of roads or sidewalks (if applicable).
- .4 Do not stack materials or supplies on existing roads or sidewalks.
- .5 Maintain access roads in good condition.
- .6 Protect permanent site improvements to remain such as curbs, pavement and utilities.
- .7 Maintain access for fire-fighting equipment and access to fire hydrants.

1.8 SECURITY

- .1 Protect and secure site, building, materials and equipment from theft, vandalism and unauthorized entry.

1.9 PROTECTION OF INSTALLED WORK

- .1 Refer to various sections of Specifications for specific requirements regarding protection of installed materials.
- .2 Provide protective coverings at walls, projections, corners and jambs, sills and soffits of openings in and adjacent to traffic areas.
- .3 Protect finished floors and stairs from dirt, wear and damage.
- .4 Waterproofed and Roofed Surfaces
 - .1 Restrict traffic to waterproofed and roofed surfaces and restrict material storage on these surfaces.
 - .2 When traffic or material storage is unavoidable, follow recommendations for protection of surfaces from manufacturer of roofing or waterproofing material.
 - .3 Keep waterproofed and roofed surfaces free of debris at all times.
 - .4 Protect pre-finished work, including windows, louvers, finish hardware and doors from damage by mortar, paint, wallboard compounds and other construction materials and operations.
 - .5 Replace or make good, to the satisfaction of the Consultant, any building surface or installed material damaged prior to acceptance by the Owner and/or due to failure to provide suitable protection.

1.10 FIRE PROTECTION

- .1 Provide and maintain, in good operating condition, adequate fire protection equipment suitable for fire hazards involved at convenient accessible locations during construction.
- .2 Avoid accumulations of combustible forms, form lumber and debris within building and vicinity.
- .3 Flammable Liquids
 - .1 Store flammable or volatile liquids in open air or in small detached structures or trailers.

- .2 Closely supervise storage of paint materials and other combustible finishing and cleaning products.
- .3 Do not store oily rags in closets or other tight spaces.
- .4 Comply with recommendations regarding fire protection made by representatives of insurance company carrying insurance on the work or by local fire chief or fire marshal.
- .5 Prohibit smoking in vicinity of hazardous operations.

1.11 SALVAGED MATERIALS

- .1 Remove salvaged materials from site unless otherwise specified.

1.12 ALTERATIONS TO EXISTING WORK

- .1 Where materials are to be removed for re-use or where existing finishes are to be cut out and later made good, employ qualified tradesmen skilled in the handling of each particular material. Make good to match existing adjoining construction.
- .2 Make good damage to the existing building or contents due to construction work.
- .3 New work in existing building shall conform to requirements of applicable trade sections.
- .4 Make certain that all services affected by work are cut off and are properly capped or diverted.
- .5 Do not interrupt services to or within the existing building without prior consultation with Owner.

1.13 SAFETY STATEMENT AND PROGRAM

- .1 Post a Safety Policy Statement at the Place of the Work and submit a copy of the safety program to the Consultant.

1.14 WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM

- .1 Ensure all workers are trained in WHMIS. Submit proof of training if requested by the Consultant.
- .2 Arrange for a complete set of material safety data sheets (MSDS) to be available at the Place of the Work for all Products being used in the Work.

1.15 DIVISION OF WORK

- .1 Division of the Work among Subcontractors and Suppliers is solely Contractor's responsibility. Consultant and Owner assume no responsibility to act as an arbiter to establish subcontract limits between Sections or Divisions of the Work.
- .2 The *Specifications* are divided into divisions and sections for convenience but shall be read as a whole and neither such division nor anything else contained in the *Contract Documents* will be construed to place responsibility on the *Consultant* to settle disputes among the *Subcontractors* and *Suppliers* in respect to such divisions.

- .3 The *Drawings* are, in part, diagrammatic and are intended to convey the scope of the *Work* and indicate general and appropriate locations, arrangement and sizes of fixtures, equipment and outlets. The *Contractor* shall obtain more accurate information about the locations, arrangement and sizes from study and coordination of the *Drawings*, including shop *Drawings* and shall become familiar with conditions and spaces affecting these matters before proceeding with the *Work*. Where site conditions require reasonable minor changes in indicated locations and arrangements, the *Contractor* shall make such changes at no additional cost to the *Owner*. Similarly, where known conditions or existing conditions interfere with new installation and require relocation, the *Contractor* shall include such relocation in the *Work*.
- .4 The *Contractor* shall arrange and install fixtures and equipment in such a way as to conserve as much headroom and space as possible. The schedules are that portion of the *Contract Documents* wherever located and whenever issued, compiling information of similar content and may consist of *Drawings*, tables and/or lists.

1.16 SPECIFICATIONS LANGUAGE AND STYLE

- .1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to Contractor, unless stated otherwise.
- .2 Complete sentences by reading "shall", " Contractor shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.
- .3 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.
- .4 When used in the context of a Product, read the word "provide" to mean "supply and install to result in a complete installation ready for its intended use".

1.17 CONTRACT DOCUMENTS FOR CONSTRUCTION PURPOSES

- .1 Contractor shall use the Issued for Construction set of documents (bid documents and all addendums) for construction purposes.
- .2 Owner will supply Contractor with a complete set of Contract Documents in electronic form before commencement of the Work. Contractor may print hard copies for construction purposes as required.

1.18 DOCUMENTS AT THE SITE

- .1 Keep the following documents at Place of the Work, stored securely and in good order and available to Owner and Consultant in hard copy form:
 - .1 Current Contract Documents, including Drawings, Specifications and addenda.
 - .2 Change Orders, Change Directives, and Supplementary Instructions.
 - .3 Reviewed Shop Drawings, Product data and samples.
 - .4 Field test reports and records.
 - .5 Construction progress schedule.
 - .6 Meeting minutes.
 - .7 Manufacturer's certifications.

- .8 Permits, inspection certificates, and other documents required by authorities having jurisdiction.
- .9 Current as-built drawings.
- .10 Material Safety Data Sheets (MSDS) for all controlled Products.

1.19 OWNER-SUPPLIED PRODUCTS

.1 Owner Responsibilities:

- .1 Order and pay for Owner-supplied Products not already in Owner's possession.
- .2 Arrange and pay for delivery of Owner-supplied Products F.O.B. the site, within time frames required by Contractor's progress schedule. If delivered sooner than required by Contractor's latest progress schedule submitted to Owner, arrange and pay for delivery to a temporary storage location and subsequent delivery to the site.
- .3 Advise Contractor in writing of the value of Owner-supplied Products for Contractor's insurance purposes.
- .4 Arrange and pay for delivery to Contractor of reviewed Shop Drawings, Product data, samples, and manufacturer's installation instructions.
- .5 Inspect deliveries jointly with Contractor.
- .6 Submit claims for transportation damage.
- .7 Arrange for replacement of damaged, defective or missing items identified at time of delivery.
- .8 Arrange for manufacturer's field services.
- .9 Arrange for delivery of manufacturer's warranties to Contractor for inclusion in operation and maintenance manual.

.2 Contractor Responsibilities:

- .1 Designate in progress schedule, time frames for delivery of Owner-supplied Products to the site and for receipt of related submittals. If the site is not ready to receive delivery of Owner-supplied Products within the time frame indicated in the latest progress schedule submitted to Owner, arrange and pay for delivery to a temporary storage location and subsequent delivery to the site.
- .2 Review all required submittals and notify Consultant of any observed discrepancies or anticipated problems.
- .3 Ensure that course of construction insurance is adequate to cover Owner-supplied Products.
- .4 Receive and unload Owner-supplied Products at the site.
- .5 Inspect deliveries jointly with Owner. Record and notify Owner and Consultant of shortages and visibly damaged or defective items.
- .6 Handle Owner-supplied Products at site, including uncrating and storage. Dispose of waste materials and debris.
- .7 Take appropriate precautions to protect Owner-supplied Products from loss or damage.

- .8 Repair or replace items damaged on site.
- .9 Assemble, install, connect, adjust, and finish Owner-supplied Products as specified.
- .10 Arrange for inspections required by authorities having jurisdiction as specified.
- .11 Arrange for or perform testing as specified.
- .12 Workmanship warranty for installation.

END OF SECTION

1 GENERAL

1.1 WORK AREAS

- .1 The Owner has arranged for easements for construction, storage and access as shown in the Contract Documents.
- .2 Make arrangements with property owners if additional areas are required. Obtain written agreements and submit copies to Consultant.
- .3 Confine operations within easements for construction, storage and access as shown in the Contract Documents.
- .4 Install and maintain snow fencing along working and storage areas and access routes.
- .5 Do not enter upon or occupy with workers, tools or materials any lands other than public streets, roadways, rights-of-way or easements indicated in the Contract Documents except after written consent has been received from property owner and a copy submitted to the Consultant. Any rentals or damages paid for occupying private lands shall be at the Contractor's expense.
- .6 Provide the Consultant with letters from owners of adjacent property stating that the reinstatement work carried out by the Contractor was satisfactory, in any case where damage has been caused to private property or work carried out on it. A similar letter is required from the owner of utilities damaged during construction.

1.2 RESTRICTED HOURS OF WORK IN OCCUPIED FACILITIES

- .1 While school is in session (January-June), no deliveries are to occur between the hours of 8:15am-9:15am and 2:45pm-4:15pm.
- .2 Hot asphalt work (including roofing) is not to occur while school is in session. Complete on weekends, PA days, and/or after hours.
- .3 Allow for hours of work restrictions in construction progress schedule.

1.3 NOISY WORK RESTRICTIONS IN OCCUPIED FACILITIES

- .1 Schedule excessively noisy work to avoid disturbance to building occupants. Perform excessive noise generating work outside of Owner's business hours.
- .2 Use powder actuated devices only with Consultant's written permission.

1.4 MAINTAINING LIFE SAFETY SYSTEMS IN OCCUPIED FACILITIES

- .1 Maintain operational life safety systems and public access to exits in occupied areas during all stages of the Work.
- .2 Determine nature and exact locations of existing fire and smoke sensors prior to the commencement of the Work. Avoid direct or indirect jarring while working in adjacent areas and exercise caution to avoid triggering these devices.
- .3 Be responsible for costs incurred by Owner on account of false fire alarms activated as a result of the execution of the Work without adequate precautions.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Refer to CCDC contract Part 4 ALLOWANCES and Supplementary Conditions for further requirements.

1.2 CASH ALLOWANCES

- .1 Cash allowances, cover the net cost to the Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation where indicated, and other authorized expenses incurred in performing the Work. Cash allowances shall not be included by a subcontractor in the amount for their subcontract work.
- .2 Supply only allowances shall include:
 - .1 Net cost of Products.
 - .2 Delivery to Site.
 - .3 Applicable taxes and duties, excluding HST.
- .3 Supply and Install allowances shall include:
 - .1 Net cost of Products.
 - .2 Delivery to Site.
 - .3 Unloading, storing, handling or products on site.
 - .4 Installation, finishing and commissioning of products.
 - .5 Applicable taxes and duties, excluding HST.
- .4 Inspection and Testing Allowances shall include:
 - .1 Net cost of Products.
 - .2 Applicable taxes and duties, excluding HST.
- .5 Other costs related to work covered by cash allowances are not covered by the allowance, but shall be included in the Contract Price.
- .6 Where costs under a cash allowance exceed the amount of the allowance, the Contractor will be compensated for any excess incurred and substantiated plus an allowance for overhead and profit as set out in the Contract Documents.
- .7 Progress payments on accounts of work authorized under cash allowances shall be included in the monthly certificate for payment.
- .8 Submit, before application for final payment, copies of all invoices and statements from suppliers and subcontractors for work which has been paid from cash allowances.
- .9 Include in the Bid Price a cash allowance of to address the cost of the following items:

#	Description	Value
.1	Inspection and Testing (As directed by Consultant)	\$5,000.00
.2	Finishing Hardware Supply and Installation	\$125,000
.3	Digitized Record Drawings (CAD)	\$1,500
.4	Communications	\$10,000
.5	Security	\$5,000
.6	PA System Extension	\$7,500
.7	Signage (including interior, exterior and construction signage)	\$2,500
	Total Cash Allowance	\$156,500

1.3 CONTINGENCY ALLOWANCE

- .1 Include in the Contract Price a 10% post contract contingency allowance.

END OF SECTION

1 GENERAL

1.1 DEFINITION

- .1 In this Section "Substitution" means a Product, a manufacturer, or both, not originally specified in Contract Documents by proprietary name but proposed for use by Contractor in place of a Product, a manufacturer, or both, specified by proprietary name.

1.2 SUBSTITUTION PROCEDURES

- .1 Contractor may propose a Substitution wherever a Product or manufacturer is specified by proprietary name(s), unless there is accompanying language indicating that Substitutions will not be considered.
- .2 Contractor may propose a Substitution wherever a Product or manufacturer is specified by proprietary name(s) and accompanied by language such as "or equal", "or approved equal", or other similar words. Do not construe such language as an invitation to unilaterally provide a Substitution without Consultant's prior acceptance in writing. Do not order or install any Substitution without a Supplemental Instruction or Change Order.
- .3 Provided a proposed Substitution submission includes all of the information specified in this Section under Submission Requirements for Proposed Substitutions, Consultant will promptly review and accept or reject the proposed Substitution.
- .4 Consultant may accept a Substitution if satisfied that:
 - .1 the proposed substitute Product is the same type as, is capable of performing the same functions as, interfaces with adjacent work the same as, and meets or exceeds the standard of quality, performance and, if applicable, appearance and maintenance considerations, of the specified Product,
 - .2 the proposed substitute manufacturer has capabilities comparable to the specified manufacturer, and
 - .3 the Substitution provides a benefit to Owner.
- .5 If Contractor fails to order a specified Product or order a Product by a specified manufacturer in adequate time to meet Contractor's construction schedule, Consultant will not consider that a valid reason to accept a Substitution.
- .6 If Consultant accepts a Substitution and subject to Owner's agreement, the change in the Work will be documented in the form of either a Supplemental Instruction or Change Order as specified in Section 01 26 00 – Contract Modification Procedures.
- .7 If a Substitution is accepted in the form of a Supplemental Instruction or Change Order, Contractor shall not revert to an originally specified Product or manufacturer without Consultant's prior written acceptance.

1.3 SUBMISSION REQUIREMENTS FOR PROPOSED SUBSTITUTIONS

- .1 Include with each proposed Substitution the following information:
 - .1 Identification of the Substitution, including product name and manufacturer's name, address, telephone numbers, and web site.
 - .2 Reason(s) for proposing the Substitution.

- .3 A statement verifying that the Substitution will not affect the Contract Price and Contract Time or, if applicable, the amount and extent of a proposed increase or decrease in Contract Price and Contract Time on account of the Substitution.
- .4 A statement verifying that the Substitution will not affect the performance or warranty of other parts of the Work.
- .5 Manufacturer's Product literature for the Substitution, including material descriptions, compliance with applicable codes and reference standards, performance and test data, compatibility with contiguous materials and systems, and environmental considerations.
- .6 Product samples as applicable.
- .7 A summarized comparison of the physical properties and performance characteristics of the specified Product and the Substitution, with any significant variations clearly highlighted.
- .8 Availability of maintenance services and sources of replacement materials and parts for the Substitution, as applicable, including associated costs and time frames.
- .9 If applicable, estimated life cycle cost savings resulting from the Substitution.
- .10 Details of other projects and applications where the Substitution has been used.
- .11 Identification of any consequential changes in the Work to accommodate the Substitution and any consequential effects on the performance of the Work as a whole. A later claim for an increase to the Contract Price or Contract Time for other changes in the Work attributable to the Substitution will not be considered.

1.4 INSTALLATION OF SUBSTITUTE PRODUCTS OR MATERIALS

- .1 When an accepted substitute, or "equivalent to" item of equipment or material, requires changes or additions to Project, make adjustments and changes required to coordinate Work for installation without additional cost to Owner.

1.5 CHANGES DUE TO SUBSTITUTIONS

- .1 Any additional cost, loss or damage arising from substitutions are Contractor's responsibility, notwithstanding approval or acceptance of such substitution by Owner or Consultant, unless such substitution was made at written request or direction by the Owner or Consultant.
- .2 Modifications to Contract Price Due to Substitutions:
 - .1 Owner will receive full credit for cost differential between specified item and proposed substitution.
 - .2 Substitution proposals that increase Contract Price will be rejected, unless proposed substitution was made at written request or direction by the Owner or Consultant.

END OF SECTION

1 GENERAL

1.1 APPLICATIONS FOR PAYMENT

- .1 Refer to GC 5.2 – APPLICATIONS FOR PAYMENTS
- .2 By the 1st day of the month following work complete, submit to Consultant a draft copy of Application for Payment.
- .3 Following review of draft and no later than the 5th day of the month, submit to Consultant one original and two copies of final form of Application for Payment.
- .4 Applications for payment must be submitted on the Contractor's invoice and must include monthly progress payment Form 00 62 76 totally complete. Refer to Section 00 73 02.
- .5 Each application for payment must include a Statutory Declaration, (except the 1st payment), and a completed Schedule of Values.
- .6 Each invoice must bear the Contractor's HST Registration Number.
- .7 The Consultant will prepare a Certificate of Payment and submit same to the Owner by the 15th of the month.
- .8 Payment of approved claims will be made by the Owner to the Contractor by the first day of the month following.

1.2 ALLOWABLE MARKUPS ON CHANGES

- .1 For extra work added to the Contract, the Contractor and Subcontractors are entitled to a total markup for overhead and profit of 10% on work carried out by their own forces and 5% on work carried out by their Subcontractors.
- .2 The proper interpretation of application of this markup shall be at the discretion of the Consultant.
- .3 Contractors and Subcontractors who subcontract work out to separate companies who are considered by the Consultant to be under the same "corporate umbrella" will be eligible for only a single markup on extra work.

END OF SECTION

1 GENERAL

1.1 SUMMARY

- .1 This Section specifies Contractor's responsibilities for preparation and submission of schedules and other documentation related to tracking construction progress.
- .2 The purpose of submitting progress schedules is to:
 - .1 inform Owner and Consultant of actual progress versus planned progress, and
 - .2 provide assurance that scheduling issues are being proactively identified and addressed in a timely manner, and that planned progress is being maintained as closely as possible.

1.2 CONSTRUCTION PROGRESS SCHEDULING

- .1 Submit initial schedule to the Consultant and the Board in duplicate within seven (7) days after following the award.
- .2 Schedule Format.
 - .1 Prepare schedule in form of a horizontal bar chart.
 - .2 Split horizontally for projected and actual performance.
 - .3 Provide horizontal time scale identifying each Working Day of each week.
- .3 Schedule Submission.
 - .1 Consultant will review schedule and return reviewed copies within five (5) days after receipt.
 - .2 Submit schedules in electronic format, forward to the Consultant and Owner as a pdf. File.
 - .3 Resubmit finalized schedule within five (5) days after return of review copy.
 - .4 Submit revised progress schedule with each application for payment.
 - .5 Distribute copies of revised schedule to:
 - .1 Job site office.
 - .2 Subcontractors.
 - .3 Other concerned parties.
 - .6 Instruct Consultant to report to Contractor within ten (10) days, any problems anticipated by timetable shown in schedule.
- .4 Submit revised schedules with Application for Payment, identifying changes since previous version.
- .5 Select either of the following paragraphs to identify the type and format of schedule required.
- .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:
 - .1 Site clearing.
 - .2 Site utilities.
 - .3 Foundation Work.
 - .4 Structural framing.
 - .5 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 written 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 subcontractors.

1.3 SCHEDULES

- .1 Within seven 7 days following the award of the Contract, submit a detailed cash flow chart broken down on a monthly basis, in a manner acceptable to the Consultant. Cash flow chart shall indicate anticipated Contractor's monthly progress billings from commencement of work until completion.
- .2 Update cash flow chart whenever changes occur to scheduling and in manner and at times satisfactory to Consultant.
- .3 Submit schedule of values at least fourteen (14) days before the first application
- .4 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.
- .4 Product Delivery Schedule.
- .5 Cash Allowance Schedule for acquiring Products and Installation.
- .6 Shutdown or closure activity.

1.4 SHOP DRAWING SUBMITTAL 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 shop drawings and samples will be required for Owner-furnished products.
- .4 Include dates when reviewed submittals will be required from Consultant.
- .5 Provide final signed off copies of the shop drawings in digital format to the Board.

1.5 RECORDING ACTUAL SITE CONDITIONS ON AS-BUILT DRAWINGS

- .1 Obtain a hard copy set of construction Drawings for the purpose of creating as-built drawings. Record information and maintain as-built drawings in clean, dry and legible condition.
- .2 Clearly label each drawing as "AS-BUILT DRAWING". Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .3 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 pipes, ducts, conduits, outlets, fixtures, access panels, and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by Change Orders and Supplemental Instructions
 - .6 References to Shop Drawings, where Shop Drawings show more detail.
- .4 Do not use as-built drawings for construction purposes.

1.6 PROGRESS PHOTOGRAPHS

- .1 Arrange for periodic digital photography to document and provide a photographic record of the progress of the Work.
- .2 Identify each photograph by project name and date taken.
- .3 Submission: Submit electronic copy of progress photographs of project, Digital format, minimum 300 in megapixel resolution.
- .4 Provide both interior and exterior photographs.

- .5 Number of Viewpoints: Locations of viewpoints determined by Consultant.
- .6 Frequency: Monthly with progress statement. Provide the required number of pictures to accurately reflect the submitted progress percentage.
- .7 Do not use progress or any other Project photographs for promotional purposes without Owner's written consent.

END OF SECTION

1 GENERAL

1.1 SUBMITTAL PROCEDURES

- .1 Refer to 01 33 00 for submittal procedures.

1.2 SHOP DRAWINGS SCHEDULE

Electrical				
SPECIFICATION SECTION	EQUIPMENT	DUE DATE	DATE SUBMITTED	REVIEWED
26 05 19 Wire and Cable	Building Wires			
	Armoured Cable			
	Aluminum Sheathed Cable			
	Tech Cable			
	Non-Metallic Sheathed Cable			
	Mineral Insulated Cables			
	Fire Alarm Cables			
	Low Voltage Wiring			
26 05 33 Raceway and Boxes For Electrical Systems	Conduit, Connectors and Fittings			

Electrical				
SPECIFICATION SECTION	EQUIPMENT	DUE DATE	DATE SUBMITTED	REVIEWED
	Rigid metal Conduit			
	E.M.T			
	Flexible Conduit			
	Rigid P.V.C			
	Outlet Boxes			
	Rigid Metal Expansion Joint			
	Rigid P.V.C Expansion joint			
26 05 39 Underfloor Raceways For Electrical Systems	Underfloor Ducts			
	Services Fittings			
26 05 73 Coordination Study	Coordination Study			
26 05 76 Arc-Flash	Arc-Flash Study			

Electrical				
SPECIFICATION SECTION	EQUIPMENT	DUE DATE	DATE SUBMITTED	REVIEWED
26 09 00 Instrumentation and Control For Electrical Systems	Modular Relay Panel			
	Switches			
	Relay Panel			
	Relays			
	PLC Control Panel			
	Meters			
	Transmitter			
	HMI			
	Sensors			
	Valves			
	PC/Software			
	Analyzer			

Electrical				
SPECIFICATION SECTION	EQUIPMENT	DUE DATE	DATE SUBMITTED	REVIEWED
26 09 01 Low Voltage Lighting Control System	Control Panel			
	Dimming/ Relay			
	System Software			
	Sensors/Wiring Devices			
	TRAINING/COMMISSIONING			
26 09 23 Occupancy Sensors	Sensors			
26 10 00 medium-Voltage Electrical Distribution	Primary Service Components			
	Primary Service Switchgears			

Electrical				
SPECIFICATION SECTION	EQUIPMENT	DUE DATE	DATE SUBMITTED	REVIEWED
26 20 00 Low Voltage Electrical Equipment	Padmount Medium Voltage Transformer			
	PRIMARY SERVICE SUBSTATION			
	Indoor Ventilation metal Enclosed Unit SubStation			
	Primary Main Switch Cubicle			
	Dry Type Power Transformer Cubicle			
	Secondary Main/metering/Distribution Cubicle			
	Air Circuit Breaker			
	Meter Cabinets			
	Dry Type Transformers			

Electrical				
SPECIFICATION SECTION	EQUIPMENT	DUE DATE	DATE SUBMITTED	REVIEWED
26 22 00 Low-Voltage Transformers	Super Isolation Transformers			
	Electrostatic Shielded Transformers			
	Control Transformers			
26 24 19 Motor Control Centres	Motor Control Centre			
	Variable Speed Drives			
	Motor Starters			
	Control Indicating Devices			
	Remote Control Stations			
26 25 00 Enclosed Bus Assemblies	Duct Housing			
	BusDuct			
	Bus plugs			

Electrical				
SPECIFICATION SECTION	EQUIPMENT	DUE DATE	DATE SUBMITTED	REVIEWED
26 27 00 Low voltage Distribution Equipment	Pre-tendered Equipment			
	Switchboard			
	Switchboard Main Disconnecting device			
	Switchboard Customer Meter Centre			
	Switchboard Circuit Breakers			
	Distribution Panels			
	Variable Speed Drives			
	Circuit Breaker Panelboards			
	Disconnect Switches			
	Motor Starters			
	Contactors			
	Relays			

Electrical				
SPECIFICATION SECTION	EQUIPMENT	DUE DATE	DATE SUBMITTED	REVIEWED
	fuses			
26 27 26 Wiring Device	Wiring Devices			
	Individual Light Dimmers			
	Interval Timers			
	Occupancy Sensors			
	Cover Plates			
	Photocells			
	Floor Boxes			
26 32 00 Packaged Generator Assemblies	Engine-Generator Set			
	Engine Cooling System			
	Engine Exhaust System			
	Engine Full System			
	Alternator			
	Engine-Generator Control			

Electrical				
SPECIFICATION SECTION	EQUIPMENT	DUE DATE	DATE SUBMITTED	REVIEWED
	Auxiliary Equipment			
	Automatic Transfer Switch			
26 33 53 Static Uninterruptable Power Systems	Performance Specifications			
	Electrical Specifications			
	Mechanical Specifications			
	Major Components Description			
26 36 00 Transfer Switches	Automatic Transfer Switch			
24 43 00 Transient Voltage Suppression	Surge Suppressors			
26 50 00 Lighting	General Fixtures			
	T8 Lamp Ballasts			

Electrical				
SPECIFICATION SECTION	EQUIPMENT	DUE DATE	DATE SUBMITTED	REVIEWED
	Dimming Ballasts			
	Compact Fluorescent Ballast			
	HID Ballast			
	Lamps			
	Lenses			
	Lighting Track			
	Accessory Products			
	Source Quality Control			
	LED Fixtures And Drives			
	Fibre Optic Lighting System			
26 52 00 Emergency Lighting	System Component Number and Dimensions			
	System Operating Characteristics and Functions			
	Rough-in Details			
	WIRING SCHEMATICS			

Electrical				
SPECIFICATION SECTION	EQUIPMENT	DUE DATE	DATE SUBMITTED	REVIEWED
26 60 00 Miscellaneous Equipment And Appliances	Battery Clocks			
	Service Poles			
	Electric Heating Units			
	Floor Boxes			
	Heat Tracing			

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with Instructions to Bidders, the General Conditions of the Contract, Supplementary Conditions and the General Requirements of Division 1.

1.2 SECTION INCLUDES

- .1 Photographs of construction prior to commencement of demolition, excavation and thereafter during the progress of the Work.

1.3 PHOTOGRAPHS

- .1 Submit electronic files and two (2) hard copies of each required photograph, mounted and labelled.
- .2 Prints: Colour, high resolution, low grain photographs with matte finish prints; 8 inches x 10 inches. Depth of field is to be maximum range and within focus to clearly show work.
- .3 Mounting: Insert each print in punched clear plastic sleeve suitable for insertion into binder.
- .4 Labelling: Affix label to back of each print with the following information:
 - .1 Project Name.
 - .2 Date of Exposure.
 - .3 Description of location or view of exposure.
 - .4 Key plan of building, indicating general location and direction of photograph.
- .5 Electronic files of photographs shall become property of Owner.

1.4 PRECONSTRUCTION PHOTOGRAPHS

- .1 Prior to commencement of excavation, take three photographs of site from different views, where directed by Owner.
- .2 Survey condition of adjoining property and improvements.
- .3 Take additional photographs to record prior settlement or cracking of structures, pavements and their improvements. Photograph interior and exterior conditions.
- .4 Prepare a list of damages, verified by dated photographs and signed by Contractor and others conducting investigation.

1.5 PROGRESS PHOTOGRAPHS

- .1 Upon commencement of construction and once a month, at same time of each month, through final completion of work, provide the following photographs:
 - .2 Locations:
 - .1 Owner will determine locations from which photographs will be taken.

.2 Such locations will remain fixed during progress of work, until otherwise directed by Owner.

.3 Quantity:

.1 Five exterior views until interior work commences.

.2 Once interior work commences, 3 exterior views, and 2 interior views for each floor.

1.6 COMPLETION PHOTOGRAPHS

.1 At completion of the work, take 10 final photographs from exterior and interior vantage points determined by the Owner.

END OF SECTION

1 GENERAL

1.1 ADMINISTRATIVE

- .1 Submit specified submittals to Consultant for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time or for Product substitutions or other deviations from the Drawings and Specifications.
- .2 Where required by authorities having jurisdiction, provide submittals to such authorities for review and approval.
- .3 Present Shop Drawings, product data, samples and mock-ups in Metric (SI) units. Shop drawings containing imperial measurements will be rejected.
- .4 Where items or information is not manufactured or produced in SI Metric units, converted values within the metric measurement to the next largest imperial size available. Tolerances of .0625 acceptable.
- .5 Do not proceed with Work affected by a submittal until review is complete.
- .6 Review submittals, provide verified field measurements where applicable, and affix Contractor's review stamp prior to submission to Consultant. Contractor's review stamp represents that necessary requirements have been determined and verified, and that the submittal has been checked and coordinated with requirements of the Work and Contract Documents.
- .7 Verify field measurements and that affected adjacent work is coordinated.
- .8 Submittals not meeting specified requirements will be returned with comments.
- .9 Reproduction of Contract Drawings are not acceptable as Shop Drawings, unless specifically authorized in writing by Consultant. Even if reproductions or Contract Drawings are accepted as Shop Drawings, the final product must match drawings exactly and must match adjoining work perfectly; and responsibility for accuracy and dimensional coordination remains with the trade.
- .10 Do not propose Substitutions or deviations from Contract Documents via Shop Drawing, Product data and sample submittals.
- .11 Maintain reviewed submittals, including all Shop Drawings, product data and samples at the Place of the Work, available for reference by Owner and Consultant.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit Shop Drawings, Product Data and Samples to:

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Kitchener, ON N2M 1A1

- .2 Indicate Products, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Work.
- .3 Where Products attach or connect to other Products, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross-references to Drawings, Specifications and other already reviewed Shop Drawings.
- .4 Accompany submittals with a transmittal information including:

- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification of each submittal item and quantity.
- .5 Other pertinent data.
- .5 Shop Drawing submittals shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, date, and signature of Contractor's authorized representative responsible for Shop Drawing review, indicating that each Shop Drawing has been reviewed for compliance with Contract Documents and, where applicable, that field measurements have been verified.
 - .5 Details of appropriate portions of the 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 Relationships to other parts of the Work.
- .6 Product data submittals shall include material safety data sheets (MSDS) for all controlled Products.
- .7 Submit three (3) copies of Shop Drawings for review.
- .8 Submit three (3) copies of Product data sheets or brochures where specified in the technical Specifications.

- .9 Where a submittal includes information not applicable to the Work, clearly identify applicable information and strike out non-applicable information.
- .10 Supplement standard information to include details applicable to Project.
- .11 Allow fourteen (14) Working Days for Consultant's review of each submittal.
- .12 If upon Consultant's review no errors or omissions are discovered, or if only minor corrections are required as indicated, submittal will be returned and fabrication or installation of Work may proceed.
- .13 If upon Consultant's review significant errors or omissions are discovered, a so noted copy will be returned for correction and resubmission. Do not commence fabrication or installation.
- .14 Consultant's notations on submittals are intended to ensure compliance with Contract Documents and are not intended to constitute a change in the Work requiring change to the Contract Price or Contract Time. If Contractor considers any Consultant's notation to be a change in the Work, promptly notify Consultant in writing before proceeding with the Work.
- .15 Resubmit corrected submittals through same procedure indicated above, before any fabrication or installation of the Work proceeds. When resubmitting, notify Consultant in writing of any revisions other than those requested by Consultant.

1.3 INTERFERENCE DRAWINGS

- .1 Prepare drawings indicating relationship of new and existing and unforeseen conditions at congested areas prior to commencement of the Work in those areas.
- .2 For congested locations, before installation, prepare drawings showing relationships of ductwork, conduit, piping, sprinklers, ceiling supports and framing, communication and specialized equipment located within ceiling and shaft spaces.
- .3 Indicate locations of visible items such as air handling outlets, light fixtures, smoke detectors, sprinkler heads, communication grilles and access panels occurring at these locations.
- .4 Ensure interference drawings are initialled by a responsible person of each Subcontractor involved along with Contractor's signature and submitted to Consultant for review and record purposes.

1.4 SAMPLES

- .1 Submit three (3) samples physically identical with proposed material or product for Consultant's review where specified in the technical Specifications. Label samples as to origin, Project name, and intended use.
- .2 Deliver samples prepay any shipping charges involved for delivering samples to destination point and returning to point of origin if required.
- .3 Notify Consultant in writing of any deviations in samples from requirements of Contract Documents.
- .4 Where a required colour, pattern or texture has not been specified, submit full range of available Products meeting other specified requirements.
- .5 Consultant selection from samples is not intended to change the Contract Price or Contract Time. If a selection would affect the Contract Price or Contract Time, notify Consultant in writing prior to proceeding with the Work.
- .6 Resubmit samples as required by Consultant to comply with Contract Documents.

- .7 Reviewed and accepted samples will establish the standard against which installed Work will be reviewed.

1.5 CONTRACTOR'S REVIEW OF SUBMITTALS

- .1 Prior to transmitting submittal, review and approve submittal, and affix Contractor's signature and stamp to submittal cover page.
- .2 Consultant will not review submittals that do not bear the Contractor's signature and in the case of mechanical and electrical, the Subcontractors' stamp and signature also. If it appears a review has not taken place, the submittal will be returned to the Contractor not reviewed.
- .3 By signing and submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents that he has approved, determined and verified dimensions, quantities, field dimensions, relations to existing work, coordination with work to be installed later, coordination with information on previously accepted Shop Drawings, Product Data, Samples, or similar submittals and verification of compliance with requirements of Contract Documents.
- .4 In reviewing Shop Drawings, Product Data, Samples, and similar submittals, the Consultant shall be entitled to rely upon Contractor's representation that information in submittals is correct and accurate.
- .5 Submittals that are returned or rejected because of insufficient Contractor review or coordination will not be justification for a claim for extension of time.

1.6 CONSULTANT'S REVIEW OF SUBMITTALS

- .1 After receipt of submittal, Consultant will review it for conformance to Contract Documents and certify that this review has been performed by affixing Consultant's review stamp.
- .2 Review Time:
 - .1 Allow not less than ten working days for processing and review of any one submittal except as noted below, and except when processing must be delayed for coordination with subsequent submittals. Consultant will advise Contractor promptly of such delay.
 - .1 Allow an additional five working days for processing and review of submittals specified in Divisions 05, 09, 21, 22, 23, 25, 26, 27, and 28.
 - .2 Identify those submittals for which review is necessary urgently.
 - .3 Allow 4 weeks after submission of all samples in Division 09, for the Consultant to select finishes and prepare a colour schedule.
 - .2 Review period begins on date of receipt of submittal by Consultant and extends to mailing date of return to Contractor.
- .3 Action Following Consultant's Review: Process submittals according to notations placed on them by Consultant.
 - .1 Reviewed:
 - .1 Proceed with fabrication, purchase, or both, of items in submittal, subject to the minor revisions or clarifications if any, included in the Consultant's review.
 - .2 Reviewed as Modified:

- .1 Proceed with fabrication, purchase, or both, only after the original drawing has been corrected. Mechanical and Electrical Contractors to include corrected drawings in Maintenance and Operating Manuals.
- .3 Resubmit:
 - .1 Submission is rejected, therefore fabrication and work indicated cannot proceed.
 - .2 Correct submission and resubmit.
- .4 Not Reviewed:
 - .1 Submission was not reviewed for one of the following reasons:
 - .1 Completed submittal cover page was not provided.
 - .2 Contractor's stamp was not found on submission.
 - .3 In the Consultant's opinion, review was not necessary.
- .4 Limitations of Consultant's Review:
 - .1 Consultant's review is not a complete check, but only review of general methods of construction and detailing, subject to limitations and requirements set forth in GC 3.10.5.
 - .2 Consultant's review does not authorize changes in Contract Amount or Contract Time unless so stated in a separate Proposed Change or Change Directive.
 - .3 If the Contractor feels the shop drawing have changed the Contract Price or Contract Time, he must notify the Consultant within 7 working days from date of Consultant's transmittal otherwise it will be assumed no change in Contract Price or Contract Time will be considered.
 - .4 Review of shop drawings is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the reviewer approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the 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 the Place of the Work, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of the Work.
- .5 After the Consultant's review of a submittal or resubmittal, changes will not be considered unless accompanied by an explanation acceptable to the Consultant concerning reason substitution is necessary.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

- .1 "Reference standards" means consensus standards, trade association standards, guides, and other publications expressly referenced in Contract Documents.
- .2 Where an edition or version date is not specified, referenced standards shall be deemed to be the latest edition or revision issued by the publisher at the time of bid closing. However if a particular edition or revision date of a specified standard is referenced in an applicable code or other regulatory requirement, the regulatory referenced edition or version shall apply.
- .3 Reference standards establish minimum requirements. If Contract Documents call for requirements that differ from a referenced standard, the more stringent requirements shall govern.
- .4 If compliance with two or more reference standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Consultant for clarification.
- .5 Within the Specifications, reference may be made to the following standards writing, testing, or certification organizations by their acronyms or initialisms:
 - .1 AA - Aluminum Association
 - .2 ACI - American Concrete Institute
 - .3 AISC - American Institute of Steel Construction
 - .4 ANSI - American National Standards Institute
 - .5 ASME - American Society of Mechanical Engineers
 - .6 ASTM - American Society for Testing and Materials
 - .7 AWMAC - Architectural Woodwork Manufacturers Association of Canada
 - .8 AWPA - American Wire Producers Association
 - .9 CaGBC - Canadian Green Building Council
 - .10 CGSB - Canadian General Standards Board
 - .11 CISC - Canadian Institute of Steel Construction
 - .12 CPCI - Canadian Prestressed Concrete Institute
 - .13 CSA - Canadian Standards Association
 - .14 CSSBI - Canadian Sheet Steel Building Institute
 - .15 CWB – Canadian Welding Bureau
 - .16 ICEA - Insulated Cable Engineers Association
 - .17 IEEE - Institute of Electrical and Electronics Engineers
 - .18 IGMAC – Insulating Glass Manufacturers Association of Canada

- .19 LEED - Leadership in Energy and Environmental Design
- .20 MPP – Master Painters Institute
- .21 MSS - Manufacturers Standardization Society of the Valve and Fittings Industry
- .22 NAAMM - National Association of Architectural Metal Manufacturers
- .23 NEMA - National Electrical Manufacturers Association
- .24 NFPA - National Fire Protection Association
- .25 NHLA - National Hardwood Lumber Association
- .26 NLGA - National Lumber Grades Authority
- .27 SSPC – The Society for Protective Coatings
- .28 TTMAC - Terrazzo, Tile and Marble Association of Canada
- .29 ULC - Underwriters' Laboratories of Canada

1.2 CERTIFICATES

- .1 Definition: Notarized certification of type specified.
- .2 Do not construe certification as relieving Contractor from furnishing satisfactory materials if, after tests are performed on selected samples, material does not meet specified requirements.
- .3 Professional Certification:
 - .1 When professional certification of performance criteria of materials, systems or equipment is required by Contract Documents, Owner and Consultant are entitled to rely on such certifications.
 - .2 Neither Owner nor Consultant shall be expected to make independent examination or verification of professional certifications.

1.3 CODES, FEES, PERMITS AND CERTIFICATES

- .1 Refer to GC 10.2.
- .2 Execute the Work in accordance with the laws, rules, and regulations of the local and provincial codes and other authorities having jurisdiction.
- .3 In the event that specified Products do not meet these conditions, notify Consultant in writing before ordering or installing same.
- .4 If any Contractor chooses to carry out work in contravention of any Code or By-law, he shall be responsible for all changes required to obtain Code acceptance.
- .5 Expedite obtaining the building permit from the municipality.
- .6 Obtain necessary permits and notices, pay all fees in order that the work hereinafter specified may be carried out and he shall furnish any certificates necessary as evidence that the work installed conforms with the laws and regulations of all authorities having jurisdiction before final certificates are issued.

- .7 All changes and alterations required by an authorized inspector of any authority having jurisdiction shall be carried out in accordance with the General Conditions of the Contract.
- .8 All equipment supplied must have approval of CSA, ULC, NFPA, IAO, FM, or FIA and any other authority having jurisdiction.

1.4 MANUFACTURER'S FIELD SERVICES

- .1 When required by Contract Documents, have manufacturer provide qualified representative to observe field conditions, conditions of surfaces and installation, quality of work to start-up equipment and to test, adjust and balance equipment as applicable.

1.5 CONTRACTOR'S QUALITY CONTROL

- .1 Maintain quality control over supervision, Subcontractors, Suppliers, manufacturers, Products, services, quality of work and existing conditions, to produce Work in accordance with requirements of Contract Documents.

1.6 INDEPENDENT INSPECTION AND TESTING AGENCIES

- .1 Except as otherwise specified, Owner will retain and pay for independent inspection and testing agencies to inspect, test, or perform other quality control reviews of parts of the Work.
- .2 Retain and pay for inspection and testing that is for Contractor's own quality control or is required by regulatory requirements.
- .3 Section 01 21 00 – Allowances specifies a cash allowance for independent inspection and testing services to be retained and paid for by Contractor. Cash allowance excludes any inspection and testing that is for Contractor's own quality control or is required by regulatory requirements.
- .4 Employment of inspection and testing agencies by Contractor or Owner does not relieve Contractor from responsibility to perform the Work in accordance with Contract Documents.
- .5 Allow and arrange for inspection and testing agencies to have access to the Work, including access to off site manufacturing and fabrication plants.
- .6 For inspection and testing required by Contract Documents or by authorities having jurisdiction, provide Consultant and inspection and testing agencies with timely notification in advance of required inspection and testing.
- .7 Submit test samples required for testing in accordance with submittals schedule specified in Section 01 32 00 – Construction Progress Documentation.
- .8 Provide labour, Construction Equipment and temporary facilities to obtain and handle test samples on site.

1.7 INSPECTION AND TESTING AGENCY REPORTS

- .1 For inspection and testing required by Contract Documents or by regulatory requirements, and performed by Contractor retained inspection and testing agencies, submit to Consultant copies of reports.
- .2 For inspection and testing performed by Owner retained inspection and testing agencies, copies of inspection and testing agency reports will be provided to Contractor.

1.8 INSPECTION AND TESTING PROCEDURES

.1 Start-up Meeting

- .1 Conduct an initial start-up meeting with the Inspection and Testing Company, scheduled at least one week in advance of work commencing at the Place of the Work.
- .2 Ensure an up-to-date construction schedule is available such that the Inspection and Testing Company and Consultant can develop a testing program.
- .3 Re-inspection
- .4 Any re-inspections that are required due to deficiencies uncovered at the initial inspection shall be at the expense of the Contractor.
- .5 Payment for Inspection and Testing Services
- .6 Pay costs for inspection and testing from the cash Allowance specified in Section 01 21 00.
- .7 Re-inspection costs are not included in the cash Allowance, and are to be paid directly by the Contractor outside of the Contract.

.2 Reports

- .1 The Inspection and Testing company shall issue written reports to the Contractor and to the Consultant indicating the location and results of specific material tests, as well as the results of visual inspections, and the instructions given at the Place of the Work.
- .2 If, in the opinion of the Inspection and Testing Company, the specified materials are not being used or the required results are not being achieved, the Inspection and Testing Company shall verbally inform the Contractor of the deficiencies and promptly confirm the deficiencies in writing to the Contractor and the Consultant. Note in the written report corrective action taken by the Contractor and the results thereof.
- .3 Accompanying each report shall be a key plan of the Project, clearly indicating the areas to which the report refers. These plans shall also be submitted with and keyed into the invoices for the inspection and testing.

.3 Responsibilities:

- .1 The following indicates the minimum responsibilities for each of the parties to ensure the quality of construction is maintained.
- .2 Contractor
 - .1 Ensure the quality of the Work meets the requirements of the Contract Documents.
 - .2 Once the testing program has been developed, notify the Testing Company and the Consultant in advance, to request the required inspection or test.
 - .3 Consult with the testing company on construction techniques, but retain responsibility for construction means, methods and techniques in accordance with the General Conditions of the Contract.
 - .4 Changes in construction means, methods and techniques required to meet quality requirements of the Contract Documents shall not be considered as cause for an extra to the Contract.

- .5 Defective materials or quality of work whenever found at any time prior to the final acceptance of the Work shall be rejected, regardless of previous inspection.
- .6 Inspection does not relieve Contractor of responsibility, but is a precaution against oversight and error.
- .7 Remove and replace defective work at own expense, and be responsible for additional costs incurred by other Sections affected by this replacement.
- .3 Inspection & Testing Company
 - .1 Provide the level of inspection, testing and reporting as described in the Contract Documents.
 - .2 Inform the Contractor and the Consultant immediately of any material, procedure or test that does not meet the Contract Documents.
 - .3 Advise the Contractor of any construction procedure that is likely to fail to meet the Contract Documents. Promptly inform the Consultant of questionable construction practices and submit a written report to the Consultant.
- .4 Consultant
 - .1 As the Owner's representative, make the final decision on changes that may increase or decrease the Contract Price or Contract Time.
 - .2 Upon notification by the Testing and Inspection Company of defective work, respond expediently to resolve the issue.

1.9 MOCK-UPS

- .1 Provide field or shop erected example of work complete with specified materials and workmanship.
- .2 Do not proceed with work for which mock-ups are required prior to *Consultant's* review of mock-ups.
- .3 Prepare mock-ups of Work as specified in the technical Specifications. If a mock-up location is not indicated in the Drawings or Specifications, locate where directed by Consultant.
- .4 Modify mock-up as required until Consultant approval is obtained.
- .5 Reviewed and accepted mock-ups shall be the standard of workmanship and material against which installed work will be compared.
- .6 Protect mock-ups from damage and maintain mock-up until the Work they represent is complete.
- .7 Commence work demonstrated in mock-up only after review and acceptance of workmanship.
- .8 Remove and replace materials or assemblies appearing in the finished work that do not match reviewed and accepted mock-ups.
- .9 Unless otherwise specified in the technical Specifications, approved mock-ups forming part of the Work may remain as part of the Work.
- .10 Remove mock-ups which will not remain as part of the Work only when the Work they represent is complete or when otherwise directed by Consultant.

END OF SECTION

1 GENERAL

1.1 SUMMARY

- .1 This Section lists construction terms and related abbreviations and acronyms that may be used in the RFP Documents.

1.2 ABBREVIATIONS:

ACT	acoustic ceiling tile	AC	air conditioning
AFF	above finished floor	ALUM	aluminum
ALT	alternate	ARCH	architectural
ASTM	American Society for Testing and Materials	ASPH	asphalt
BD	board	BLDG	building
BLK	block	BLKG	blocking
BM	beam	BOT	bottom
BRK	brick	BRKT	bracket
CB	catch basin	CEM	cement
CER	ceramic	CFM	Cubic feet per minute
CG	corner guard		
CGSB	Canadian General Standard Board	CL	cast iron
CJ	control joint	CL	centre line
cm	centimeter	COL	column
CONC	concrete	CONT	continuous
CORR	corridor	CPT	carpet
CR	card reader	CSA	Canadian Standards Association
CT	Ceramic Tile	CTR	centre
CW	cold water	C/W	complete with
DBL	double	DET	detail
DIA	diameter	DIM	dimension
DO	ditto	DR	door
DS	downspout	DWG	drawing
E	east	EA	each
EIFS	exterior insulation finish system	ELEC	electric(al)
ELEV	elevation	ENCL	enclosure
ENG	engineer	ENT	entrance
EQ	equal	EXP	exposed
EXPAN JT	expansion joint	EXT	exterior

FA	fire alarm	FAS	fire alarm station
FD	floor drain	FDN	foundation
FE	fire extinguisher	FEC	fire extinguisher cabinet
FF	finish floor	FFD	funnel floor drain
FH	fire hydrant	FHC	fire hose cabinet
FHV	fire hose valve	FIN	finished
FLUOR	fluorescent	FT	foot or feet
FTG	footing	FURR	furring
FVC	fire valve cabinet		
GA	gauge	GALV	galvanized
GEN	generator	GF	ground floor
GL	glass	GR	grade
GRAN A	Granular A	GRAN B	Granular B
GWB	gypsum wall board		
HB	hose bibb	HC	handicapped
HM	hollow metal	HORIZ	horizontal
HP	hydro pole	HR	hour
HT	height	HW	hot water
ID	inside diameter	INCAN	incandescent
INSUL	insulation, insulated	INV	invert
JAN	janitor's closet	JST	joist
JT	joint		
KD	knock down	KO	knockout
KP	kick plate		
LAB	laboratory	LAM	laminated
LAV	lavatory	LED	light emitting diode
M	men's	m	meter
MAS	masonry	MAX	maximum
MECH	mechanical	MET	metal
MEZZ	mezzanine	MFR	manufacturer
MIN	minimum	MISC	miscellaneous
mm	millimeter	MO	masonry opening
N	north	NFPA	National Fire Prevention Association
NIC	not in contract	No.	number
NOM	nominal	NTS	not to scale
OA	overall	OBC	Ontario Building Code

OC	on centre	OD	outside diameter
O/H	overhead	OH	opposite hand
OPNG	opening	OPP	opposite
OWSJ	open web steel joist		
PTN	partition	PCONC	precast concrete
PG	pipe guard	PL	plate
PLAM	plastic laminate	PLEXI	plexiglass
PLYWD	plywood	PNT	paint
POL	polished	PR	pair
PSF	pounds per square foot	PSI	pounds per square inch
PT	point	PVC	polyvinyl chloride
QT	quarry tile		
R	radius	RCP	reflected ceiling plan
RD	roof drain	REINF	reinforce
REQ'D	required	RESIL	resilient
REV	revision	RM	room
RO	rough opening	RWL	rain water leader
S	south	SCH	schedule
SEAL	sealant	SECT	section
SF	square feet	SHT	sheet
SIM	similar	SN	stair nosing
SP	standpipe	SPEC	specification
SQ	square	S.S.	stainless steel
STD	standard	STL	steel
STRUCT	structural	SYM	symmetrical
TB	tack board	TD	trench drain
TEL	telephone	T & G	tongue & groove
THK	thick	THR	threshold
T.O.	top of	TYP	typical
U/C	undercut	U/G	underground
UL	Underwriter Laboratory	UNFIN	unfinished
UON	unless otherwise noted	U/S	underside
UTIL	utility		
VCT	vinyl composition tile	VEST	vestibule
W	west	WC	water closet
WD	wood	WHTR	water heater
WP	waterproof(ing)	WR	washroom

WS	weatherstripping	WT	weight
WWF	welded wire fabric	WWM	welded wire mesh

1.3 WASHROOM ACCESSORIES ABBREVIATIONS

CH	coat hook	CHH	coat hook handicapped
GB	grab bar	MIR	mirror
MIRH	mirror handicapped	MPH	mop holder
NVU	napkin vending unit	ND	napkin disposal
SHROD	shower rod	SHROD/C	shower rod with curtain
SHST	shower seat	SD	soap dispenser
TTD	toilet tissue dispenser	TD	towel dispenser
TDD	towel dispenser and disposal		

1.4 SYMBOLS

&	and	@	at
⌒	centreline	∅	diameter
#	number		

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with Instructions to Bidders, the General Conditions of the Contract, Supplementary Conditions and the General Requirements of Division 1.

1.2 SECTION INCLUDES

- .1 Temporary utilities, services, and facilities.
- .2 Temporary controls.

1.3 GENERAL

- .1 Pay for installation and maintenance of temporary service, energy used, utility costs, filters and restoration of permanent systems.
- .2 Provide temporary meters. Pay for connect and disconnect charges, and costs of maintenance and operation.
- .3 Relocate temporary facilities and equipment as required by the progress of the Work.
- .4 Remove temporary materials, equipment and construction at completion of Work.

1.4 TEMPORARY LIGHT AND POWER:

- .1 Provide temporary lighting and power for building, site and field office to serve construction trades for duration of construction.
- .2 Arrange for transfer to permanent power.
- .3 Materials in temporary construction:
 - .1 Do not use materials of temporary service in permanent installation.
 - .2 Materials used for temporary lighting and power shall meet the Electric Safety Code and Ontario Hydro Inspection standards.
- .4 Provide sufficient lighting levels as required to suit particular locations and operations, but not less than 107 lumens.
 - .1 When finishing operations are underway, Provide illumination levels equivalent to final illumination levels required by the Contract Documents.
- .5 Pay all permits required.

1.5 TEMPORARY HEAT AND VENTILATION

- .1 Carry out the work with all possible speed throughout all months from the date of commencement of the Work until Owner occupancy.
- .2 Provide temporary ventilation for comfort and protection of workmen and for proper drying of wet Work.

- .3 Provide temporary heat as necessary to ensure suitable working conditions for construction operations of construction trades.
- .4 Provide temporary heat by use of self-contained portable heating units.
- .5 Comply with codes, rules and regulations concerning operations of temporary heating units and with requirements of Owner's insurer.
- .6 Do not permit temperature to reach a level that will cause damage to the Work.
- .7 Replace interior or exterior surfaces damaged by the use of space heaters with new materials or refinish at no cost to Owner.
- .8 As soon as practical after permanent heating and air circulation system is in place and operable, provide heat from permanent building heating system, under operation and supervision of heating Subcontractor, until building is complete. Use permanent building heating system only after the majority of dust (including drywall dust) is thoroughly vacuumed.

1.6 TEMPORARY WEATHER PROTECTION

- .1 Provide protection at all times against weather, rain, wind, storms, frost or excessive heat. At the end of the day's work, cover new work liable to be damaged.
- .2 Remove snow and ice from any part of the structure (other than finished roofs) as soon as possible.
- .3 Make good Products and portions of the Work damaged as a result of improper weather protection.

1.7 TEMPORARY WATER

- .1 Provide temporary connections, valves, piping and hoses required for construction operations.
- .2 Provide temporary water meter.

1.8 USE OF PERMANENT SYSTEMS

- .1 Heating System: Permanent heating equipment may not be used to supply temporary heat unless approved by the Consultant. If approval for use is granted, all equipment and ductwork shall be thoroughly cleaned before turn over to the Owner. Temporary filters must be used in any fan equipment and replaced with the permanent filters before Substantial Performance of the Work.
- .2 Correct damaged or malfunctioning parts of permanent systems, balance, change filters, clean and restore systems to good working condition before date of Substantial Performance of the Work and acceptance by the Owner.
- .3 Commencement of warranties for permanent systems will be date of Substantial Performance of the Work regardless of Contractor's use of such systems during construction period.

1.9 TEMPORARY SANITARY FACILITIES

- .1 Supply and maintain in sanitary condition sufficient temporary toilets that meet the latest edition of the Occupational Health and Safety Act for use of construction personnel for duration of Contract.
- .2 Do not use permanent sanitary facilities for temporary purposes.
- .3 Locate temporary toilets so that they are secluded from public view.

- .4 Remove temporary fixtures upon completion of Project.

1.10 PROTECTION AND COORDINATION OF EXISTING UTILITIES:

- .1 Do not interrupt utilities located in or near Project which are providing services to general area without approval of Owner and coordination with local utility companies.
 - .1 Provide Owner and local utility companies with at least 10 working days written notice for outages or connections to utilities.
- .2 Send proper notices, make necessary arrangements and perform other services required for care, protection and maintenance of public utilities, including mail boxes, fire plugs, telephone poles and wires, and other items of this character on or around building site.
- .3 Permit entrance of public utilities or other parties to Project so that they may perform their necessary Work.

1.11 TEMPORARY BARRIERS AND ENCLOSURES:

- .1 Site:
 - .1 Provide and maintain covered walkways to maintain pedestrian access along public rights-of-way.
 - .2 Provide and maintain barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.
 - .3 Construction fence: Provide and maintain fence around construction site, to design indicated on Drawings; equip with gates and locks.
 - .4 Repaint and reletter walkways and construction fence during construction operations as may be required by Owner.
 - .5 Paint fence of public sides with 2 coats of paint including signage as indicated on Drawings.
 - .6 All fencing shall be removed at the completion of the Work.
- .2 Building Exterior: Provide and maintain temporary weather-tight closures at exterior openings to maintain suitable conditions and protection for interior Work.
- .3 Building Interior: Provide and maintain temporary enclosures to separate Work areas from areas occupied by Owner or tenants to prevent penetration of dust, moisture and noise into occupied areas.
- .4 Construct temporary barriers with adequate framing and surface with plywood or gypsum board, and polyethylene vapour barrier having closed joints and sealed edges at intersections with existing surfaces.

1.12 PROJECT IDENTIFICATION

- .1 Fabricate a Project sign according to Consultant's design.
- .2 Erect Project sign at location directed by the Consultant.
- .3 Remove Project sign and all related supports from the Place of the Work upon Substantial Performance of the Work when directed by Consultant.

- .4 No other construction signs will be allowed to be displayed on the premises without the approval and acceptance by the Owner.

1.13 FIELD OFFICES

- .1 Provide field office(s) and storage shed(s) of approved design and appropriate size within the hoarded worksite area only.
- .2 Provide a facility for on-site meetings appropriate to the size of the project.
- .3 Provide and maintain telephone service, including facsimile service, to field office for duration of construction.

1.14 TEMPORARY STORAGE

- .1 Provide and maintain upon premises in an approved location suitable sheds or trailers for protection and storage of materials to be incorporated in Project.
- .2 Keep clean and tidy.
- .3 Provide light and heat as required.
- .4 Store combustible materials apart from building materials.

1.15 TEMPORARY STATIONARY CONVEYANCES

- .1 Furnish and maintain temporary construction lifts, hoists, chutes, scaffolds, staging, stairs, ramps, runways, ladders, platforms, railings and similar items required for proper execution of Work and in accordance with the latest edition of the Occupational Health and Safety Act.
- .2 Coordinate use of temporary conveyances with Subcontractors, and provide necessary temporary protections to surrounding assemblies.
- .3 Upon removal of such temporary conveyances, remove temporary protections and complete the Work.

1.16 DUST CONTROL

- .1 Execute work by methods to minimize raising dust from construction operations.
- .2 Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.17 WATER CONTROL

- .1 Provide methods to control surface and ground water to prevent damage to site or adjoining properties.
- .2 Control fill, grading and ditching to direct surface drainage away from excavations, pits, tunnels and other construction areas, and to direct drainage to proper runoff.
- .3 Maintain excavations free of water. Provide, operate and maintain pumping equipment.

1.18 SNOW AND ICE CONTROL

- .1 Keep access to building and work areas clear of snow while work is in progress.

- .2 Do not allow snow or ice to accumulate over surfaces that can be damaged upon thawing.
- .3 Do not allow snow or ice accumulation to overload or otherwise endanger any part of work.
- .4 Take precautions against damage to materials stored and work installed in freezing weather.

1.19 EROSION AND SEDIMENT CONTROL

- .1 Plan and execute construction by methods to control surface drainage from cut and fill and from borrow and waste disposal areas.
- .2 Prevent erosion and sedimentation.
- .3 Minimize amount of bare soil exposed at one time.
- .4 Provide temporary measures to prevent water flow.
- .5 Locate fill and waste areas to avoid erosive surface silts or clays.

1.20 RODENT AND VERMIN CONTROL

- .1 Retain an exterminator to protect premises from rodent and vermin infestation if deemed necessary by the Consultant.
- .2 Use extermination materials approved by local Health Department or other agency having jurisdiction.

1.21 FIRE PROTECTION

- .1 Provide and maintain temporary fire protection in the form of fire extinguishers, in accordance with the authorities having jurisdiction, including the local Fire Department and the insurance companies.
- .2 Protect the Work, adjacent properties, Owner's equipment and Contractor's equipment against fire hazards.
- .3 Adjust and modify temporary fire protection facilities to accommodate the progress of the Work.
- .4 Provide and maintain access routes to exits, clean and visibly identified.
- .5 Fire Watch
 - .1 A fire watch is required for each of the following activities, regardless of the number in a single area:
 - (1) Any open flame activity, including soldering and welding.
 - (2) Shut down of the fire detection system.
 - (3) Shut down of the sprinkler system.
- .6 Temporary Buildings
 - .1 Locate temporary buildings and storage areas in relation to their hazards and probability of damage to existing buildings under construction. Unless constructed of non-combustible materials, wherever possible locate them at least 10 metres away from buildings.
 - .2 If constructed of combustible materials separate these structures into small detached units.

.7 Access To Fire Extinguishing Equipment and Exits

- .1 Provide and maintain free access at all times from the street to fire hydrants and to outside connections for standpipes or other fire extinguishing equipment whether permanent or temporary. Do not place material or construction equipment within 3 metres of hydrants or connection, nor between them and centre line of the street.
- .2 Maintain free access at all times to control valves and hose on fire lines within building and to all portable extinguishers.

.8 Fire Doors

- .1 Install fire doors and put into operating condition at the earliest possible time.

.9 Rubbish

- .1 Remove flammable rubbish promptly from the premises. If removal is unavoidably delayed reduce fire hazards by wetting down. Disposal of waste material by burning on or near the premises is not permitted.
- .2 Clean up and remove rubbish into containers. Removal of containers and disposal off the site including all dumping fees will be the responsibility of the Contractor.

.10 Cutting and Torching

- .1 Where electric or gas welding or cutting is to be done within 3 metres of, or above space that may be occupied by persons, or combustible material interpose shields of incombustible material.
- .2 Maintain appropriate fire extinguishing equipment near all welding and cutting operations.

.11 Storage of Paints, Oils and Gasoline

- .1 Store paints and volatile liquids in a separate shed, and inspect frequently. Place fire extinguisher at the door of paint storage shed.
- .2 Store gasoline outside under lock and key, well away from the structure.

.12 Temporary Wiring

- .1 Inspect temporary wiring, drop cords or temporary extension cables frequently for defective insulation or connections.

END OF SECTION

1 GENERAL

1.1 SUMMARY

.1 Section Includes:

- .1 Control of traffic during construction operations.

.2 Intent:

- .1 Conduct operations along roads and highways in a manner that inconvenience and hazards to traffic are minimized.
- .2 Maintain roadways safe for traffic.
- .3 Confine operations so that only a minimum length of trench is open at any time.
- .4 Backfill a length each day equivalent to that opened.
- .5 Provide and maintain pedestrian access to all properties.
- .6 Provide and maintain emergency access to all properties.
- .7 Provide and maintain emergency access for fire trucks, ambulances and other vehicles for emergency services.

1.2 APPROVALS AND NOTICES

- .1 Obtain approval from the authority having jurisdiction for closing any road to traffic.
- .2 Notify Fire Department, Police Department, Works Department and any other necessary authority of approximate times roads will be closed for.

1.3 TRAFFIC CONTROL

- .1 Provide all flagmen necessary to direct flow of traffic.
- .2 Provide and maintain traffic signals and warning signs as required.
- .3 Provide and maintain detours for traffic where required. Mark detours as directed by Police Department, Works Department.
- .4 Make arrangements with appropriate authorities if single lane conditions continue past normal working hours.
- .5 Supply and plane crushed stone on road shoulder to maintain traffic on road shoulders as required.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with Instructions to Bidders, the General Conditions of the Contract, Supplementary Conditions and the General Requirements of Division 1.

1.2 SECTION INCLUDES

- .1 Noise control.

1.3 INTENT

- .1 Establish and maintain site procedures such that construction noise levels are minimized.
- .2 Control noise level in accordance with local by-laws.

1.4 MEASURES

- .1 Use vehicles and equipment equipped with efficient muffling devices.
- .2 Provide devices and temporary barriers to restrict noise from the Place of the Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with Instructions to Bidders, the General Conditions of the Contract, Supplementary Conditions and the General Requirements of Division 1.

1.2 SECTION INCLUDES

- .1 Temporary pollution control methods.

1.3 REFUELLING AREAS

- .1 Review in detail proposed route of construction to plan access routes and fuelling areas.
- .2 Establish suitable fuelling and maintenance areas and obtain approval from Consultant.
- .3 Do not fuel or maintain equipment adjacent to or in watercourses.
- .4 Do not fuel equipment within 30 metres of any watercourse unless non-spill facilities are used.

1.4 CLEANING EQUIPMENT

- .1 Do not clean equipment in streams or lakes.
- .2 Clean construction equipment prior to entering roadways.
- .3 Do not clean equipment in locations where debris can gain access to sewers or watercourses.

1.5 SPILLS

- .1 Submit procedures for interception, rapid clean-up and disposal of spillages that may occur, for Consultant's review, prior to commencing work.
- .2 Be prepared at all times to intercept, clean-up and dispose of any spillage that may occur whether on land or water.
- .3 Keep materials required for clean-up of spillages readily accessible at the Place of the Work.
- .4 Report immediately any spills causing damage to environment to local authority having jurisdiction.

1.6 USE OF PESTICIDES

- .1 Use of herbicides and pesticides is prohibited.

1.7 SENSITIVE AREAS

- .1 Notify Consultant, in writing, of particular schedule for each river crossing, channelizing or other work in designated sensitive areas.
- .2 Avoid encroachment on unique natural areas.
- .3 Do not disturb habitats of rare or endangered species.

- .4 Protect wetland sites used as feeding or breeding areas by migratory fowls or as habitats for other animals.
- .5 Schedule construction in sensitive areas so that there will be minimal interference with water uses including fish migration or spawning, or disruption of incubation period of eggs.
- .6 Keep removal of vegetation to a minimum.
- .7 Contain and deposit on land all aquatic plants uprooted or cut prior to or during construction.

1.8 CHANNEL DIVERSIONS AND STREAM CROSSINGS

- .1 Provide adequate stream flow whenever temporary rivers, dams or stream diversions are required to avoid interference with downstream water uses.
- .2 Restrict number of locations where equipment is allowed to cross a watercourse.
- .3 Install culverts for temporary stream crossings with minimum possible disturbance to channel. Do not restrict flows.
- .4 Do not restrict or impede movement of migrating fish.
- .5 Clean-up stream channel upon completion of work. Clean-up to include removal of any temporary structures, re-shaping of stream to an approved configuration, protection of stream banks and removal of all construction materials and debris.

1.9 DISPOSAL

- .1 Do not empty fuel, lubricants or pesticides into sewers or watercourses.
- .2 Dispose of all construction debris in an approved location.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Provide Products that are not damaged or defective, and suitable for purpose intended, subject to specified requirements. If requested by Consultant, furnish evidence as to type, source and quality of Products provided.
- .2 Unless otherwise specified, maintain uniformity of manufacture for like items throughout.
- .3 Permanent manufacturer's markings, labels, trademarks, and nameplates on Products are not acceptable in prominent locations, except where required by regulatory requirements or for operating instructions, or when located in mechanical or electrical rooms.

1.2 PRODUCT OPTIONS

- .1 Subject to the provisions of Section 01 25 00:
 - .1 Wherever a Product or manufacturer is specified by a single proprietary name, provide the named Product only.
 - .2 Wherever more than one Product or manufacturer is specified by proprietary name for a single application, provide any one of the named Products.
- .2 Wherever a Product is specified by reference to a standard only, provide any Product that meets or exceeds the specified standard. If requested by Consultant, submit information verifying that the proposed Product meets or exceeds the specified standard.
- .3 Wherever a Product is specified by descriptive or performance requirements only, provide any Product that meets or exceeds the specified requirements. If requested by Consultant, submit information verifying that the proposed Product meets or exceeds the specified requirements.

1.3 PRODUCT AVAILABILITY AND DELIVERY TIMES

- .1 Promptly upon Contract award and periodically during construction, review and confirm Product availability and delivery times. Order Products in sufficient time to meet the construction progress schedule and the Contract Time.
- .2 If a specified Product is no longer available, promptly notify Consultant. Consultant will take action as required.
- .3 If delivery delays are foreseeable, for any reason, promptly notify Consultant.
 - .1 If a delivery delay is beyond Contractor's control, Consultant will provide direction.
 - .2 If a delivery delay is caused by something that was or is within Contractor's control, Contractor shall propose actions to maintain the construction progress schedule for Consultant's review and acceptance.

1.4 STORAGE, HANDLING, AND PROTECTION

- .1 Store, handle, and protect Products during transportation to Place of the Work and before, during, and after installation in a manner to prevent damage, adulteration, deterioration, and soiling.
- .2 Comply with manufacturer's instructions for storage, handling, and protection.

- .3 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in Work.
- .4 Comply with the requirements of the workplace hazardous materials information system (WHMIS) regarding use, handling, storage, and disposal of hazardous materials, including requirements for labeling and the provision of material safety data sheets (MSDS).
- .5 Store Products subject to damage from weather in weatherproof enclosures.
- .6 Store sheet Products on flat, solid, supports and keep clear of ground. Slope to shed moisture.
- .7 Remove and replace damaged Products.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with Instructions to Bidders, the General Conditions of the Contract, Supplementary Conditions and the General Requirements of Division 1.

1.2 SECTION INCLUDES

- .1 Requirements for preservation and protection of existing services and structures.

1.3 REGULATORY REQUIREMENTS

- .1 Comply with all requirements and regulations of Road Authorities, Utility Companies or Railway Companies, especially those pertaining to protective work, inspection and safety.

1.4 NOTIFICATION TO UTILITIES

- .1 Advise all Road Authorities, Utility Companies and Railway Companies, in writing, at least 48 hours before approaching utility or entering right-of-way.
- .2 Request Owners of all underground services to locate, stake and clearly mark in field all services, which are located on or near line of, proposed work.
- .3 Obtain certificates from all Utility Companies or Departments having facilities in area of proposed work certifying that facilities have been marked to confirm utility location.
- .4 Make necessary arrangements with Railway Company for support and protection of tracks.

1.5 EXISTING SERVICES AND STRUCTURES

- .1 Sustain in place and protect from damage, any and all water or gas mains, public or private sewers or drains, conduits service pipes, sidewalks, curbs and all other structures or properties in vicinity of work, whether above or underground, and be entirely responsible for any damage caused to such service or structure.
- .2 Provide access to all fire hydrants to satisfaction of local authority.
- .3 Provide and maintain gas and water services, flow of all sewers, drains, house or inlet connections, and all watercourses that are encountered during progress of work.
- .4 Immediately repair all sewers and drains that have been damaged.
- .5 If gas or water mains or services are broken, stop flow of gas or water from pipe and immediately notify Utility Company who will repair or supervise and inspect repair of damaged main or service.
- .6 Whenever construction approaches indicated location of buried services, carefully excavate by hand in advance of trench excavation to expose buried pipes, cables, conduits and structures.
- .7 Should pipes be laid with shallow cover, protect the pipe from the passage of trucks or other heavy equipment.

1.6 SURVEY MONUMENTS

- .1 Do not remove survey monuments, iron bars, round iron pipes and stakes representing property boundaries and locations encountered on line of work without written permission of Consultant.
- .2 Replacement of all monuments removed on written permission of Consultant to be done by Owner.

1.7 ACCESS

- .1 Provide access route for landowners to cross rights-of-way, easements or temporary work areas during all phases of construction.

1.8 CONTAMINATION

- .1 Do not allow contents of any sewer, drain or inlet connection to flow into trench.
- .2 Remove all offensive matter from proximity of work as directed by Consultant.

1.9 BASIS OF PAYMENT

- .1 Cost of all repair to damaged utilities or contamination due to his actions to be at Contractor's expense.
- .2 Cost for replacement of survey monuments removed without written permission of Consultant to be at Contractor's expense.

END OF SECTION

1 GENERAL

1.1 SUMMARY

- .1 Except where otherwise specified in technical Specifications or otherwise indicated on Drawings, comply with requirements of this Section.

1.2 MANUFACTURER'S INSTRUCTIONS

- .1 Install, erect, or apply Products in strict accordance with manufacturer's instructions.
- .2 Notify Consultant, in writing, of conflicts between Contract Documents and manufacturer's instructions where, in Contractor's opinion, conformance with Contract Documents instead of the manufacturer's instructions may be detrimental to the Work or may jeopardize the manufacturer's warranty.
- .3 Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
- .4 Provide manufacturer's representatives with access to the Work at all times. Render assistance and facilities for such access so that manufacturer's representatives may properly perform their responsibilities.

1.3 QUALITY OF WORK

- .1 Comply with industry standards specified except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise quality of work.
- .2 Where no explicit quality or standards for materials or quality of work are established for Work, such Work shall be of good quality for the intended use and consistent with the quality of the surrounding Work and of the construction of the Project generally.

1.4 ANCHORAGE

- .1 Secure products with positive anchorage devices designed and sized to withstand stresses, vibration and racking.

1.5 MOUNTING HEIGHTS

- .1 Where mounting heights are not indicated, mount individual units of Work at industry-recognized standard mounting heights for applications indicated.
- .2 Refer questionable mounting height choices to Consultant before proceeding.
- .3 Obtain exact locations of fixtures and outlets from Consultant before Work is roughed in; Work installed without such information from Consultant shall be relocated at Contractor's expense.

1.6 EQUIPMENT PREPARATION

- .1 Lubricate moving parts.
- .2 Test and start up motors and machinery.
- .3 Replace defective or damaged equipment.

1.7 OVERLOADING

- .1 Precautions shall be taken to prevent overloading of any part of the structure, falsework or scaffolding during operations. If doubt exists, obtain approval from Consultant.

1.8 LOAD BEARING MEMBERS

- .1 Load bearing members shall not be cut, bored or sleeved without written approval of the Consultant. All cuts shall be made with clean, true and smooth edges.
- .2 Where required by the Consultant, reinforcement of any such openings shall be made at the Contractor's expense. Any such reinforcement shall be detailed by the Contractor and bear the stamp of a Professional Engineer.

1.9 CONCEALMENT

- .1 Conceal pipes, ducts, and wiring in floors, walls and ceilings in finished areas:
 - .1 after review by Consultant and authority having jurisdiction, and
 - .2 where locations differ from those shown on Drawings, after recording actual locations on as-built drawings.
- .2 Provide incidental furring or other enclosures as required.
- .3 Notify Consultant in writing of interferences before installation.

1.10 FASTENINGS - GENERAL

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials.
- .2 Prevent electrolytic action and corrosion between dissimilar metals and materials by using suitable non-metallic strips, washers, sleeves, or other permanent separators to avoid direct contact.
- .3 Use non-corrosive fasteners and anchors for securing exterior work and in spaces where high humidity levels are anticipated.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Do not use fastenings or fastening methods that may cause spalling or cracking of material to which anchorage is made.
- .7 Powder Activated Fasteners:
 - .1 Powder activated fastenings shall not be used on any portion of the Work unless approval for a specific use is obtained from the Consultant.

1.11 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Bolts shall not project more than one diameter beyond nuts.

1.12 FIRE RATED ASSEMBLIES

- .1 When penetrating fire rated walls, ceiling, or floor assemblies, completely seal voids with fire-stopping materials, smoke seals, or both, in full thickness of the construction element as required to maintain the integrity of the fire rated assembly.

1.13 LOCATION OF FIXTURES, OUTLETS AND DEVICES

- .1 Consider location of fixtures, outlets, and devices indicated on Drawings as approximate.
- .2 Locate fixtures, outlets, and devices to provide minimum interference, maximum usable space, and as required to meet safety, access, maintenance, acoustic, and regulatory, including barrier free, requirements.
- .3 Promptly notify Consultant in writing of conflicting installation requirements for fixtures, outlets, and devices. If requested, indicate proposed locations and obtain approval for actual locations.

1.14 PROTECTION OF COMPLETED WORK AND WORK IN PROGRESS

- .1 Adequately protect parts of the Work completed and in progress from any kind of damage.
- .2 Promptly remove, replace, clean, or repair, as directed by Consultant, work damaged as a result of inadequate protection.
- .3 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the safety or integrity of the Work.

1.15 REMEDIAL WORK

- .1 Notify Consultant of, and perform remedial work required to, repair or replace defective or unacceptable work. Ensure that properly qualified workers perform remedial work. Coordinate adjacent affected work as required.

END OF SECTION

1 GENERAL

1.1 REGULATORY REQUIREMENTS

- .1 Comply with applicable regulatory requirements when disposing of waste materials.
- .2 Obtain permits from authorities having jurisdiction and pay disposal fees where required for disposal of waste materials and recyclables.

1.2 GENERAL CLEANING REQUIREMENTS

- .1 Provide adequate ventilation during use of volatile or noxious substances. Do not rely on building ventilation systems for this purpose.
- .2 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .3 Prevent cross-contamination during the cleaning process.
- .4 Notify the Consultant of the need for cleaning caused by Owner or other contractors.

1.3 PROGRESSIVE CLEANING AND WASTE MANAGEMENT

- .1 Maintain the Work in a tidy and safe condition, free from accumulation of waste materials and construction debris.
- .2 Provide appropriate, clearly marked, containers for collection of waste materials and recyclables. Sort waste as required by the local authority having jurisdiction.
- .3 Remove waste materials and recyclables from work areas, separate, and deposit in designated containers at end of each Working Day. Collect packaging materials for recycling or reuse.
- .4 Remove waste materials and recyclables from Place of the Work.
- .5 Vacuum clean interior building areas prior to start of finish painting and continue vacuum cleaning in each area on "as needed" basis until that area is ready for occupancy.
- .6 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly finished surfaces nor contaminate building systems.
- .7 Damp mop and vacuum clean all spaces under access flooring on a regular basis during the construction period.

1.4 FINAL CLEANING

- .1 Exterior Cleaning:
 - .1 Remove debris, waste and surplus materials from site, from roofs and from drainage systems.
 - .2 Remove temporary protection and temporary construction.
 - .3 Remove stains, spills and foreign substances from exterior surfaces.
 - .4 Rake lawn areas and clean grounds.
 - .5 Sweep and hose down paving and walks.

- .6 Clean exterior materials according to product manufacturer's directions.
- .2 Interior Cleaning:
 - .1 Remove temporary protection, tags, labels and markings from materials, fixtures, accessories and equipment.
 - .2 Clean transparent and glossy materials to polished condition; remove foreign substances.
 - .3 Polish reflective surfaces to clear shine.
 - .4 Clean switch and outlet plates, finish hardware, handrails and metal trim of smudges, paint and soiling.
 - .5 Clean aluminum, stainless steel, bronze and similar metals according to instructions of metal manufacturer.
 - .6 Vacuum clean carpeted and similar soft surfaces.
 - .7 Clean resilient floors thoroughly with well-rinsed mop containing only enough moisture to remove surface dirt and dust; then buff dry by machine, bringing surfaces to sheen.
 - .8 Clean tile in accordance with grout and tile manufacturer's recommendations.
 - .9 Broom clean and vacuum concrete floors.
 - .10 Clean under and behind convectors and other equipment.
 - .11 Clean inside cabinets and other concealed areas.
 - .12 Repaint surfaces and items that cannot be cleaned.
 - .13 Do not remove ULC or CSA Approved labels.
- .3 Cleaning Glass:
 - .1 Wash and polish both sides of glass.
 - .2 Remove temporary labels.
 - .3 Employ window-cleaning firm or personnel experienced in window cleaning work.
- .4 Access Floor Areas:
 - .1 Cleaning and disposal operations to comply with all local ordinances, anti-pollution laws, and recommendations of Construction Safety Association.
 - .2 Employ trained personnel with complete knowledge of computer room and access floor cleaning requirements.
 - .3 Professional equipment common to this trade shall be used at all times, and in particular vacuum equipment to be used shall have a filter media capable of removing a five (5) micron particle size.
 - .4 Contractor shall ensure adequate ventilation during use of volatile or noxious substances.
 - .5 Only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer shall be used.

- .6 The Contractor shall co-ordinate shutdown of all electrical panels in the Computer Room or Data Centre Area with electrical Subcontractor. Where this is not possible he will advise the cleaning Subcontractor which panels are to remain "live". If all panels are shut down, this Contractor will provide temporary lighting for work area.
- .7 Remove access floor tiles as required to satisfactorily vacuum, damp mop and air dry the entire painted concrete subfloor. Replace tiles to the exact locations from which they were removed. Do not permit dust, water, dirt or cleaning solution to enter joints of tiles after the underfloor area has been cleaned. Clean the support structure for access floor.
- .8 All electrical boxes, conduit and supports shall be cleaned. Extreme care shall be taken to ensure there is no damage to electrical fixtures and smoke or heat detectors.
- .5 Cleaning Mechanical and Electrical Equipment:
 - .1 Clean surfaces of equipment; remove excess lubrication.
 - .2 Clean plumbing fixtures to sanitary condition.
 - .3 Clean permanent filters of ventilating equipment and replace disposable filters when units have been operated during construction; in addition, clean ducts, blowers and coils when units have been operated without filters during construction.
 - .4 Light fixtures and lamps:
 - .1 Wipe light fixtures with anodized aluminum louvers or reflectors free of dust, grease and fingerprints, using non-abrasive cloth and suitable cleaner, recommended by fixture manufacturer.
 - .2 Replace burnt-out bulbs with new specified bulbs.
 - .3 Replace construction bulbs with new specified bulbs.

1.5 DAMAGED MATERIALS

- .1 Replace Products damaged during final cleaning.
- .2 Do not use extra stock materials for such replacement.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Dispose of waste materials and recyclables at appropriate municipal landfills and recycling facilities in accordance with applicable regulatory requirements.
- .2 Do not burn or bury waste materials at Place of the Work.
- .3 Do not dispose of volatile and other liquid waste such as mineral spirits, oil, paints and other coating materials, paint thinners, cleaners, and similar materials together with dry waste materials or on the ground, in waterways, or in storm or sanitary sewers. Collect such waste materials in appropriate covered containers, promptly remove from Place of the Work, and dispose of at recycling facilities or as otherwise permitted by applicable regulatory requirements.
- .4 Cover or wet down dry waste materials to prevent blowing dust and debris.

END OF SECTION

1 GENERAL

1.1 GENERAL TAKE-OVER PROCEDURES

- .1 The procedures for completing Contract and acceptance by the Owner shall be in accordance with the methods described in OAA/OGCA Document 100 (July 1, 2018, and reissued January 8, 2019) and any additional requirements described below.

1.2 SUBSTANTIAL PERFORMANCE

- .1 Prior to requesting a Substantial Performance deficiency inspection submit 2 hard copies, 1 digital copy of the Operating and Maintenance Manuals for Consultants approval.
- .2 Application for Substantial Performance must include.
 - .1 One (1) electronic copy of inspection and acceptance certificates required from regulatory agencies, including but not limited to.
 - .1 Certificates of Approval of the Work by the local Building Department.
 - .2 Electrical Inspection Certificate of Inspection.
 - .3 Fire Alarm Verification Certificate.
- .3 Advise Consultant in writing, when the project has been substantially completed. If Consultant agrees this stage has been reached, the Consultant shall prepare a complete list of deficiencies and submit copies of this list to Contractor and the Board.

1.3 COMMENCEMENT OF LIEN PERIODS

- .1 The date of publication of the Certificate of Substantial Performance of the Work, provided to the contractor by the Consultant, shall be the date for commencement of the lien period.

1.4 TOTAL PERFORMANCE

- .1 Prior to requesting a final inspection submit written certificate that the following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents and is ready for final inspection
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested and are fully operational. Submit two copies of the balancing reports
 - .4 Certificates required by the contractor have been submitted.
 - .5 Operation of systems have been demonstrated to Owner's personnel.
 - .6 Submit Record drawings.
 - .7 Submit maintenance materials.
 - .8 Provide certified site survey

- .2 When items noted above are completed, request final inspection of Work by consultant, and building inspector. If Work is deemed incomplete by Consultant, complete outstanding items and request re-inspection.

1.5 PAYMENT OF SUBSTANTIAL PERFORMANCE HOLDBACK

- .1 Prior to the release of lien holdback provide one copy of the following by the Contractor and each subcontractor:
 - .1 Statutory Declaration or Declaration of Last supply
 - .2 Workplace Safety and Insurance Board "Certificate of Clearance".
- .2 The Contractor shall submit an application for payment of the holdback amount.
- .3 After the receipt of an application for payment which will include a Statutory Declaration and WSIB Clearance from the, the Consultant will issue a certificate for payment of the holdback amount.

1.6 FINAL PAYMENT

- .1 When the Contractor considers final deficiencies and defects have been corrected and it appears requirements of Contract have been completed, make application for final payment.
- .2 When the Consultant finds the Contractor's application for final payment valid, the Consultant will issue a final certificate of payment

1.7 CLOSEOUT SUBMITTALS

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products and submit them to the Consultant for review.
- .2 Copy will be returned to the contractor with the Consultant's comments.
- .3 Revise content of documents as required prior to final submission.
- .4 Two (2) weeks prior to Substantial Performance of the Work, submit to the Consultant, the final copies of operating and maintenance manuals.
- .5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .6 If requested, furnish evidence as to type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .8 Pay costs of transportation.

1.8 CLOSEOUT REQUIREMENTS

- .1 Project Record Documents: as specified in Section 01 78 39.
- .2 Information Manuals: as specified in Section 01 78 39.
- .3 Keys and keying schedule including statement that construction lock cylinders have been converted.

1.9 EXTRA STOCK AND PARTS

- .1 Deliver to Owner extra stock of materials, spare parts and loose accessories required by Contract Documents.
- .2 Include special tools for items such as thermostats and adjustable dampers and give instructions for use.
- .3 Provide protective wrapping or packaging labelled with full identification of item. Materials are to be provided in unbroken cartons, or if not supplied in cartons, they shall be strongly packaged.
- .4 Store neatly in the storage locations as predetermined by Owner.

1.10 WARRANTIES AND BONDS

- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Except for items put into use with Owner's permission, leave the date of beginning of time of warranty until the Date of Substantial Performance is determined. The date of Substantial Performance of the Work shall be the date for commencement of the warranty period.
- .4 Verify that documents are in proper form, contain full information, and are notarized.
- .5 Co-execute submittals when required.
- .6 Retain warranties and bonds until time specified for submittals.

1.11 DEMONSTRATION OF SYSTEMS

- .1 Provide instruction to the Owner's operating and maintenance personnel, during regular work hours, on the care, operation and maintenance of all equipment and systems as specified in the applicable sections. Refer to the various sections of the specifications for the specific instructional requirements.
- .2 All instructional periods shall be prior to the acceptance and handover of systems to the Owner for operation responsibility and also prior to Final Payment Certification.
- .3 For equipment requiring seasonal operation, perform instructions for other seasons within six months.
- .4 Use Information Manual for basis of instruction. Review contents of Manual with personnel in detail to explain operation and maintenance.
- .5 Prepare and insert additional data in the Information Manual when need for such data becomes apparent during instruction.
- .6 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance and shutdown of each item of equipment at equipment location.
- .7 Refer to mechanical and electrical documents for additional requirements.

1.12 TESTING AND BALANCING OF MECHANICAL SYSTEMS

- .1 The Mechanical Subcontractor is to include all costs to employ an independent testing company to test and balance all mechanical systems.

- .2 The Consultant reserves the right to have the air and water balancing verified by an independent agency.

1.13 FINAL INSPECTION FOR COMPLETION OF THE CONTRACT

- .1 Deficiencies and defects shall be made good before the Contractor submits a written request for final review of the Work and before the Contract is considered complete.
- .2 When Contractor is satisfied that the Work is complete, and after the Contractor has reviewed the Work to verify its completion in accordance with the requirements of the Contract Documents, the Contractor shall submit a written request for a final review by the Consultant, who in turn will notify the Owner.
- .3 If there are any deficiencies identified as a result of this review, they shall be listed by the Consultant and submitted to the Contractor. This list shall be recognized as the final deficiency list for purposes of acceptance of the Work under the Contract.
- .4 Such deficiencies shall be corrected by a date mutually agreed upon between Consultant and the Contractor, unless a specific date is required by Contract, and a further review by the Consultant shall be called for by the Contractor following his own review to take place within 7 days from date of request.
- .5 Contractor shall thereafter submit invoice for final payment.
- .6 Money withheld for deficiency work shall be released only when all deficiencies have been completed. No partial payment to be recognized until all work is completed

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with Instructions to Bidders, the General Conditions of the Contract, Supplementary Conditions and the General Requirements of Division 1.

1.2 PROJECT RECORD DOCUMENTS

- .1 The Project record documents consist of as-built drawings and specifications, and the accepted Shop Drawings, product data sheets, and samples.
- .2 Maintain the as-built documents, Shop Drawings, product data sheets and samples at the Place of the Work.
- .3 Request from the Consultant a complete set of the Contract Documents for creation of the as-built documents. Costs of obtaining these documents are the responsibility of the Contractor.
- .4 Record the actual "as-built" details of the Project throughout the duration of the Work.
 - .1 Modify the documents and accurately record significant deviations from the Contract Documents, caused by existing conditions and changes originated by the Consultant, Contractor and Subcontractor originated changes, Change Orders, Supplemental Instructions, Addenda, instructions by correspondence and jurisdictional authority approvals.
 - .2 Carefully record location of concealed elements required for maintenance, alteration work and building additions.
 - .3 Eradicate obsolete information.
- .5 Clearly mark each set as "As-Built Copy". It includes both hard copy and AutoCAD (the latest version) files. Maintain in good condition, available at all times for inspection by the Consultant. Do not use for construction purposes. The Contractor must submit all as-builts (hard copy as well as AutoCAD and PDF format on a USB flash drive) prior to the release of any holdback payments.
- .6 The original AutoCAD tender drawings are available at the Consultant's office at an extra cost to the General Contractor of \$3,000 for the entire set.
- .7 Keep as-built documents current and do not record irrelevant information.
 - .1 Do not permanently conceal any work until the required information has been recorded.
 - .2 Proof that the as-built documents are current will consist of the Consultant making a visual check.
- .8 Maintenance of the as-built documents to current stage of construction shall be considered a condition precedent for validation of any application for payment made by Contractor.
- .9 Date entries with proper reference to the appropriate Change Order or approval number. Call attention to the entry by a "cloud" around the area or areas affected.
- .10 At Substantial Performance of the Work, submit one complete set of final "Reviewed" or "Reviewed-As-Modified" Shop Drawings and product data sheets, on which corrections have been recorded of changes made during fabrication and installation of unforeseen conditions. Do not include drawings which were "Returned and Resubmit."

.11 Conversion of Schematic Layouts:

- .1 Drawings indicate mechanical and electrical conduits, circuits, piping, ducts and other similar items, in schematic form and do not indicate precise physical layout.
- .2 Indicate on As-Built Drawings, by accurate dimension, centerline of each run for relevant items.
- .3 Clearly identify items by accurate note such as "cast-iron drain", "galv. water pipe" or "return air duct".
- .4 Indicate by symbol or note, vertical locations of items such as "under slab", "in ceiling plenum" or "exposed".
- .5 Identify elements and locations with description that can be related reliably to Contract Documents.
- .6 Site Plan: Refer to Section 01 10 00 for requirements for foundation verification and site compliance surveys.

1.3 INFORMATION MANUAL

.1 Format:

- .1 Covers: Plastic covered, 3-ring, loose-leaf binders bearing title of Project and date on typed label.
- .2 Sheets: 8-1/2 inches x 11 inches, except pullout sheets may be neatly folded to 8-1/2 inches x 11 inches.
- .3 Organize contents into applicable sections of work to parallel project section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.
- .4 Provide manual in three separate volumes: One for Mechanical, one for Electrical and one for all other disciplines.
- .5 Provide a minimum of one copy of the information manual in electronic format on a USB flash drive.
- .6 Submit three copies of each volume to Owner.
- .7 Each manual shall include individual electronic copies of each section of the manual in Adobe Portable Document Format (.pdf) stored and individually indexed to match the specified manual format on a labelled USB flash drive.

.2 Contents:

- .1 Provide the following information for products and systems scheduled for inclusion in Manual:
 - (1) Names, addresses, phone and fax numbers
 - (2) Copy of hardware and finish schedule.
 - (3) Copies of final revised shop drawings of each trade. Reinforcing steel bar lists and structural steel detail drawings need not be part of this manual.
 - (4) Maintenance instructions for finished surface materials.

- (5) Description, operation and maintenance instructions for equipment and systems, including complete list of equipment and parts list. Indicate nameplates information such as make, size, capacity and serial numbers.
 - (6) Materials used on the project as required by extras, alternates or substitutions showing name of manufacturer and source of supply.
- .2 Where required in technical Specification Sections, include, as applicable, the following additional information provided by manufacturer or fabricator:
- (1) Written recommendations for cleaning agents, methods and precautions and recommended cleaning and maintenance schedules.
 - (2) Written operating and emergency procedure instructions for equipment and recommended maintenance procedures and schedules.
 - (3) Equipment or product catalogue data, wiring diagrams, spare parts lists for each piece of equipment, accessories, controls and fixtures.
 - (4) Include name, address and telephone number of local representative for principal items of equipment.
- .3 Roofing and waterproofing systems:
- (1) List manufacturer, installer, material properties and composition and details of installation.
 - (2) List every component of system including insulation and flashings.
 - (3) Provide manufacturer and installer recommendations for inspections, maintenance and repair.
- .4 Mechanical, plumbing and electrical systems: See mechanical and electrical documents for specific requirements.
- .5 Provide additional information for the Information Manual as may be specified in the technical specification Sections.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with Instructions to Bidders, the General Conditions of the Contract, Supplementary Conditions and the General Requirements of Division 01.

1.2 SUMMARY

- .1 Section includes:
 - .1 Complete all the removal and demolition work as indicated on the drawings and as specifically mentioned in these Specifications, including but not limited to the following:
 - (1) Demolition and removal of selected portions of existing building components or structural elements.
 - (2) Repair procedures for selective demolition operations
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Owner's Documents and Conditions

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - (1) CSA S350-M – Code of Practice for Safety in Demolition of Structures.
 - (2) CSA Z783 – Deconstruction of Buildings and Their Related Parts.
 - .2 National Fire Protection Association (NFPA):
 - (1) NFPA 241 – Standard for Safeguarding Construction, Alteration, and Demolition Operations

1.4 REPORTS

- .1 Refer to Owner's Documents and Conditions
- .2 The Owner and Consultant assume no responsibility for any interpretation or deduction that the Contractor may make from third-party reports. Establish the nature of existing conditions to own satisfaction.

1.5 PERMITS AND REGULATIONS

- .1 Refer to GC 10.2.
- .2 Apply for the demolition permit.
- .3 Arrange and pay for landfill fees, notices, and inspections necessary for the proper execution and completion of the demolition.

1.6 PROTECTION

- .1 This Contractor shall be entirely responsible for, and make good damage to adjoining properties and buildings, adjacent walks, curbs, etc.
- .2 This Contractor shall be entirely responsible for the safety of all persons lawfully engaged on the Work when such injury is caused by negligence or any act of this Contractor or any person or persons engaged in the work of this Section.
- .3 It shall be the responsibility of this Contractor to protect the public from injury during the course of demolition by providing suitable barriers, fences, coverings, guardrails, etc., that may be required by the Owner or authorities having jurisdiction.

1.7 EXISTING SERVICES

- .1 Locate and disconnect, cap and plug gas, water, sewer, hydro, telephone and other services as required. In each case, notify the authority having jurisdiction and obtain their written approval obtained before commencing that portion of the Work. Approximate locations of existing utilities have been indicated on the accompanying drawings. No responsibility is assumed by the Consultant for the exact locations as shown.

1.8 SUBMISSIONS

- .1 The Contractor shall submit a detailed demolition methodology statement covering equipment to be used, safety procedures to be adopted, temporary shoring if required, demolition sequence, etc.

2 PRODUCTS

2.1 SALVAGE MATERIAL

- .1 All material from the demolition shall become the property of this Contractor unless noted, who shall remove all material and debris from the Place of the Work as quickly as possible. Burning debris at the Place of the Work will not be permitted.
- .2 Endeavour to sort and recycle materials wherever practical.

3 EXECUTION

3.1 EXAMINATION

- .1 Visit the Place of the Work and note conditions affecting the work of this Section.
- .2 No allowance will be made for any difficulties encountered or any expenses resulting from conditions at the Place of the Work or any item existing thereon which is visible or known to exist at the time of bidding.

3.2 REMOVALS

- .1 General:
 - .1 Carry out demolition, removal and disposal in accordance with the methodology statement and with applicable provincial and local regulations and the demolition methodology statement submitted for demolition permit issuance.

- .2 Execute demolition in an orderly and careful manner with due consideration for adjacent structures and finishes.
- .3 Keep work wetted down thoroughly to prevent dust and dirt from rising during demolition operations. Water shall be provided for this purpose by this Contractor. Upon completion of work, any temporary water and power lines shall be removed.
- .4 Take necessary precautions to guard against movement or settlement of the remaining structure, including necessary bracing or shoring.
- .5 Where demolition results in obsolete openings in existing walls, floors, ceilings, roofs, etc., such openings shall be infilled and patched to match existing adjacent construction, structural integrity, workmanship and fire ratings. Where demolition leaves existing finishes, surfaces, etc. in a state of noticeable disrepair, unevenness, with voids, dissimilar colour, etc., patching shall be completed as referenced in other specification sections.

3.3 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.
- .2 Remove all excess materials from site as Work proceeds and at completion.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy to the satisfaction of the Owner.
- .4 Clean and make good surfaces soiled or otherwise damaged as a result of Work of this Section at no additional cost to the Owner.
- .5 Leave the Place of the Work in a clean and orderly condition to the satisfaction of the Consultant. If this Contractor fails to do so the Consultant may order excess debris to be removed at this Contractor's expense.

3.4 PROTECTION

- .1 This Contractor shall be entirely responsible for, and make good damage to adjoining properties and buildings, adjacent walks, curbs, etc.
- .2 This Contractor shall be entirely responsible for the safety of all persons lawfully engaged on the Work when such injury is caused by negligence or any act of this Contractor or any person or persons engaged in the work of this Section.
- .3 It shall be the responsibility of this Contractor to protect the public from injury during the course of demolition by providing suitable barriers, fences, coverings, guardrails, etc., that may be required by the Owner or authorities having jurisdiction.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified, or required to complete the work of this Section including but not limited to the following:
 - .1 All concrete formwork and accessories required to complete the building as shown in the Structural Drawings and in accordance with these Specifications.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 03 20 00 – Concrete Reinforcing.
 - .2 Section 03 30 00 – Cast-in-Place Concrete.

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 Canadian Standards Association (CSA):
 - .1 CSA A23.1: Concrete Materials and Methods of Concrete Construction.
 - .2 CSA A23.2: Methods of Test and Standard Practices for Concrete.
 - .3 CSA O121: Douglas Fir Plywood.
 - .4 CSA O142: Softwood Lumber.
 - .5 CSA O151: Poplar Plywood
 - .6 CSA S269.1: Falsework and Formwork.
 - .7 CSA-S269.2: Access Scaffolding for Construction Purposes.
 - .2 American Concrete Institute (ACI):
 - .1 ACI 117: Specification for Tolerances for Concrete Construction and Materials.
 - .2 ACI 347: Guide to Formwork for Concrete.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordination under this Section shall be in accordance with General Conditions and Division 01.
 - .2 Coordinate with other work having a direct bearing on the Work of this Section.

1.5 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements.
- .3 Shop Drawings:
 - .1 Submit shop drawings for formwork and falsework stamped and signed by the Professional Engineer responsible for their design. Shop drawings to include:
 - .1 Formwork design data: permissible rate of concrete placement and temperature of concrete in forms.
 - .2 Erection sequence.
 - .3 Stripping and re-shoring procedure.
 - .4 Locations of all construction and control joints in slabs and walls.
 - .5 Shoring of existing construction where required to carry construction loads.
- .4 Site Quality Control Submittals
 - .1 Obtain field review of falsework and reshoring by the Professional Engineer responsible for that work prior to each pour. The Consultant will not field review the formwork, falsework, or reshoring.

1.6 QUALITY ASSURANCE

- .1 Licenced Professional's:
 - .1 Engage a Professional Engineer licensed in the place where the project is located to be responsible for design, installation and site review of all formwork, falsework, and re-shoring.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials of this Section in accordance with Section 01 61 00 – Common Product Requirements.

2 PRODUCTS

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Design Requirements:
 - .1 Design in accordance with CSA 269.1.
 - .2 For multi-storey construction, ensure that sufficient re-shoring is installed to prevent overloading of the structure while constructing the work above.
 - .3 Design and detail temporary bracing for tall concrete walls/columns as required to keep them stable until the structure above which is used to brace them is completed.

- .4 The Consultant accepts no responsibility for the structural adequacy of formwork, falsework, and re-shoring and will not review its design.

2.2 MATERIALS

- .1 Formwork and Falsework Materials to conform to CSA 269.1.
 - .1 For typical applications, use wood and wood product formwork materials conforming to CSA O121, CSA O141, CSA O151, CSA O437, or CSA O153.
 - .2 Stay forms: expanded hot dip galvanized sheet steel, with min. 20 mm (3/4") deep V- shaped ribs and perforations suitable to carry through reinforcing steel. Adequately stiffened to support weight of concrete without deflection.
 - .3 Void Form: Cellular cardboard with minimum compressive strength of 62 kPa (9 psi) designed to carry weight of wet concrete and loads associated with placing concrete and designed to disintegrate and create an air space below the fully hardened concrete.

2.3 ACCESSORIES

- .1 Form Ties: removable or snap-off metal type of fixed and adjustable length, with cones and neoprene plugs when used for exposed conditions; to CSA S269.3.
- .2 Form Release Agent: colourless, non-toxic, low VOC, mineral oil that will not stain concrete.
- .3 Form liner: high density overlay plywood to CSA O121 or other special materials to achieve the required concrete finish.
- .4 Grooves, reglets and chamfers: White pine or rigid formed plastic, selected for straightness and sized to suit requirements.
- .5 Waterstops:
 - .1 PVC waterstops: flexible, extruded, heat weldable, ribbed:
 - .1 Tensile strength: ASTM D638, min 13 MPa
 - .2 Ultimate elongation: ASTM D638, min 350%
 - .3 Water absorption: ASTM D570, 0.15% Max.
 - .4 Tear resistance: ASTM D624, Min 50 kN/m.
 - .5 Low temperature brittleness: ASTM D746, no failure at -37C
 - .6 Width in construction joints: 100mm min
 - .7 Width in control joints: 150mm min; if surface mounted, with 25mm deep centre key to create reglet.
 - .8 Width in expansion joints: 225mm, with 31mm O.D centre bulb.
- .6 Dovetail Anchor Slots: Minimum 0.65mm thick galvanized steel with insulation filled slots; bend tab anchors.
- .7 Weep hole tubes: plastic.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of this Section depends.
 - .2 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .3 Commencement of work implies acceptance of existing conditions and work by others.

3.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Provide temporary protection of adjacent areas and surfaces by means of masking (enclosures) where necessary to prevent contamination by Work of this Section.
- .2 Surface Preparation:
 - .1 Formwork Cleaning:
 - .1 Clean forms as erection proceeds, to remove foreign matter.
 - .2 During cold weather, remove ice and snow from within forms. Do not use calcium chloride or other salt-based de-icing compounds.

3.3 ERECTION / INSTALLATION

- .1 Conform to CSA A23.1
- .2 Fabricate and construct formwork, shoring and bracing in accordance with CSA S269.1 to meet design requirements, and to produce finished concrete conforming to shape, dimensions, locations, and levels indicated within tolerances required by CSA A23.1/A23.2.
- .3 Provide bracing to ensure stability of formwork. Shore or strengthen previously constructed formwork liable to be over stressed by construction loads
- .4 Align joints and make watertight. Keep form joints to a minimum.
- .5 Do not place shores and mud sills on frozen ground.
- .6 Ensure there is site drainage to prevent washout of the soil supporting shores and mud sills.
- .7 Form sides of footings unless earth forms are permitted by the Geotechnical report and structural drawings.
- .8 When using earth forms, hand trim sides and bottoms, and remove loose dirt prior to placing concrete.
- .9 Provide 25mm chamfer strips on all external corners and 25mm fillets at interior corners unless specified otherwise. Do not put chamfers on horizontal ledges supporting masonry. Chamfers and fillets are not necessarily shown on drawings.
- .10 Apply form release agent prior to placing reinforcing steel, anchoring devices, and embedded items. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent.

- .11 Provide formed openings where required for pipes, conduits, sleeves, and other work to be embedded in and passing through concrete members. If opening is not shown on structural drawings, obtain approval prior to forming opening.
- .12 Place items which will be cast directly into concrete.
- .13 Coordinate work of other sections involved in forming and setting openings, slots, chases, sleeves, bolts, anchors, and other inserts.
- .14 Provide vertical dovetail anchor slots where masonry veneer covers face of concrete.
- .15 Install void forms in accordance with manufacturer's recommendations.
- .16 Concrete Joints:
 - .1 Refer to structural drawings for concrete joint requirements.
 - .2 Provide construction joints in formed slabs and slab on deck.
 - .3 Provide evenly spaced vertical control joints in walls.
 - .4 Provide expansion joints where shown on structural drawings.
 - .5 Provide construction gaps where shown on structural drawings.
 - .6 Refer to Section 03 30 00 for other joint requirements.
- .17 Waterstops:
 - .1 PVC Waterstops:
 - .1 Provide PVC waterstops for expansion, construction and control joints in exterior walls, basement walls, retaining walls, slabs supporting earth, and other locations shown on structural drawings.
 - .2 Do not use surface mounted PVC waterstops at control joints which are to be protected by applied waterproofing.
 - .3 Install waterstops continuous without displacing reinforcement. Follow manufacturers requirements. Heat seal joints watertight. Use factory welded corners and intersections.
 - .4 Tie waterstops to reinforcement at minimum 1m spacing to ensure alignment is maintained when concrete is placed.
- .18 Concrete Exposed to View:
 - .1 Minimize formwork joints. Locate joints and ties in a uniform pattern and do not place ties within 300mm of a joint. Ensure panels forming slab soffits are symmetrical and as large as possible.
 - .2 Align panel form joints with any grooves, reglets, or chamfers required. Provide reglets at all concrete joints.
 - .3 Seal all joints in formwork and between formwork and concrete.
 - .4 Do not re-use formwork with any surface damage.
 - .5 Re-use forms only on identical sections, using original tie holes. Clean forms prior to use. Use only galvanized nails.

- .6 Where removable tie rods are used, plug all holes with precast concrete plugs bonded to the concrete.

.19 Form Removal and Reshoring:

- .1 Conform to CSA A23.1 and ACI 347.
- .2 Survey top of formwork and slab elevations prior to concrete placement, after concrete placement, and after removal of formwork.
- .3 Do not remove formwork supporting beams and slabs until concrete has reached at least 75% of the specified strength.
- .4 Do not remove formwork supporting walls and columns until concrete reaches at least 15 MPa.
- .5 Provide bracing of columns and walls as required until the permanent structure which braces those column/walls is completed.
- .6 Keep falsework or reshoring in place until concrete reaches the specified design strength, but not less than 28 days. If reshoring is installed to replace falsework, strip and re-shore simultaneously so that no more than 9 m² of soffit is left unsupported by either formwork or reshoring at any time.
- .7 Install re-shores tight to structure above and below so that they do not shorten under load. Do not pre-load or lift the structure above by overtightening.
- .8 When a floor is required to support weight of newly placed concrete on the floor above, provide not less than two levels of re-shoring below it (so that the new concrete load is shared by three levels) and maintain until the newly placed concrete above has reached at least 75% of the specified 28-day strength. If the new structure above is thicker than the floors supporting it, more than two levels of reshoring may be required.
- .9 Construction joints: maintain falsework supporting beams and slab adjacent to the construction joint until the concrete beyond the joint reaches at least 75% of its specified 28-day strength.
- .10 Construction gaps: Do not remove falsework supporting beams and slabs adjacent to construction gaps until the gaps are filled and concrete in gaps has reached at least 75% of its specified 28-day strength.
- .11 Re-use formwork and falsework subject to requirements of CSA A23.1/A23.2.

3.4 SITE QUALITY CONTROL

- .1 Non-Conforming Work:
 - .1 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.

3.5 CLEANING

- .1 Remove all excess materials from site as Work proceeds and at completion.
- .2 Leave surfaces clean and ready for subsequent Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified, or required to complete the work of this Section including but not limited to the following:
 - .1 All reinforcing steel required to complete the building as shown in the Structural Drawings and in accordance with these Specifications.
- .2 Related Sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 03 10 00 – Concrete Forming and Accessories.
 - .2 Section 03 30 00 – Cast-in-Place Concrete.
 - .3 Section 04 22 00 – Concrete Unit Masonry.

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 Canadian Standards Association (CSA):
 - .1 CSA A23.1: Concrete Materials and Methods of Concrete Construction.
 - .2 CSA A23.2: Test Methods and Standard Practices for Concrete.
 - .3 CSA A23.3-04: Design of Concrete Structures for Buildings.
 - .4 CSA G30.18: Carbon Steel Bars for Concrete Reinforcement.
 - .5 CSA G40.20: General Requirements for Rolled or Welded Structural Quality Steel.
 - .6 CSA G40.21: Structural Quality Steel.
 - .7 CSA W186: Welding of Reinforcing Bars in Reinforced Concrete Construction.
 - .2 Reinforcing Steel Institute of Canada (RSIC):
 - .1 RSIC: Reinforcing Steel Manual of Standard Practice.
 - .3 American Concrete Institute (ACI):
 - .1 SP-66: ACI Detailing Manual.
 - .4 American Society for Testing and Materials (ASTM):

- .1 ASTM A1064/A1064M: Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .2 ASTM A775/A775M: Standard Specification for Epoxy-Coated Reinforcing Steel.
- .3 ASTM D3963 / D3963M: Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.
- .4 ASTM A1044 / A1044M: Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete.
- .5 ASTM A108/108M: Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordination under this Section shall be in accordance with General Conditions and Division 01.
 - .2 Coordinate with other work having a direct bearing on the Work of this Section.

1.5 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 01 33 00 – Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements.
- .3 Shop drawings:
 - .1 Submit shop drawings prepared according to RSIC Manual of Standard Practice.
 - .2 Shop drawings should clearly indicate the following without reference to structural drawings:
 - .1 Size, spacing, and location of reinforcement, with identifying labels.
 - .2 Masonry wall reinforcement.
 - .3 Bar bending details.
 - .4 Lengths and locations of lap splices.
 - .5 Types and locations of mechanical splices.
 - .6 Placing sequence, if required.
 - .7 Drawn details for areas with high concentration of reinforcement.
 - .8 Bar lists.
 - .9 Quantities of reinforcement.
 - .10 Construction joint, control joint, and pour gap locations.

- .11 Strip dimensions for flat slab and flat plate.
- .12 Concrete cover.
- .13 Details and layouts of shear stud rail reinforcing.
- .3 Shop drawings should not contain reproductions of the structural drawings.
- .4 Do not release for fabrication reinforcing bars whose length may be impacted by field conditions, such as final elevation of footings, until field measurement have been obtained.
- .4 Source Quality Control Submittals:
 - .1 Upon request provide certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.
 - .2 Upon request, inform proposed source of reinforcing steel to be provided.
- .5 Site Quality Control Submittals
 - .1 Submit testing and inspection reports from the appointed Independent Inspection and Testing Agency.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Welding of reinforcing steel to be performed by welders certified under CSA W186.
 - .2 Shear stud reinforcing to be fabricated in an ICC ES approved facility.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials of this Section in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Storage and handling procedures:
 - .1 Store Products off ground, free from dirt accumulation.
 - .2 Maintain fabricated shapes.

2 PRODUCTS

2.1 MATERIALS

- .1 Reinforcing Steel: carbon steel, deformed bars to CSA-G30.18., unless indicated otherwise.
- .2 Weldable Reinforcing steel: weldable low alloy steel deformed bars to CSA G30.18.
- .3 Welded steel wire fabric: to ASTM A1064/A1064M. Provide in flat sheets only.
- .4 Epoxy Coating of reinforcement: to ASTM A775/A775M.
- .5 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- .6 Mechanical splices: to concentrically align bars and develop specified tensile strength of rebar. Threaded couplers to have plastic internal coupler thread protectors.

- .7 Shear stud reinforcing: per ASTM A1044. Min yield strength for studs – 350 MPa, for rails – 300 MPa.
- .8 Expansion cap for dowels at expansion / contraction joints: plastic, tight fitting, with internal pin to locate dowel and create void for expansion.
- .9 Tie Wire: to ASTM A82, minimum 3 mm size, annealed type.
- .10 Fabrication:
 - .1 Fabricate reinforcing steel to CSA A23.1 and RSIC Manual of Standard Practice.
 - .2 Fabricate epoxy coated reinforcing steel in accordance with ASTM D3963/D3963M.
 - .3 Locate reinforcement splices at point of minimum stress. Fabricate splices with lap lengths as indicated on the Drawings.
 - .4 Stagger mechanical splices 750 mm (30") unless otherwise noted on drawings.
 - .5 Weld reinforcement in accordance with CSA W186 where indicated.
 - .6 Fabricate shear stud reinforcing according to ASTM A1044. Weld studs to rail to develop yield strength of stud.
 - .7 Provide standard hooks at ends of all hooked bars.
 - .8 Ship bundles of bar reinforcement clearly identified in accordance with bar lists.
 - .9 Substitutes of different size bars will be permitted only upon written approval of the Consultant.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of this Section depends.
 - .2 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .3 Commencement of work implies acceptance of existing conditions and work by others.

3.2 INSTALLATION

- .1 Place reinforcing to contract documents, CSA A23.1/A23.2 and the RSIC Manual of Standard Practice.
- .2 Place reinforcing accurately and secured in place using chairs, spacers, and hangers. Special care shall be taken to see that the bars in the top of the concrete members are supported in such a manner that they will not be displaced during the pouring of the concrete:
 - .1 Use bar supports for beams and slabs.
 - .2 Use side form spacers for walls and columns.
 - .3 Use plastic bar supports, epoxy coated support bars and plastic-coated tie wire for epoxy coated reinforcement.

- .4 Use precast concrete chairs where supports rest on the ground. Where welded wire fabric is used in slabs-on- grade, place precast concrete chairs at 600 mm (24") on centre each way. Do not attempt to position welded wire fabric by lifting it after concrete is poured.
- .3 Use only the placing shop drawings that were reviewed.
- .4 Bars shall be held and securely tied together using tie wire.
- .5 Remove all loose scale, dirt, oil, or other coatings which would reduce bond.
- .6 Ensure cover to reinforcement is maintained during concrete pour.
- .7 Turn ends of tie wire towards the interior of concrete.
- .8 Do not splice reinforcing at locations other than shown on placing or structural drawings.
- .9 Do not cut reinforcement without approval from the Consultant.
- .10 Unless noted on drawings, do not displace bars from locations shown on reviewed shop drawings.
- .11 Do not field weld reinforcement except where indicated on structural drawings.
- .12 Do not weld epoxy coated reinforcement.
- .13 Any bars which are displaced during the pouring of the concrete shall be immediately re-set.

3.3 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Conduct field inspection and testing as specified in Section 01 40 00
 - .2 An independent Inspection and Testing Agency will be appointed to carry out inspection and testing of concrete reinforcing and check conformance with applicable Standards and Contract documents.
 - .3 The Inspection Agency will inspect installation of 15% post installed dowels for compliance with the procedure described on the Contract Documents and the adhesive supplier's requirements.
- .2 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.

3.4 CLEANING

- .1 Remove all excess materials from site as Work proceeds and at completion.
- .2 Leave surfaces clean and ready for subsequent Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01 (and Division 20 or 26).

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified, or required to complete the work of this Section including but not limited to the following:
 - .1 All cast-in-place concrete required to complete the building as shown in the Structural Drawings and in accordance with these Specifications.
- .2 Related Sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 03 10 00 – Concrete Forming and Accessories.
 - .2 Section 03 20 00 – Concrete Reinforcing.
 - .3 Section 03 35 00 – Concrete Finishing.
 - .4 Section 05 12 23 – Structural Steel for Buildings.

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 Canadian Standards Association (CSA):
 - .1 CSA A23.1: Concrete Materials and Methods of Concrete Construction.
 - .2 CSA A23.2: Methods of Test and Standard Practices for Concrete.
 - .3 CSA A23.3: Design of Concrete Structures.
 - .4 CSA-A3000: Cementitious Materials Compendium (Includes A3001, A3002, A3003, A3004, and A3005).
 - .5 CSA S413: Parking Structures.
 - .2 American Concrete Institute (ACI):
 - .1 ACI 544.3R: Guide for Specifying, Mixing, Placing and Finishing Steel Fibre Reinforced Concrete.
 - .3 American Society for Testing and Materials (ASTM):
 - .1 ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .2 ASTM C920: Standard Specification for Elastomeric Joint Sealants.

- .3 ASTM C1059: Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
- .4 ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- .5 ASTM E1155M: Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Number (Metric).
- .4 Canadian General Standards Board (CGSB):
 - .1 CGSB-51.34: Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordination under this Section shall be in accordance with General Conditions and Division 01.
 - .2 Coordinate with other work having a direct bearing on the Work of this Section.
- .2 Pre-installation Meetings:
 - .1 Hold pre-installation meeting with key personnel minimum one week prior to start of concrete works.
 - .2 Hold pre-pour meeting prior to any mass concrete pours with the supplier, placing trade and independent testing and inspection agency.
- .3 Batch Logs: keep record of each batch delivered to site.
- .4 Concrete Delivery Slips: Keep all concrete delivery slips on site until building is completed.
- .5 A set of drawings and specifications shall be kept at the Place of the Work, upon which the Contractor shall record the progress of the concrete installation, giving the time and date of each pour, the date of form removal and a daily record of the environmental conditions.

1.5 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 01 33 00 - Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements.
- .3 Shop Drawings:
 - .1 Minimum 2 weeks prior to starting concrete work, submit all concrete mix designs, and indicate where each concrete mix is to be used. Minimum submission requirements for each concrete mix design shall include:
 - .1 Minimum compressive strength at 28 days (or other duration if indicated on the drawings).
 - .2 Maximum aggregate size.
 - .3 Aggregate type.

- .4 Concrete density.
- .5 CSA exposure class.
- .6 Cement type.
- .7 Percentage and type of supplemental cementing materials.
- .8 Maximum water/cement ratio.
- .9 Slump at point of discharge.
- .10 Assumed method of concrete placement.
- .11 Corrosion inhibitor (type, name, and quantity).
- .12 Alkali-aggregate resistance.
- .2 Minimum 2 weeks prior to placing concrete, submit drawings showing proposed locations of all construction joints, control joints, and expansion joints.
- .3 Submit sleeving drawings, including all sleeves, conduits, and openings required by all trades.
- .4 Flatness and levelness: when requested, submit measurements of slab tolerances for each concrete pour.
- .4 Site Quality Control Submittals:
 - .1 Submit proposed quality control procedures meeting CSA A23.1/A23.2 requirements on the following items:
 - .1 Hot weather concrete
 - .2 Cold weather concrete
 - .3 Finishing
 - .4 Protection
 - .5 Temperature control for mass concrete pours, including details of the measures that will be taken to ensure that maximum concrete temperature, maximum temperature gradients in concrete, and maximum temperature gradients between the concrete and the ambient temperature are not exceeded.
 - .2 Submit testing and inspection reports from the appointed Independent Inspection and Testing Agency.

1.6 CLOSEOUT SUBMITTALS

- .1 On completion of the works, provide letter certifying that the concrete meets all the performance requirements set out in this Section.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Concrete supplier to have a valid "Certificate of Ready Mixed Concrete Production Facilities" issued by the Ready Mixed Concrete Association of Ontario.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials of this Section in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Storage and Handling procedures:
 - .1 Store Products to CSA A23.1.
 - .2 Store cement and aggregates in a manner to prevent deterioration or intrusion of foreign matter.
 - .3 Protect liquid mixtures from freezing and from settling out of solution.
 - .4 Do not use deteriorated or damaged Products for concrete.
 - .5 Store steel fibres in a manner intended to prevent deterioration and intrusion of moisture or foreign matter.

2 PRODUCTS

2.1 PERFORMANCE

- .1 Proportion concrete to CSA A23.1; Alternative 1 – Performance Method for Specifying Concrete.
- .2 Concrete supplier to meet performance criteria of concrete established in the structural drawings.
- .3 All concrete slabs over 600 mm (2'-0") thick, and all walls over 1000 mm (3'-4") thick are considered mass concrete, and the concrete supply, placement and curing to conform to the mass concrete requirements per CSA A23.1.
- .4 The use of supplementary cementing materials (SCM), where permitted by the mix design, shall conform to CSA A23.1 and CSA-A3001 and as follows:
 - .1 Follow slag and fly ash manufacturers directions for proportioning into concrete mix.
 - .2 Avoid using SCM in Architectural Concrete.
 - .3 Use a minimum of 15% SCM for concrete that is not architecturally exposed.
 - .4 Do not use concrete with more than 40% of SCM when ambient temperature is forecast to be below +10°C at the time of concrete pour and during the seven days after the pour, except for footings, walls, and columns.
 - .5 Reduce W/C ratio to 0.45 where using more than 40% of SCM in concrete for slabs and other horizontal finished surfaces, in order to reduce bleed water and to increase rate or strength gain.
- .5 Mix design for concrete placed by pump shall take into consideration the pump equipment and shall not exceed the specified water/cementing materials ratio.
- .6 All admixtures shall be used according to the manufacturer's recommendations.

2.2 MATERIALS

- .1 Portland Cement: to CAN/CSA-A3001, Type GU unless noted otherwise.
- .2 Fly Ash: to CAN/CSA-A3001, Type CI.
- .3 Cementitious Hydraulic Slag: to CA/CSA-A3001.

- .4 Condensed Silica Fume: to CAN/CSA-A3001, Type SF.
- .5 Blended Hydraulic Cement: to Can/CSA-A3001, Type GUb.
- .6 Aggregate: Coarse and fine aggregates to CSA A23.1.
- .7 Admixtures: air entrainment, chemical and super plasticizing admixtures, to CSA A23.1. Do not use admixtures containing chlorides.
- .8 Corrosion-inhibiting admixture: calcium nitrite solution.
- .9 Water: potable, to CSA A23.1.

2.3 ACCESSORIES

- .1 Concrete Reinforcement: as specified in Section 03 20 00.
- .2 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2. Minimum compressive strength: 40 MPa at 28 days.
- .3 Non premixed dry pack grout: composition of non-metallic aggregate and Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 40 MPa at 28 days.
- .4 Curing/sealing compound: to CSA A23.1/A23.2 and ASTM C309, Type 1, Class B, water-based acrylic, compatible with surface hardener where hardener is used.
- .5 Floor surface hardener: non-metallic, natural grey colour, premixed, Mohs Hardness 7 or better.
- .6 Pre-moulded joint fillers: min. 12 (1/2") bituminous impregnated fiber board to ASTM D1751.
- .7 Compressible filler: flexible polyethylene closed cell expansion joint filler to ASTM D 4819, type II.
- .8 Control joint filler: semi-rigid two component epoxy or polyurea with 100% solids, Shore A hardness (per ASTM D2240) min. 85, tensile strength at 7 days (per ASTM D638) min 5.0 MPa.
 - .1 For saw-cuts in exterior slabs and in slabs in vehicle accessible areas use only polyurea fillers.
- .9 Joint Sealants: to ASTM C920, class 100/50.
- .10 Bonding adhesive: synthetic latex per ASTM C1059.
- .11 Rigid insulation: extruded polystyrene boards per ASTM C578, structural grade, compressive strength 40 psi (275 kPa), deformation not greater than 5%.
- .12 Bond Breaker: 0.25 mm (10 mil) polyethylene or grade D, 30-minute building paper perforated with 8 mm (5/16") holes at 150 mm (6") centres, each way.
- .13 Weep hole tubes: plastic.
- .14 Crack Filler: low viscosity epoxy resin.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:

- .1 Examine all work of other Sections upon which the Work of this Section depends.
- .2 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
- .3 Commencement of work implies acceptance of existing conditions and work by others.

3.2 PREPARATION

- .1 Provide advance notice prior to placing concrete and/or closing wall forms to allow for general review of the concrete reinforcement.
- .2 Obtain written confirmation from Geotechnical Consultant that each foundation bearing surface is acceptable and meets the specified bearing capacity prior to placing concrete.
- .3 Ensure all excavations and bearing surfaces are free of water and disturbed soil prior to placing concrete.
- .4 Provide vapour barrier under slabs placed on ground per the Architectural specifications:
 - .1 Lap minimum 150mm at joints and seal
 - .2 Seal all punctures before placing concrete.
- .5 Prepare concrete slabs designated to receive bonded topping slabs to CSA A23.1.
- .6 Provide bond-breaker under unbonded concrete toppings. Attach to base slab, lap min. 150 mm (6") and seal.
- .7 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.

3.3 INSTALLATION

- .1 Review drawings and specifications for other Sections which will affect the placement of concrete.
- .2 Form openings and build in anchors, rolled steel sections, sleeves, inserts, sub-frames or finished work supplied by other Sections as indicated in the Contract Documents and on Shop Drawings, and as required for the proper completion of the Work and Project. These locations are the responsibility of the Trade for whom the sleeve, etc. has been placed.
- .3 Placement and positioning of reinforcement take precedent over embedded items. Do not field modify reinforcement to suit added openings.
- .4 Confirm locations and sizes of sleeves and openings shown on Structural Drawings with Architectural, Mechanical and Electrical Drawings.
- .5 Obtain approval for any required sleeves and openings which were not shown on structural drawings or reviewed sleeving drawings.
- .6 Placing Concrete:
 - .1 Convey and place concrete to CSA A23.1.
 - .2 During extremes in weather, floors shall not be placed unless the slab is protected by a roof and other suitable protective measures can be taken.
 - .3 Equipment for chuting, pumping and pneumatically conveying concrete shall be such size and design as to ensure a practically continuous flow of concrete at the delivery end without separation of materials.

- .4 Deposit concrete as nearly as practicable in its final position to avoid segregation due to re-handling or flowing. The placing of concrete shall be carried on at such a rate that concrete is at all times plastic and flows readily into the spaces between the bars.
- .5 Once placing has started, it shall be carried on as a continuous operation without cold joints. If cold joints develop inadvertently, obtain instructions for required remedial work.
- .6 Thoroughly consolidate concrete by vibration or suitable means during placement. It shall be thoroughly worked around reinforcement and embedded fixtures and into the corners of the forms. Vibrators shall not be used to move concrete horizontally.
- .7 Use rubber tipped vibrators for concrete containing epoxy coated reinforcement.
- .8 Beams and girders, column capitals and haunches shall be placed monolithically without horizontal joints in their depths, unless specifically indicated otherwise on the drawings.
- .9 Cast slabs with a top surface that is level or sloping as indicated by the Drawings. Allow for cambering where required.
- .7 Concrete exposed to view:
 - .1 Exposed surfaces to be dense, even, uniform in colour, texture, and distribution of exposed aggregate.
 - .2 Defects such as honeycombing, voids, loss of fines, visible flow lines, cold joints or excessive bug holes may be cause for rejection.
- .8 Unbonded concrete topping:
 - .1 Place unbonded topping over bond breaker.
 - .2 Provide construction, control, and isolation joints the same as for a slab on grade.
- .9 Bonded concrete topping:
 - .1 Place bonded topping over hardened base slab per CSA A23.1
 - .2 Prior to placing topping ensure all dirt, laitance, debris, and other substances that can potentially interfere with the bond, are removed from the base slab by one or more of the following methods:
 - .1 Wet or dry grit sand-blasting.
 - .2 High-pressure water-blasting.
 - .3 Mechanical removal by scarifiers, scabblers, or grinding wheels.
 - .3 Bond topping to base slab using bonding agent.
 - .4 Provide joints in bonded topping to match those in the base slab.
- .10 Finishing Concrete:
 - .1 Finish concrete to CSA A23.1/A23.2.
 - .2 Concrete to be covered by other materials:
 - .1 All void holes and cavities should be filled with grout to provide relatively smooth surface.
 - .2 Cut back any projecting metal ties and wires.

- .3 Coordinate with any trade applying finishes to ensure the concrete surface is sufficient to ensure adequate bond.
- .4 Provide chases and reglets where required.
- .3 Finishing Flatwork:
 - .1 Protect concrete during finishing process. Use evaporation reducer if required.
 - .2 Refer to Section 03 35 00 – Concrete Floor Finishing
 - .3 Provide concrete finish to suit proposed use:
 - .1 Screeded and bull floated: mud slabs and footings/pile caps.
 - .2 Screeded and bull floated with scratch finish: base slabs which receive mortar setting beds or bonded toppings.
 - .3 Powered float finish: roofs and slabs which received a membrane.
 - .4 Wood float finish with brooming: exterior exposed slabs.
 - .5 Powered steel trowel finish: interior exposed slabs, slabs which receive resilient flooring, carpet, epoxy-based finishes, thin tile sets etc. Do not trowel air-entrained concrete.
 - .6 Steel trowel exposed interior concrete floors at least twice. Provide final spin troweling when non-slip finish is required.
 - .7 Use laser screed machine to screed concrete reinforced with steel fibres. Use magnets, or other means, to remove any surface fibres during finishing operations so that no fibres are left exposed on the surface.
 - .4 Surface hardeners:
 - .1 Provide surface hardener if required by Architectural drawings or specifications.
 - .2 Use only liquid hardeners on air-entrained concrete.
 - .3 Follow manufacturers directions for application and dosage.
 - .5 Surface Tolerances:
 - .1 Conform to finish tolerance Class A per CSA A23.1, unless noted otherwise on drawings.
 - .2 Measure surface tolerances using the F-Number method in accordance with ASTM E1155M within 72h of each concrete pour.
- .4 Finishing Formed Surfaces:
 - .1 Concrete exposed to view:
 - .1 Provide smooth form finish.
 - .2 If irregularities exist grind surface using carborundum and use cement slurry to make good.
 - .3 Rub exposed sharp edges with carborundum to produce 3 mm radius edges unless otherwise indicated.

.11 Concrete Curing:

- .1 Cure and protect concrete to CSA A23.1
- .2 Provide necessary protection to maintain concrete temperature above 10°C for the curing period.
- .3 Curing exposed surfaces shall commence as soon as the concrete has hardened sufficiently to prevent surface damage and after finishing is completed. Curing of concrete surfaces shall be achieved using one or more of the following methods:
 - .1 Curing compound compatible with applied finishes.
 - .2 Continuous sprinkling.
 - .3 Absorptive mat or fabric kept continuously wet.
 - .4 4 mil polyethylene plastic film.
 - .5 Forms in contact with concrete surface; or
 - .6 Other moisture-retaining methods as approved by the Consultant.
- .4 The basic curing time shall be extended on all structural concrete until the concrete has achieved sufficient strength for structural safety. Sufficient strength is defined as 75% of the specified 28-day compressive strength of the concrete unless otherwise directed by the Consultant.
- .5 For air entrained concrete, and concrete containing admixtures and supplemental cementing materials, curing and protection times may need to be extended beyond those outlined in A23.1 to ensure the concrete has achieved the sufficient strength of 75% of the 28 days compressive strength.
- .6 Do not use curing compounds on parking garage slabs or concrete surfaces where a bonded topping will be applied. Cover slab with absorptive mat or fabric and keep continuously wet.
- .7 For curing and protection slabs on grade and structural slabs which are to receive resilient flooring or other types of moisture sensitive finishes:
 - .1 Apply 24 hours of continuous sprinkling with water immediately after finishing.
 - .2 Cover slab with plastic sheets with all joints/edges taped for at least 72 hours.
 - .3 Protect finished and cured slab from any surface moisture/water.
 - .4 Refer to architectural documents for moisture testing requirements prior to application of finishes.
- .8 Do not load concrete until sufficient concrete strength is achieved.
- .9 Penetrating Sealer:
 - .1 Any concrete surface to receive penetrating sealer to be at least 28 days old.
 - .2 Surfaces to dry, cleaned of debris, and have all curing compounds removed prior to sealer application.
 - .3 Follow manufacturers recommendations for coverage rate, application procedure, and weather restrictions to ensure proper application.

.12 Construction Joints, Control Joints, and Saw Cuts:

- .1 Provide construction joints, control joints, and saw cuts as shown on the Drawings.
- .2 Clean construction joints of dirt and laitance. Saturate joint with water before placing adjacent concrete.
- .3 Where shown, at construction joints and control joints in all walls retaining grade, a PVC waterstop shall be provided for the full length of the joint, wired to reinforcing to ensure proper alignment in the concrete and heat welded at all laps and splices in accordance with manufacturer's recommendations. Coordinate placement with Section 03 10 00
- .4 Slabs on grade:
 - .1 All saw cuts shall be made on the day of the finishing operations (within 6 to 18 hours) using "soff-cut" saws. Where saw cuts are not shown on the drawings, space saw cuts at 25 times the slab thickness, but not greater than 5m (16' 8").
 - .2 Locate joints on column lines wherever possible and on intermediate lines which result in square panels without re-entrant corners. Do not create "L" or "T" shaped joint intersections.
 - .3 Saw cut control joints to depth equal to one quarter of the concrete thickness, unless noted otherwise on the drawings.
 - .4 At least 120 days after placing slab on grade, prior to occupancy, clean all dust and debris from the saw cuts and immediate area and fill the saw cuts with the specified joint filler.
 - .5 In refrigerated and freezer areas, seal joints 14 to 21 days after the temperature has been brought down.
 - .6 Isolation Joints:
 - .1 Unless otherwise shown on structural drawings, provide pre-moulded joint filler of the same depth as the thickness of the concrete wherever slabs-on-grade abut foundation walls, columns, and piers. Omit if slab is chased or dowelled into structure.
 - .2 Place pre-moulded joint filler in required joints in a single piece for the depth and width required for the joint.
 - .7 Cracks in Slab on Grade:
 - .1 Any cracking in excess of 3mm in width may be cause for rejection.
 - .2 Unless slab is rejected, repair any cracks in exposed slab on grade that are in excess of 0.4mm.
 - .3 Fill crack with epoxy after concrete is at least 120 days old.

3.4 SITE QUALITY CONTROL

- .1 Conduct field inspection and testing as specified in Section 01 40 00.
- .2 An independent Inspection and Testing Agency (certified under CSA A283) to be appointed to carry out all inspection and testing of concrete to check conformance with contract documents and all applicable standards.
- .3 If instructed, the Inspection Agency shall secure production samples of materials at the plant or stockpiles during the course of the work and test for compliance with the Contract Documents.
- .4 Sample, store, and test concrete to CSA A23.1/A23.2.

- .5 The Inspection Agency to review all concrete submittals pertaining to concrete mix designs and certification of concrete plant, equipment, and materials.
- .6 The Inspection Agency will submit reports detailing the work inspected and the testing performed. The reports to include the Supplier's mix design numbers, location in structure from where the concrete applies and comments on abnormal results and conditions. The reports will be provided not later than five working days after the testing is completed
- .7 On a representative number of pours, the Inspection Agency to observe measurement of slab surface tolerances (flatness and levelness) to confirm Contractor's compliance with ASTM E1155M.
- .8 Concrete Compressive Strength Tests:
 - .1 A technician shall make at least three (3) compression-test specimens for each day's concrete placement but not less than three (3) cylinders for each 100 cu. m. of individual placement. There shall be no less than one set of three cylinders for each concrete mix design placed on any one day. One cylinder shall be tested at seven (7) days and one at twenty-eight (28) days. Additional test specimens may be taken at the discretion of the Consultant.
 - .2 The third cylinder to be tested at 56 days, should the required strength at 28 days not be achieved.
 - .3 Additional cylinders may be cast at the expense of the Contractor if the Contractor requests them. The timing of tests on these extra cylinders shall be as required by the Contractor.
 - .4 If the concrete strength is specified in the contract documents at greater than 28 days (i.e. 56, 90, or 120 days) then an additional cylinder is to be provided.
 - .5 One additional cylinder will be provided for each concrete mix during cold weather concreting. The specimens will be cured on site adjacent to and under the same conditions as the work they represent and will be tested prior to form removal.
 - .6 If standard on site cured cylinders are used to determine concrete strength prior to removal of formwork, they will be kept adjacent to and under the same conditions as the work they represent.
- .9 Concrete Slump Tests:
 - .1 A technician shall make standard slump tests as directed by the Consultant. A slump test shall be made with every strength test.
 - .2 For concrete to which a high range water reducing admixture (superplasticizer) is to be added, the Inspection and Testing Company shall take a slump test on a sample obtained before the superplasticizer is added.
 - .3 Any concrete failing to meet the specified slump requirements shall be rejected by the Inspection and Testing Company.
- .10 Entrained Air Tests:
 - .1 Air content measurements of air-entrained concrete shall be made for each load of air entrained concrete and not less than one standard test for each 25cu.m of air entrained concrete.
 - .2 Concrete subject to exposure classifications F-1, C-1, and C-2 shall be retested for conformance to air content requirements when more than 90 minutes have elapsed since batching.
- .11 Concrete Slabs with Steel Fibres:

- .1 For slabs on grade containing steel fibres, the Inspection and Testing Company shall monitor on site, to ensure that the amount of fibres added meets the specification.
- .2 For the first loads deposited that contain steel fibres, a sample shall be taken from the first quarter of the load and the steel fibres, washed out, collected, and weighed to ensure proper distribution of the fibres throughout the concrete.
- .3 Should the steel fibre density fall outside 10% of the required value, adjustments shall be made to the method of addition, to the duration of mixing or as required to achieve proper distribution.
- .4 Adjustments and samples shall be taken from each load until two successive loads are mixed within the specified tolerance.
- .12 Mass Concrete Testing:
 - .1 All concrete slabs (including raft foundation slabs) over 600 mm (2'-0") thick, and all walls over 1000 mm (3'-4") thick are considered mass concrete.
 - .2 The Inspection Agency will record concrete temperature at placing.
 - .3 The Inspection Agency will record concrete temperature and temperature gradient during the 7-day curing period by providing, installing and monitor sufficient number of thermocouples.
- .13 Fresh Density Testing:
 - .1 One standard fresh density test will be performed on site for each 50 cubic meters of semi-low density, low density, and high-density concrete. Assist the Agency to correlate fresh density with air-dry density prior to the work beginning on site. Reports will include both fresh density and air-dry density.
- .14 Bond Strength Testing:
 - .1 One standard bond test will be provided for each 200 square meters of bonded concrete topping placed over hardened concrete and designed to act compositely with it.
- .15 Grout Testing:
 - .1 One standard test per ASTM C1107 will be made each day when concrete grout is installed under base plates.
 - .2 A group of 6 cubes for each test will be provided. 3 cubes will be tested after 7 days, and 3 after 28 days.
- .16 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.

3.5 CLEANING

- .1 Leave surfaces clean and ready for subsequent Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section Includes: Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required to complete the work of this Section including but not limited to:
 - .1 Finishing of horizontal concrete surfaces, including concrete floor slabs and toppings.
 - .2 Surface treatment with concrete.
 - .3 Cast-in tactile warning tiles
 - .4 Cast-in nosing strips
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 03 30 00 – Cast-in-Place Concrete

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American Concrete Institute (ACI):
 - (1) ACI 302.1R: Guide for Concrete Floor and Slab Construction.
 - .2 American Society for Testing and Materials (ASTM):
 - (1) ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 Canadian Standards Association (CSA):
 - (1) CSA A23.1 – Concrete Materials and Methods of Concrete Construction. CSA A23.2-04: Methods of Test and Standard Practices for Concrete.
 - (2) CSA A23.2 – Methods of Test and Standard Practices for Concrete.

1.4 SUBMITTALS

- .1 Submit required submittals as specified in Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this Section.

- .2 Provide list of Products proposed for use on project where such products are not specified by trade name or where specification permits choice or alternatives. Include descriptive manufacturer or supplier literature.
- .3 Include application instructions for concrete hardener and sealer.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer's:
 - (1) Manufacturer shall have a minimum of 5 years' experience having successfully supplied products required for the Work of this Section for other projects of similar size and complexity.
 - .2 Applicator's:
 - (1) Applicator shall have a minimum of 5 years' continuous Canadian experience successfully completing projects similar in size and complexity as the Work of this Section. Submit proof of experience upon Consultant's request.
 - (2) Applicator shall be a person or firm specializing in commercial concrete floor finishing, and with five years documented experience.
 - (3) The concrete floor finisher is to have demonstrated experience in the placement of steel fibre reinforced concrete floors and is to be approved by the Contractor. The assessment of floor finishers experience will be based upon their previous successful installations of steel fibre reinforced concrete floors.

1.6 PROJECT CONDITIONS

- .1 Perform Work only when environmental conditions are as specified in Section 03 30 00.
- .2 Ensure that adequate temporary heating is provided as required for cold weather work.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - (1) BASF Group ; www.basf.com
 - (2) CPD Construction Products; www.cpd.ca
 - (3) Euclid Chemical Canada Ltd.; www.euclidchemical.com
 - (4) Mapei; www.mapei.com
 - (5) Sika Canada Inc.; www.sika.ca
 - (6) W.R. Meadows of Canada; www.wrmeadows.com

- .2 Requests for substitutions shall be made in conformance with Section 01 25 00.

2.2 MATERIALS

- .1 Hardener: Liqui-Hard by W.R. Meadows.
- .2 Slip Resistant Finish: silica sand type, colour as selected by Consultant;
- .3 Curing-Sealing Compound: 100 percent water based acrylic copolymer, to ASTM C309, Type 1, Class B; Vocomp 20 by W. R. Meadows or Masterkure N-Seal-HS by Degussa.
- .4 Water: as specified in Section 03 30 00.
- .5 Cast in place tactile warning tiles:
 - .1 AODA compliant porcelain tactile tiles
 - .2 Acceptable products and manufacturers:
 - (1) Olympia Tile Dome Series – Colour to be selected by consultant from manufacturer's range of colours.
 - (2) Or equivalent
- .6 Cast in place non-slip stair nosing:
 - .1 Aluminum nosing
 - .2 26mm deep, in lengths as required on Drawings.
 - .3 Acceptable products and manufacturers:
 - (1) Schluter TREP-SE, black
 - (2) Or equivalent

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of this Section depends.
 - .2 Verify concrete does not contain admixtures which would be incompatible with floor hardener materials or other applied finishes.
 - .3 Report in writing to the Consultant any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of this Section.
 - .4 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .5 Commencement of work implies acceptance of existing conditions and work by others.

3.2 APPLICATION

.1 Finishing:

.1 Finish concrete floor surfaces to CSA A23.1.

.2 Floating:

- (1) After the concrete has been properly placed, struck off, and darried or bullfloated, it shall not be worked until ready for floating. The lapse of time between darrying and power floating may vary from 2 to 8 hours or more depending on the weather conditions, concrete temperature, and the concrete mixture. Floating shall begin when the water sheen has disappeared and/or the mix has stiffened sufficiently that the weight of a man standing on it leaves only a slight imprint on the surface. If two power floating operations are necessary to bring the surface to the desired state, the concrete shall be allowed to stiffen or become harder before beginning the second floating operation.

.3 Trowelling:

- (1) Both power and hand trowelling shall be required. Power trowelling shall begin as soon as little or no cement paste clings to the blades. Trowelling shall be continued until the surface is dense, smooth, and free of all minor blemishes, such as trowel marks.
- (2) Final hand trowelling shall be required to remove slight imperfections left by trowelling machines and to bring the surface to a dense, smooth polished finish. Final hand trowelling shall be continued until a ringing sound is heard as the trowel passes over the surfaces.
- (3) Sprinkling of dry cement or a mixture of dry cement and sand on the surface of the fresh concrete to absorb water or to stiffen the mix shall not be permitted during any stage of floor construction.

.4 Floor Finish:

- (1) Interior slabs receiving a permanent covering (eg. tile, linoleum, carpet), shall have a hard, smooth dense trowelled surface free from blemishes.
- (2) Interior exposed slabs in shall receive a trowel finish plus fine hair brooming or a swirl-trowel finish to the Consultant's approval.

.2 Sealers:

- .1 Floor Sealing: concrete floors that are to be left exposed shall receive a coating of concrete floor sealer, applied according to the manufacturer's recommendations, no sooner than seven days after the specified curing has been completed.
- .2 Wall Sealing: concrete block walls that are to be left exposed to elements shall receive sealer, applied to surface by brushing, rolling or spraying over entire area moving in one direction uniformly. Avoid puddling of product in any area. A maximum of two (2) coats may be required, depending on porosity of surface. Recommended application temperature (ambient and substrate) is between 7 and 35 °C (45 - 95 °F).

.3 Curing:

- .1 Cure concrete to CSA A23.1/A23.2.

- .2 Curing of exposed surfaces shall commence as soon as the concrete has hardened sufficiently to prevent surface damage. Curing of concrete surfaces shall be achieved using one or more of the following methods:
 - (1) ponding or continuous sprinkling;
 - (2) absorptive mat or fabric kept continuously wet;
 - (3) 4 mil thick polyethylene plastic film;
 - (4) other moisture-retaining methods as approved by the Consultant.
- .3 Basic Curing: moist cure concrete for a period of either three days at a minimum temperature of 10 degrees C (52 degrees F) or for the time necessary to attain 35% of the specified 28 day compressive strength of the concrete.
- .4 Cure air-entrained concrete an additional four consecutive days (for a total of seven days) at a minimum temperature of 10 degrees C (52 degrees F) or for the time necessary to attain 70% of the specified 28 day compressive strength of the concrete.
- .5 The basic curing time shall be extended on all structural concrete until the concrete has achieved sufficient strength for structural safety. (70% of the specified 28 day compressive strength of the concrete unless otherwise directed by the Consultant.)
- .6 When the air temperature is above 27 degrees C (86 degrees F), perform curing to CSA A23.1.
- .7 During freezing weather, terminate water curing of concrete 12 hours before the end of the protection period.
- .8 Moisture cure fibre-reinforced slabs for a minimum of 7 days.
- .4 Concrete tolerances: F-number in accordance with CAN/CSA A23.1/A23.2.
 - .1 Level surface to the following minimum tolerance. Grind smooth surface defects that would be visible or telegraph through applied floor finishing system.
 - (1) Class A: FF 20 - FL 15 for fluid applied floor coatings.
 - (2) Class B: FF 25 - FL 20 for carpet.
 - (3) Class C: FF 35 - FL 25 for resilient sheet flooring, resilient plank flooring and ceramic / porcelain tile flooring.
 - (4) Class D: FF45/FL30 for polished concrete floors
 - .2 The Consultant may direct the Contractor to grind the floor to bring the surface within the requirements. Patching of low spots shall not be permitted. Grinding shall be done as soon as possible, preferably within 3 days, but not until the concrete is sufficiently strong to prevent dislodging coarse aggregate particles.
 - .3 When performed, floor tolerance compliance tests should be completed (and all defective areas identified) within 24 hours after placement and reported to all parties not later than 72 hours after installation. All tests must be conducted before forms, including edging, forms and/or shoring, have been removed.

3.3 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.

- .2 Remove all excess materials from site as Work proceeds and at completion.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy to the satisfaction of the Owner.
- .4 Clean and make good surfaces soiled or otherwise damaged as a result of Work of this Section at no additional cost to the Owner.
- .5 Leave surfaces clean and ready for subsequent Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01.

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified or required, to complete the work of this Section including but not limited to the following:
 - .1 Provide masonry units, and related products including but not limited to the following:
 - (1) Brick.
 - (2) Concrete masonry units.
 - (3) Mortar and mortar aggregate.
 - (4) Mortar net.
 - (5) Grout fill for interior door frames.
 - (6) Control joints and expansion joints in masonry walls.
 - (7) Concrete grout in the cells of reinforced block.
 - (8) Reinforcing in cells of concrete unit masonry for reinforced masonry construction.
 - (9) Masonry reinforcement, ties, anchors, connectors and accessories.
 - (10) Firestopping insulation as required of all masonry wall fire separations.
 - (11) Grout in all bearing plates in masonry walls.
 - (12) Infill all beam pockets in masonry walls.
 - .2 The summarized breakdown of the above mentioned work does not set out all the work of this Section of the Contract but rather outlines the essentials. Provide any masonry work indicated on the drawings or hereinafter specified, all whether enumerated above or not.
 - .3 Products Installed But Not Supplied Under This Section
 - .1 Build, bed and secure into the masonry work the following materials which are supplied by other trades.
 - (1) Masonry inserts, hangers, anchors, sleeves, bolts, etc.
 - (2) Steel lintels supplied by structural steel and/or miscellaneous metals contractor.
 - (3) Louvres in masonry, supplied by general contractor or mechanical trade.
 - (4) Conduit, boxes and devices supplied by general contractor, mechanical and electrical contractors.
 - .4 Related Sections
 - .1 Section 03 30 00 - Cast-in-place Concrete.
 - .2 Section 05 50 00 – Metal Fabrications
 - .3 Section 07 84 00 – Firestopping.
 - .4 Section 07 92 00 – Joint Sealants.
 - .5 Section 08 11 00 – Metal Doors and Frames.

- .6 Section 08 41 00 – Entrances and Storefronts
- .7 Section 08 44 00 – Curtain Wall and Glazed Assemblies.
- .8 Section 09 90 00 – Painting and Coating: Backpainting of hollow metal door frames in masonry walls.

1.3 REFERENCES

- .1 ASTM A82-05: Standard Specification for Steel Wire, Plain, For Concrete Reinforcement.
- .2 ASTM A123/A123M-02: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A153/A153M-05: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .4 ASTM A167-99 (2004): Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .5 ASTM A580/A580M-06: Standard Specification for Stainless Steel Wire.
- .6 ASTM A641/A641M-03: Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- .7 ASTM A1011/A1011M-06b: Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- .8 ASTM C207-06: Standard Specification for Hydrated Lime for Masonry Purposes.
- .9 ASTM C331-05: Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
- .10 CAN/CSA A82.1-M87 (R2003): Burned Clay Brick (Solid Masonry Units Made from Clay or Shale).
- .11 CSA A165 Series-04: CSA Standards on Concrete Masonry Units.
- .12 CSA A179-04: Mortar and Grout for Unit Masonry.
- .13 CSA A370-04: Connectors for Masonry.
- .14 CSA A371-04: Masonry Construction for Buildings.
- .15 CAN/CSA-A3001-03: Cementitious Materials for Use in Concrete.
- .16 CAN/CSA-A3002-03: Masonry and Mortar Cement.
- .17 CAN/CSA-G30.18-M92 (R2002): Billet-Steel Bars for Concrete Reinforcement.
- .18 CSA S304.1-04: Design of Masonry Structures.
- .19 CAN/CGSB-1.40-M89: Primer, Structural Steel, Oil Alkyd Type.
- .20 CISC CPMA 2-75: Quick Drying Primer for Use on Structural Steel.

1.4 SUBMITTALS

- .1 Submit a list of products to be used in the work of this section, including insulation manufacturer, mortar supplier, concrete unit masonry supplier, and air barrier products for review by the Consultant

- .2 Prior to commencing the work submit manufacturers' complete set of standard details for the air/vapour barrier membrane system showing a continuous plane of air tightness throughout the building envelope.

1.5 SAMPLES

- .1 Submit samples as specified in Section 01 33 00.
- .2 Samples: duplicate full-size samples of each type of specified masonry unit; showing size, colour, design and pattern of faces.

1.6 QUALITY ASSURANCE

- .1 Submit documentation verifying that the air barrier applicator is a recommended installer by the air barrier manufacturer.

1.7 MOCK-UPS

- .1 Construct a mock-up of the inner wythe masonry together with air/vapour barrier, insulation, and transition membranes to window frame. Once approved, this will become the standard for the work.
- .2 Construct a mock-up of a brick veneer cavity wall assembly on site, complete with backup masonry wall, overall size to be approximately 1200 mm high x 1800 mm long (4' high by 6' long). Build in the bond and with the mortar and jointing as specified for the brick and concrete unit masonry. The panel shall show the range of the brick in a colour pattern and be representative of the quality of work by this Contractor. Brick veneer cavity wall assembly work shall not commence until the mock-up has been approved by the consultant and Owner representative. If the panel is not satisfactory, erect a further mock-up or mock-ups until the range, pointing, joints, etc., are satisfactory to the consultant and Owner representative. The mockup panel when accepted will be used as the quality standard for the project.

1.8 STATEMENT OF COMPATIBILITY

- .1 Submit Statement of Compatibility from manufacturers of: insulation, air barrier, air barrier flashing and insulation fastener adhesive.
- .2 Statement of Compatibility to be on letterhead of manufacturer and be signed by an individual with appropriate authority. Statement of Compatibility to indicated that the manufacturer warrants the performance of their product when it is used in contact with the other manufacturer's products listed above.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Thaw and dry ice and snow which have formed on the bedding surface by the application of heat.
- .2 Remove masonry that has, in the opinion of the Consultant, been frozen or damaged due to weather conditions, before that section of wall is continued.
- .3 Do not lay masonry units that are wet or covered with ice.
- .4 Heating Requirements
 - .1 Provide heat enclosures and heat as required, in accordance with CSA A371.

.2 Observe the following heating requirements:

- (1) Air Temperature 4°C – 0°C (40°F – 32°F): Mortar aggregate or mixing water shall be heated to produce mortar temperatures between 5°C (40°F) and 45°C (110°F).
- (2) Air Temperature 0°C - -4°C (32°F – 25°F): Mortar aggregate and mixing water shall be heated to produce mortar temperatures between 5°C (40°F) and 45°C (110°F). Mortar temperatures shall be maintained above freezing on the boards.
- (3) Air Temperature -4°C - -7°C (25°F – 20°F): Mortar aggregate and mixing water shall be heated to produce mortar temperatures between 5°C (40°F) and 45°C (110°F). Mortar temperatures shall be maintained above freezing on the boards. Salamanders or other sources of heat shall be used on both sides of walls under construction. Wind breaks shall be employed when wind is excess of 25 km/hour (15 m.p.h.)
- (4) Air Temperature -7°C and below (20°F and below): Mortar aggregate and mixing water shall be heated to produce mortar temperatures between 5°C (40°F) and 45°C (110°F). Enclosure and auxiliary heat shall be provided to maintain air temperatures above 0°C (32°F). Temperature of units when laid shall not be less than -7°C (20°F).

.5 Protection Requirements for Completed Masonry

.1 The following protection requirements apply to complete masonry and masonry not being worked:

- (1) Air Temperature 4°C – 0°C (40°F – 32°F): Masonry shall be protected from rain or snow for 24 hours by covering with a weather resistive membrane.
- (2) Air Temperature 0°C - -4°C (32°F – 25°F): Masonry shall be completely covered with weather resistive membrane for 24 hours.
- (3) Air Temperature -4°C - -7°C (25°F – 20°F): Masonry shall be completely covered with insulating blanket or equally protected for 24 hours.
- (4) Air Temperature -7°C and below (20°F and below): Masonry temperature shall be maintained above 0°C (32°F) for 24 hours by enclosure and supplementary heat, by electric heating blankets, infra-red heat lamps or other approved method.

.6 Construct and maintain temporary protection as required to permit continuous progress of the Work. Areas so protected shall be of sufficient size to permit progress of all work necessary to maintain an orderly and efficient sequence of construction operations.

.7 Provide temporary lighting at levels adequate to permit work to be performed in accordance with the Contract Documents.

.8 Give adequate notification to the Consultant and Subcontractors prior to the erection and removal of temporary protective enclosures.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Refer to Section 01 61 00.

.2 Deliver Products in dry condition, and keep dry until use.

.3 Deliver cement, lime and other packaged materials in original unbroken and undamaged packages with the marker's name and brand distinctly marked therein, and upon delivery store in a shed until used on the work.

.4 Deliver masonry units palletized and protected with Shrink-Film.

.5 Store or pile mortar aggregate on plywood, asphalt or concrete area, and protect from dirt and rubbish.

- .6 Store masonry units off the ground with care to avoid damage. Damaged units will not be acceptable for face work.
- .7 Do not double stack cubes masonry units.

2 PRODUCTS

2.1 MORTAR MATERIALS

- .1 Portland Cement: to CAN/CSA-A3001, Type GU, Grey colour.
- .2 Masonry Cement: to CAN/CSA-A3002, Type N.
- .3 Hydrated Lime: to ASTM C207, Type N – Normal.
- .4 Sand: to CSA A179, standard masonry type; free from loam, clay, vegetable or organic matter, acid, alkali, salt or other soluble or deleterious matter.
- .5 Water: clean, potable.

2.2 MASONRY UNITS

- .1 Face Brick: burned clay brick, to CAN/CSA A82.1-M, Riverdale Matt as manufactured by Hanson Brick; metric modular size, denoted in Materials Legend as “Field Colour Type 1”
- .2 Concrete Masonry Units – Normal Weight (CMU) where indicated on Drawings: to CSA A165.1, using N aggregate; 190 x 390 mm size; solid factory-finished ends with bull nosed corners for use at exposed wall corners, special shapes as required; types as follows:
 - .1 Hollow: Type H/15/A/M.
 - .2 Solid (100 percent): SF/15/A/M.
 - .3 Solid (75 percent): SS/15/A/M.
- .3 Concrete Masonry Units – Lightweight (LCMU) where indicated on Drawings: to CSA A165.1, using L₂20S slag aggregate to ASTM C331; 190 x 390 mm size, bed depth as indicated on Drawings; solid factory-finished ends with bull nosed corners for use at exposed wall corners, special shapes as required; types as follows:
 - .1 Hollow: Type H/15/C/M
 - .2 Solid (100 percent): SF/15/C/M
 - .3 Solid (75 percent): SS/15/C/M

2.3 JOINT REINFORCEMENT

- .1 Single Wythe Joint Reinforcement: Ladder type, 4.8 mm side rods with 4.8 mm cross ties; to ASTM A82; hot dipped galvanized; e.g. Blok-Lok BL-10, unless noted on Drawings.
- .2 Bed Joint Reinforcement: single 3.7 mm OD wire rod to ASTM A82; hot dipped galvanized.
- .3 Reinforcing Steel: to CSA G30.18, as specified in Section 03 20 00; sizes as indicated on Drawings.

- .4 Strap Anchors: 6.35 mm thick steel plate, hot dipped galvanized; U-shaped and Z-shaped to suit application; e.g. BLT11Z by Blok-Lok.

2.4 VENEER WALL TIES

- .1 Wall Tie (Steel Stud Back-up): to CSA A370, adjustable, dual component slotted design; e.g. Fero Slotted Stud Tie (Type I), comprised of:
 - .1 Slotted Stud Plate: 1.61 mm thick hot dipped galvanized steel plate, to ASTM A1011/A1011M; length to suit air space dimension and stud width.
 - .2 V-Tie: 4.76 mm diameter hot dipped galvanized steel wire to ASTM A82 length to provide placement of tie legs at centerline of veneer.
 - .3 Fasteners: self-tapping sheet metal screws, hex washer head, suitable length to penetrate stud no less than 13 mm; minimum 2 screws per tie.
 - .4 Insulation Retaining Clip: purpose-made plastic, as recommended by tie manufacturer.
- .2 Wall Tie (CMU Back-up): to CSA A370, adjustable, dual component slotted design; e.g. Fero Slotted BlockTie (Type I), comprised of:
 - .1 Slotted Block Plate: 1.61 mm thick hot dipped galvanized steel plate, to ASTM A1011/A1011M length to suit air space and CMU width dimension, less 6 mm.
 - .2 V-Tie: 4.76 mm diameter hot dipped galvanized steel wire to ASTM A82 length to provide placement of tie legs at centerline of veneer.
 - .3 Insulation Retaining Clip: purpose-made plastic, as recommended by tie manufacturer.
- .3 Wall Tie (Concrete Back-up): to CSA A370, adjustable, dual component slotted design; e.g. Fero Slotted Rap-Tie, comprised of:
 - .1 Slotted L-Plate: 1.61 mm thick hot dipped galvanized steel plate, to ASTM A1011/A1011M; length to suit air space dimension.
 - .2 V-Tie: 4.76 mm diameter hot dipped galvanized steel wire to ASTM A82; length to provide placement of tie legs at centerline of veneer.
 - .3 Fastener: 6 mm OD Tapcon screws; minimum 2 screws per tie.
 - .4 Insulation Retaining Clip: purpose-made plastic, as recommended by tie manufacturer.
- .4 Wall Tie (Structural Steel Back-up): to CSA A370, adjustable, dual component design; suitable for welded attachment; Fero CAT-TIE or Blok-Lok BL507, comprised of:
 - .1 AB-Clip: 94 x 15 mm size, 1.61 mm thick hot dipped galvanized steel plate, to ASTM A1011/A1011M.
 - .2 V-Tie: 4.76 mm diameter hot dipped galvanized steel wire to ASTM A82: length to provide placement of tie legs at centerline of veneer.

2.5 ACCESSORIES

- .1 Firestop Insulation: as specified in Section 07 84 00.

- .2 Cavity Vents and Weephole Vents: Goodco P.V.C. injection moulded brick vents with louvers, by Williams-Goodco or DA 1069 cell vent by Dur-O-Wal or weephole ventilator by Blok-Lok; locate weep vents at a rate of 1 vent per 10sq.ft. of wall, surface to be vented, and 1 per 24" length of wall for weephole drainage.
- .3 Mortar Dropping Control Device: High density polyethylene, 25 mm thick, 250 mm high; MortarNet by MortarNet USA Ltd.
- .4 Through-Wall Flashing Supports: At every location where a flexible membrane flash crosses a cavity, provide continuous 0.6 mm (24 ga.) thick galvanized steel flashing support for the membrane.
- .5 Control Joints: in accordance with PCA Concrete Masonry Handbook, latest edition, and as detailed in Standard Details described in Section 00 01 13.
- .6 Expansion Joint: pre-compressed expanding foam sealant; Model 25V by Emseal Corporation.
- .7 Cavity Compartmentalization: 0.91 mm (20ga) galvanized sheet metal.
- .8 Shop Paint: for steel angle lintels, CPMA 2-75.
- .9 Sealants: as specified in Section 07 92 00.
- .10 Hollow Metal Coating: as specified in Section 09 90 00.

2.6 AIR BARRIER MEMBRANES AND TRANSITIONS

- .1 Air Barrier Membrane: Liquid air/vapour barrier (thick system type): Air-Bloc 06 as manufactured by Bakor, a one component elastomeric bitumen, trowel or spray applied to a wet film thickness of 3mm and having the following characteristics:
 - .1 Air leakage 0.002 L/s m² @ 75Pa., 0.005 L/s m² @ 500Pa., 0.017 L/s m² @ 3000Pa and resists suction pressure of 3000Pa maintained for 5 seconds with no increase in air leakage rate when tested at 75Pa.
 - .2 Water Vapour Permeance: 2.8ng/Pa.m² .s. (0.05 perms)
 - .3 Elongation: 1200% to ASTM D 412
 - .4 Recovery: 75% to CAN/CGSB-37.58-M.
- .2 Transition membrane (self-adhering): Blueskin SA as manufactured by Bakor, an SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film. For application temperatures down to minus 12 deg C use Blueskin SA LT. Membrane shall have the following physical properties:
 - .1 Thickness 1.0 mm (40 mils)
 - .2 Air leakage: <0.005 L/s m² @ 75 Pa to ASTM E283-91
 - .3 Water vapour permeance: 2.8ng/Pa.m².s (0.05perms) to ASTM E96
 - .4 Low temperature flexibility: -30°C to CGSB 37-GP-56M
 - .5 Elongation: 200% to ASTM D412-modified

- .3 Through-wall flashing membrane and dampproof course (self-adhering): Blueskin TWF as manufactured by Bakor, an SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film, having the following physical properties:
 - .1 Colour: Yellow
 - .2 High temperature stability: 110C min. to ASTM D5147 (resistance to flow)
 - .3 Puncture resistance (film): 586N minimum to ASTM E154
 - .4 Tear resistance (film): 213N MD; to ASTM D1004
 - .5 Air leakage: <0.005 L/s m² @75Pa to ASTM E283-91
 - .6 Water vapour permeance: 2.8 ng/Pa.m².s (0.05 perms) to ASTM E96
 - .7 Low temperature flexibility: -30°C to CGSB 37-GP-56M
- .4 Air Barrier Primer for self-adhering membranes: For all temperatures, Blueskin Primer as manufactured by Bakor, a synthetic rubber based adhesive type, quick setting, having the following physical properties:
 - .1 Colour: Blue
 - .2 Weight: 0.8 kg/l
 - .3 Solids by weight: 35%
 - .4 Drying time (initial set): 30 minutes
- .5 Air Barrier Primer for self-adhering membranes: For temperatures above -4 C, Aquatac Primer as manufactured by Bakor, a polymer emulsion based adhesive type, quick setting, having the following physical properties:
 - .1 Colour: Aqua
 - .2 Weight: 1.0kg/l
 - .3 Solids by weight: 53%
 - .4 Water based, no solvent odours
 - .5 Drying time (initial set): 30 minutes at 50% RH and 20°C
- .6 Liquid air seal mastic and insulation adhesive: Air-Bloc 21 or 230-21 Insulation Adhesive as manufactured by Bakor, a synthetic, trowel applied, rubber based adhesive type, having the following characteristics:
 - .1 Compatibility: With air/vapour barrier membrane, substrate and insulation
 - .2 Air leakage: 0.013 L/s m² @ 100Pa
 - .3 Water vapour permeance: 1.7ng/Pa. m².s. (0.03 perms)
 - .4 Long term flexibility: CGSB 71-GP-24M

- .5 Chemical resistance: Alkalis and salt

2.7 MORTAR TYPES

- .1 Mortar Types: to CSA A179-04 (R2014) as follows:
- .1 Non-loadbearing Interior Partitions: Type N (compressive strength 750 psi).
 - .2 Loadbearing Walls, Inner-wythe of Exterior Walls, Piers, and Foundation Walls: Type S (compressive strength 1800 psi).
 - .3 Exterior Masonry Veneer: Type N Mortar for exterior masonry veneer.
 - .4 Parging Mortar: Type N.
- .2 Mortar Colour
- .1 Colour of mortar as directed by the Consultant, Loading shall be as directed by the Consultant (6% maximum).
 - .2 Use natural mortar (without colour additives) in all areas to be painted or covered.

2.8 CONCRETE GROUT

- .1 Proportion normal density concrete to meet the following criteria for concrete grout in reinforced masonry units.
- | | |
|--|---------------|
| .1 Portland Cement | Type GU |
| .2 Supplementary Cementing Materials | Permitted |
| .3 Minimum 28 Day Compressive Strength | 15 MPa |
| .4 Minimum Cementitious Content | As required |
| .5 Normal Size for Course Aggregate | 10 mm |
| .6 Slump Range at Point of Discharge | 180 to 220 mm |
| .7 Air Content | Less than 3% |
| .8 Water/Cementing Materials Ratio | 0.55 |

2.9 STONE MASONRY (STONE CROSS – EXTERIOR MASONRY FEATURE)

- .1 Arriscraft International Inc., Adair Limestone Marble: to ASTM C568, Category III - High Density; to nominal dimensions as indicated on Drawings; having the following typical average properties when tested to the identified standard:
- .1 Compressive Strength: 1610 Kgf/cm², to ASTM C170.
 - .2 Absorption: 0.75 percent, to ASTM C97.
 - .3 Density: 2675 Kg/m³ to ASTM C97.
 - .4 Modulus of Rupture: 158 Kgf/cm², to ASTM C99.

- .5 Flexural Strength: 112 Kg/cm² to ASTM C880.
- .6 Abrasion Resistance: 18.0 to ASTM C241.
- .7 Face Finish: Split Face
- .8 Color and Pattern: Sepia-veined to match approved sample range.
- .2 Stone Masonry Accessories
 - .1 Wall Ties and Anchorages: Stainless Steel.
- .3 Stone Masonry Mortar and Mortar Mix
 - .1 Portland Cement: to CAN/CSA-A3001, Type GU; Grey colour.
 - .2 Hydrated Lime: to ASTM C207, Type S-Special.
 - .3 Mortar for Use with Exterior Stone: to CSA A179, Type N using the Proportion specification method, Portland cement-hydrated lime-sand mix; c/w integral colour as selected by Consultant.
 - .4 Mortar Aggregate: natural sand to CSA A179, standard masonry type; clean, dry, protected against dampness, freezing and foreign matter.
 - .5 Water: potable, clean and free of deleterious amounts of acids, alkalies or organic materials.

2.10 SHOP FINISHES

- .1 Hot Dip Galvanizing:
 - .1 Horizontal Joint Reinforcement Wire and V-Ties: to ASTM A153/A153M, Class B2, minimum 458 g/m² zinc coating.
 - .2 Stud Mount RAP Tie Plates: to ASTM A123/A123M, minimum 610 g/m² zinc coating.
 - .3 Slotted L-Plates, Slotted Block Plates and AB-Clips: to ASTM A123/A123M, minimum 401 g/m² zinc coating.
 - .4 Strap Anchors: to ASTM A123/A123M, minimum 503 g/m² zinc coating.

3 EXECUTION

3.1 EXAMINATION

- .1 Prior to the commencement of work, examine all areas that are to receive the work of this Section.
- .2 Report misalignments that may affect the Work to the Consultant for correction.
- .3 Commencement of the work or any parts thereof shall mean acceptance of the prepared substrate.

3.2 RELATIONSHIP TO OTHERS

- .1 Co-operate with other Sections, leaving chases, slots and reglets.
- .2 Build-in frames, sleeves, anchors, bolts, etc. as supplied by others. Ensure items are set square and true.

- .3 Set metal, wood, and wood buck frames for louvres, pressed metal screens and doors, etc. All pressed metal and wood frames for doors and screens in masonry and concrete shall be set and braced by others. Be responsible for and ensure that all frames are set plumb, true and accurately remain in position. Solidly build-in all frames and anchor with the backs of all jambs solidly packed with mortar unless otherwise noted on Drawings.
- .4 Provide openings and lintels in masonry walls where required by other Sections or where indicated; including those required by the Mechanical and Electrical Subcontractors. Locations of such openings must be coordinated by the Subcontractor involved. Cutting and patching for openings that have been missed or incorrectly located shall be provided at no cost to the Owner.
- .5 Accurately locate and neatly finish chases and openings to the required sizes.
- .6 Do not cover pipe, conduit chases or enclosures until advised that the work has been inspected and tested.

3.3 QUALITY OF WORK

- .1 Perform work by skilled workers under the continuous supervision and direction of skilled and experience foremen in each branch of the work. At least one thoroughly experienced and competent man is to be in charge of all mortar mixing.
- .2 Build work plumb, true, level and square, accurately to the dimensions shown and with all angles and reveals at right angles to faces unless distinctly shown otherwise.
- .3 Set out and build masonry work to the respective dimensions called for on drawings. Build and lay work true in line, plumb, square and level; align vertical joints. Keep angles, reveals etc., strictly true and square and plumb.
- .4 All masonry courses to be of uniform height, and both vertical and horizontal joints to be of equal and uniform thickness.
- .5 Do not use chipped, cracked or otherwise damaged units in exposed and load-bearing masonry walls.

3.4 NON-LOADBEARING PARTITIONS

- .1 Extend non-loadbearing partitions in all cases from the top of the structural floor to the bottom surface of the floor or roof construction above unless noted otherwise on Drawings.
- .2 Anchor wall to the underside of the floor structure according to Standard Details.
- .3 In walls exposed to view, support tops of walls with concealed angle clips fastened to deck above wall.

3.5 DAMPPROOFING MEMBRANE

- .1 At the joint between foundation walls and masonry above, provide a continuous horizontal dampproofing membrane for the full width of masonry wall.
- .2 Use adhesive to seal spliced lapping joints minimum 100 mm (4").

3.6 MOISTURE CONTROL

- .1 Interior wythes of masonry must be protected from rain with tarpaulins. Excessive moisture will cause blistering of the air vapour barrier, and will cause longer drying out periods before finishing work can commence.

3.7 PROVISION FOR MOVEMENT

- .1 Leave 25 mm space between top of non load-bearing walls and partitions and structural elements.
- .2 Do not use wedges.
- .3 Fill space with mineral wool.

3.8 TEMPORARY WALL BRACING

- .1 Provide temporary engineered wall bracing design.
- .2 Brace masonry walls to resist wind pressure and other temporary lateral loads during the construction period.

3.9 BRICK BRICKWORK

- .1 Brick having absorption rates in excess of 30 g/min/194 cm² (1 oz./min/30 sq.in) shall be wetted from 3 to 4 hours before it is used and the method of wetting shall be such as to ensure that each brick is uniformly wetted. All bricks shall be free from water adhering to their surfaces when they are placed in the wall. No bricks shall be wetted during freezing weather.
- .2 Use face brick on exterior and interior wall surfaces as indicated. lay Brickwork up in a full mortar bed, and with vertical joints filled solid.

3.10 BONDS AND COURSING

- .1 Lay face brick in a running bond unless otherwise detailed.
- .2 Set brickwork out on a storey rod and bricks arranged to line up with masonry openings and exposed structural members with full course.

3.11 CONCRETE UNIT MASONRY

- .1 Lay units in face shell mortar bedding, plumb, level and true in line, in running bond and properly jointed with other connecting work. Units with open cells exposed in walls will not be permitted.
- .2 Use lightweight concrete unit masonry for exposed interior walls and partitions. Normal weight concrete blocks may be used for all concealed surfaces unless otherwise noted.
- .3 Remove excess mortar and objects. Exercise special care to prevent breaking block corners and the tooled joints shall be made uniform on exposed work.
- .4 Use special concrete unit masonry as indicated on the drawings.
- .5 Use bull-nosed concrete unit masonry for all interior external corners unless noted otherwise on the drawings.
- .6 While laying units, avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after they are set in position. Where an adjustment must be made after the mortar has started to harden, remove mortar and replace with fresh mortar.
- .7 Exercise special care in laying up concrete unit masonry in locations where plastic wall coating finish or painting is indicated. Plumb and tool all joints of concrete unit masonry walls in these locations.

- .8 Tie tee-shaped intersecting walls together with truss-type joint reinforcement. Do not use masonry header bond. Rake and tool joints as indicated on Drawings.
- .9 Sealants to be completed by Section 07 92 00.

3.12 CAVITY WALLS

- .1 The air space in cavity walls must be kept free of mortar.
- .2 Provide weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm (2'-0") O.C. Mortar or debris must not plug holes.
- .3 Provide vent holes in vertical joints at top of walls and/or immediately below flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm O.C. Mortar or debris must not plug holes.
- .4 Mortar Dropping Control: After the first one or two courses of brick are laid, place one continuous row of the mortar net in the collar joint or cavity on the flashing against the inside of the outer wythe at the base of the wall, zig zag side up. No adhesives or fasteners are required, and the mortar need not have set for cavities larger than 25 mm, several thicknesses of the mortar net may be combined or rigid insulation extending at least 150 mm above the top of the mortar net may be used as a filler.
- .5 Mortar Dropping Control: Fill the bottom 75 mm (3") of the cavity with pea gravel after laying the first few courses of brick.
- .6 Provide vertical galvanized sheet metal separators across cavity continuous between top and bottom of cavity, at 1.5 metres from all external corners. Sheet metal to extend out to face of exterior wythe. Section 07 92 00 to provide 2 stage backer rod for sealant at each side of the compartment.
- .7 Provide sheet metal vertical firestops in the cavity to achieve maximum horizontal cavity of 6.5 metres; and maximum vertical cavity of 3.0 metres.
- .8 Provide mineral wool stuffing between tops of all fire rated masonry walls and underside of steel deck construction and around all wall penetrations, in thickness to achieve fire ratings shown on drawings.
- .9 The inner wythe may be constructed to its full height if it is laterally braced to withstand wind forces.
- .10 Tie the outer brick wythe to the inner wythe using the approved cavity wall masonry reinforcing on every second bedding course.

3.13 AIR BARRIER MEMBRANE

- .1 Primer
 - .1 Apply primer for self-adhering membranes at rate recommended by manufacturer.
 - .2 Apply primer to all areas to receive transition sheet and /or through-wall flashing membrane, as indicated on drawings by roller or spray and allow minimum 30 minute open time. Primed surfaces not covered by transition membrane or through-wall flashing membrane during the same working day must be re-primed.

- .2 Transition Membrane (self-adhering type)
 - .1 Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm (2") overlap at all end and side laps.
 - .2 Tie-in to window frames, aluminum screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings.
 - .3 Promptly roll all laps and membrane with a counter top roller to effect seal.
 - .4 Ensure all preparatory work is complete prior to applying liquid-applied air barrier.
- .3 Through-Wall Flashing Membrane (self-adhering type)
 - .1 Align and position the leading edge of self-adhering through-wall flashing membrane with the front horizontal edge of the foundation walls or shelf angles, partially remove protective film and roll membrane over surface and up vertically.
 - .2 Press firmly into place. Ensure minimum 50 mm overlap at all end and side laps.
 - .3 Promptly roll all laps and membrane to effect the seal.
 - .4 Ensure all preparatory work is complete prior to applying self-adhering through-wall flashing membrane.
 - .5 Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.
 - .6 Apply through-wall flashing membrane along the base of masonry veneer walls, over windows, doors and all other wall openings. Membrane shall form continuous flashing and shall extend up a minimum of 200 mm up the back-up wall.
- .4 Primary Air/Vapour Barrier
 - .1 When transition membrane is installed, apply by spray or flat trowel a complete and continuous unbroken film of air/vapour barrier membrane at a minimum wet film thickness of 3 mm. Overlap transition membrane a minimum of 25 mm. Spray apply or trowel around all projections ensuring a complete and continuous air seal.
 - .2 Allow air/vapour barrier membrane to fully cure prior to placement of insulating materials.
- .5 Inspection: Notify Consultant when sections of work are complete so as to allow for review prior to installing insulation.
- .6 Protection: air barrier membranes are not designed for permanent exposure. Cover and protect from environment and UV radiation as soon as possible.

3.14 MORTAR JOINTS

- .1 Mortar Joint Thickness: to CSA A371.
- .2 Mortar joints shall be straight, clean and uniform in thickness.
- .3 Tool joints to a dense, slightly concave curved surface well bonded to the unit at the edges.

3.15 POINTING

- .1 Point and fill holes and cracks in exposed mortar joints.
- .2 Cut out defective joints, refill solidly with mortar and tool to form a neat joint to match existing.

3.16 CONCRETE UNIT MASONRY REINFORCING

- .1 Continuously reinforce and tie together with reinforcing in every second block bed joint concrete unit masonry. Refer to Standard Details.
- .2 Provide horizontal reinforcing in first and second bed joints above and below openings. The first bed joint immediately above and below openings shall have continuous reinforcing. In second bed joint, the reinforcing shall extend 600 mm (24") beyond each side of the opening. Refer to Standard Details.
- .3 Place continuous reinforcing in the second bed joint below the top of the wall. Refer to Standard Details.
- .4 Lap reinforcement a minimum of 150 mm (6") at splices, and cut and bend at corners. Overall width of reinforcement shall be according to the manufacturer's recommendations for the various wall thicknesses.
- .5 Do not use crimped metal wall ties.
- .6 Where vertical bars are called for, fill cores of block full with concrete grout.

3.17 CONTROL JOINTS

- .1 Provide control joints at locations in accordance with Portland Cement Association Concrete Masonry Handbook and determined by the Consultant unless indicated on the drawings to maintain construction integrity.
- .2 Break vertical mortar bond with extruded neoprene gasket
- .3 Prime control joint surfaces to prevent drying out of sealant.
- .4 Provide 2:1 width-to-depth joint for sealant Section 07 92 00.
- .5 To form control joints in interior block walls, fill completely with mortar the core of a full height vertical joint after inserting a strip of building paper to keep the mortar from bonding to one side. Refer to Standard Details.

3.18 EXPANSION JOINTS

- .1 At locations in the building where expansion joints are indicated, provide specified jointing systems in both interior and exterior wythes of masonry.
- .2 Provide additional loop of air/vapour membrane flashing across the expansion joint.
- .3 Cut insulation vertically and leave dry butt joint.

3.19 BEARING

- .1 Fill concrete masonry units acting as bearing structural members solid with 15 MPa (2175 psi) concrete for a width and depth equal to 3 times the length of bearing.

- .2 Use solid concrete masonry units where indicated on Drawings.

3.20 BEAMS AND LINTELS

- .1 Provide steel angle lintels in accordance with the Drawings unless indicated otherwise.
- .2 Clean steel lintels by scraping, wire brushing or other effective means to remove loose scale, rust, grease, oil or other foreign matter.
- .3 Apply one coat of paint prior to installation, unless lintels are galvanized.
- .4 Angle lintels shall have a bearing of not less than 150 mm (6") at each end.

3.21 THROUGH-WALL FLASHINGS

- .1 Provide flashings in masonry in accordance with CSA A371.
- .2 Provide through-wall flashings in the following locations:
 - .1 Under exterior masonry walls bearing on foundation walls or slabs
 - .2 Over shelf angles
 - .3 Over steel angle lintels
 - .4 At window frame and door frame heads
- .3 Provide a soft joint at the soffit of shelf angles, and a slip joint at lintels for movement control.
- .4 In double wythe walls and veneered walls, carry flashings from front edge of masonry, under outer wythes, then up backing not less than 150 mm (6") and as follows:
 - .1 For masonry backing embed flashing 25 mm (1") in joint.
 - .2 For concrete backing, insert flashing into reglets and seal joint.
 - .3 For frame backing, secure flashing to studs behind moisture barrier.
- .5 Lap joints 150 mm (6") and seal with compatible adhesive.
- .6 Flashing over openings shall be installed with dams at both ends to prevent water from travelling horizontally past the flashing ends.
- .7 Horizontal (base) flashing shall be returned a minimum of 100 mm (4") around corner to overlap abutting flashing. Overlapped flashing shall be sealed with compatible adhesive.
- .8 Protect base wall flashing from mortar droppings.
- .9 Ensure that flashings have a drip edge extending 12 mm (½") past exterior wall face. Provide safety edge on exposed edges.

3.22 SHEET METAL WORK

- .1 Cut and form reglets in masonry walls as required for the securing of flashings.

3.23 ANCHORAGE TO CONCRETE

- .1 Provide continuous dovetail anchor slots to be supplied and set by the Concrete Contractor in the concrete for the anchorage of all masonry facing, furring, abutting walls and partitions to the concrete walls, concrete spandrels, concrete columns, etc. Slot shall be for full height as required equal to D & R galvanized steel dovetail type with fibreglass filler and provided complete with adjustable galvanized steel anchors to be placed at 400 mm (16") vertically. Slots are to be at 400 mm (16").

3.24 FIELD QUALITY CONTROL

- .1 Drying Out
 - .1 When masonry work is completed, provide ventilation and heat as required to reduce moisture level in masonry to maximum 15%, sustained for a 48 hour period. Timing for achieving this to be determined by Contractor, but no later than start of finishing work.
 - .2 Testing may be performed as specified in Section 01 45 00. In the absence of such testing, random sampling with moisture meter will be conducted by the Consultant.
- .2 Air Barriers
 - .1 Arrange for inspection of air barrier application by the air barrier manufacturer, of a 1.5 x 1.5 metre sample panel. Obtain report from air barrier manufacturer identifying any recommendations/requirements based on visual review.
 - .2 Arrange for inspection of the air barrier application before the insulation is installed, as specified in Section 01 40 00.
 - .3 Provide inspection report from a qualified building sciences inspection company that the air vapour barrier has been satisfactorily installed in accordance with the performance criteria. Refer to Section 01 40 00.
 - .4 The air leakage rate of the air-barrier assembly is limited to a maximum of 0.1L/s.m².
 - .5 Site testing of assembled components will be done using ASTM E1186, if the inspection and testing company recommends and the owner approves such testing.
 - .6 The Inspection and Testing company shall arrange a meeting to discuss the principal requirements of the air-barrier assembly with all Subcontractors involved in the assembly prior to commencement of construction.
 - (1) This meeting will be attended also by the Consultant and the Contractor.
 - (2) The meeting will also enable all parties to discuss the sequencing necessary to ensure a continuous air-barrier assembly.
 - (3) The Contractor will be responsible for carrying out the work in the agreed sequence.
 - .7 A mock-up of the building exterior wall measuring 2.0 metres wide and incorporating the air-barrier connections at glazed areas, (sill, jamb, head) as well as the wall to roof transition is required to be constructed prior to commencing the building envelope.
 - (1) This mock-up will serve as the model for the work on the building.
 - (2) The mock-up may become part of the final exterior wall as long as it is constructed before the main work of the exterior wall assembly is started.

- (3) If any mock-up assembly specimen is found to be defective with respect to specified requirements for the air-barrier assembly, further fabrication or installation of this assembly will be stopped until the cause(s) of the defect has been identified and a new test assembly has been retested.
- .8 Based on a schedule of work prepared by the Contractor, the inspection and testing company are to be notified by the Contractor at the following milestones: The inspection and testing company will attend the site at these times:
 - (1) completion of primer coat if applicable.
 - (2) completion of spray/trowel applied membrane, or installation of sheet material.
 - (3) during assembly of exterior wythe (in cavity wall construction) to inspect insulation adhesion; cavity clearance, continuity, and compartmentalization.
 - (4) installation of all transitions, prior to commencement of interior finishes.
 - (5) installation of flashings at roof.
- .9 The Inspection and Testing Company will provide inspection reports at each milestone, indicating if the work is satisfactory, or if re-inspection is required.
- .10 If the performance of building envelope cannot be determined by visual inspection, the inspection and testing company may recommend that a differential pressure test be performed on the mock-up and again on the exterior wall assembly.
 - (1) If the performance of the overall building envelope does not meet the air leakage limitation, then the Contractor will be required to undertake remedial repairs at his own expense.
 - (2) Do not proceed with insulation installation until air/vapour barrier installation has been approved.
- .3 Hose Test: On completion of masonry cavity walls, and prior to installing parapets, perform a hose test at 5 metre intervals along length of walls by inserting water hose into top of cavity wall; have Consultant and/or third party testing agent review the test in progress; continue until Consultant and/or third party testing agent is satisfied that the cavities are clear and free draining.

3.25 PROTECTION

- .1 Cover walls exposed to the elements with waterproof membranes at the end of each Working Day and keep covered until work is re-commenced.
- .2 Protect visually-exposed Products from marks and damage.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified, or required to complete the work of this Section including but not limited to the following:
 - .1 All structural steel and accessories to complete the building as shown in the Structural Drawings and in accordance with these Specifications
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 03 30 00 – Cast-in-Place Concrete.
 - .2 Section 04 20 00 – Unit Masonry.
 - .3 Section 05 21 00 – Steel Joist Framing.
 - .4 Section 05 31 00 – Steel Decking.
 - .5 Section 05 50 00 – Metal Fabrications.
 - .6 Section 07 81 00 – Applied Fireproofing.
 - .7 Section 09 90 00 – Painting.

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 Canadian Standards Association (CSA):
 - .1 CSA G40.20/ G40.21: General Requirements for Rolled or Welded Steel Structural Quality Steel.
 - .2 CAN/CSA-G164: Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CAN/CSA-S16: Limit States Design of Steel Structures.
 - .4 CAN/CSA-S136: North American Specification for the Design of Cold-Formed Steel Structural Members.
 - .5 CSA W47.1: Certification of Companies for Fusion Welding of Steel Structures.
 - .6 CSA W48: Filler Metals and Allied Materials for Metal Arc Welding.
 - .7 CSA W55: Certification of Companies for Resistance Welding of Steel and Aluminum.
 - .8 CSA W59: Welded Steel Construction (Metal Arc Welding).

- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A36/A36M: Standard Specification for Carbon Structural Steel.
 - .2 ASTM A123/A123M: Standard Specification for Zinc (Hot Dip Galvanized) coating on Iron and Steel Products.
 - .3 ASTM A307: Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - .4 ASTM A325M: Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength.
 - .5 ASTM A500: Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - .6 ASTM A563M: Standard Specification for Carbon and Allow Steel Nuts.
 - .7 ASTM A992: Standard Specifications for Structural Steel Shapes.
 - .8 ASTM A1011/A1011M: Standard Specifications for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability and Ultra High Strength.
 - .9 ASTM A1085/A1085M: Standard Specification for Cold Formed Welded Carbon Steel Hollow Structural Sections (HSS).
 - .10 ASTM F436M: Standard Specifications for Hardened Steel Washers.
 - .11 ASTM F1136/F1136M: Standard Specification for Zinc/Aluminum Corrosion Protective Coating for fasteners.
 - .12 ASTM F1554: Standard Specification for Anchor Bolts, Steel 36, 55 and 105 ksi Yield Strength.
 - .13 ASTM F2329/F2329M: Standard Specification for Zinc Coating, Hot-Dip, requirements for Application to Carbon and Alloy Steel Bolts, Screws, washers, Nuts and Special threaded Fasteners.
 - .14 ASTM F3125/F3125M: Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 830 MPa and 1040 MPa Minimum Tensile Strength.
- .3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA):
 - .1 CISC: Handbook of Steel Construction.
 - .2 CISC/CPMA Standard 1-73a: A Quick-drying One-coat Paint for Use on Structural Steel.
 - .3 CISC/CPMA Standard 2-75: Quick-drying Primer for Use on Structural Steel.
 - .4 CISC Code of Standard Practice, Appendix I: Architecturally Exposed Structural Steel (AESS).
- .4 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International:
 - .1 SSPC-SP 1: Solvent Cleaning.

- .2 NACE No. 3 / SSPC-SP 6: Commercial Blast Cleaning.
- .3 NACE No.4 / SSPC-SP 7: Brush Off Blast Cleaning.
- .4 NACE No.2 / SSPC-SP 10: Near White Blast Cleaning.
- .5 SSPC Technology Guide No.14: Guide for the Repair of Imperfections in Galvanized, Organic or Inorganic Zinc-Coated Steel Using Organic Zinc Rich Coating.
- .6 SSPC Paint Specification No. 20: Zinc Rich Coating, Type I – Inorganic and Type II – Organic.
- .5 Crane Manufacturers Association of America Inc (CMAA):
 - .1 CMAA Specification No. 70.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordination under this Section shall be in accordance with General Conditions and Division 01.
 - .2 Coordinate with other work having a direct bearing on the Work of this Section.

1.5 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 01 33 00 – Submittals.
- .2 Provide all submittals a minimum 4 weeks prior to the start of fabrication.
- .3 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements.
- .4 Shop Drawings:
 - .1 Provide fabrication and erection documents which indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, fasteners, connections, cambers, loads, and all other relevant details. Shop drawings must be sealed, by the Professional Engineer who is responsible for the connection details.
 - .2 Erection documents to show all details and information necessary for erection and assembly of the steel work, including:
 - .1 Erection procedure indicating methods, sequence, and temporary bracing.
 - .2 Erection diagrams indicating member sizes and labels, relevant section and perimeter details, size, and finish of field bolts, and all relevant AESS information.
 - .3 Sliding bearing assemblies.
 - .4 Details of field welded connections, and finish requirements for AESS if required.
- .3 Assemblies cast in concrete:

- .1 Provide details and dimensions for all steel assemblies which are to be cast into concrete. Coordinate details as required with other Sections.
- .4 Fabrication documents to show all details and information necessary for fabrication of the Steel Work, including:
 - .1 Material specifications.
 - .2 Surface preparation.
 - .3 Finishing/painting/galvanizing (including vent holes).
 - .4 Splices.
 - .5 All types of shop and field connections including size and type of bolts and weld types and lengths.
 - .6 Cambers.
 - .7 AESS requirements for members and connection details including their category per CISC Code of Standard Practice, Appendix I.
- .5 Upon request provide connection calculations and/or sketches stamped by the Professional Engineer responsible for connection design.
- .6 Source Quality Control Submittals:
 - .1 Mill test reports:
 - .1 Provide mill test reports to show chemical and physical properties and other details of the steel to be used on the project.
 - .2 In addition to mill test reports, any steel sourced and manufactured outside of Canada, US, or EU countries to provide testing report indicating that the maximum boron content does not exceed 0.0008%.
 - .1 Provide material testing of each batch to show the steel meets or exceeds CSA G40 and applicable ASTM standards.
 - .2 Testing of the steel to be performed in Canada by an ISO 17025 accredited testing laboratory.
- .7 Site Quality Control Submittals:
 - .1 Submit testing and inspection reports from the appointed Independent Inspection and Testing Agency.

1.6 CLOSEOUT SUBMITTALS

- .1 Upon completion of steel erection, Professional Engineer responsible for connections to provide letter certifying the work has been completed per Contract Documents and as per connection design requirements.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Structural Steel Fabricator:

- .1 Must be a company specializing in fabricating structural steel to CAN/CSA-S16. Fabricator to be a member of the Canadian Institute of Steel Construction.
- .2 Fabricator shall have a minimum of 5 years' continuous Canadian experience successfully fabricating materials specified herein for projects similar in size and complexity as the Work of this Section. Submit proof of experience upon Consultant's request.
- .2 Connection Design Engineer:
 - .1 Fabricator to engage a professional structural engineer, experienced in structural steel design and licensed in the Place of the Work. Engineer to be responsible for design, detailing, and installation of all connections related to structural steel work.
 - .2 The Professional Engineer designing connections to hold a Certificate of Authorization, and to carry min. \$1,000,000.00 in liability insurance (per occurrence).
- .3 Erector:
 - .1 Erector shall have a minimum of 5 years' continuous Canadian experience successfully completing projects similar in size and complexity as the Work of this Section. Submit proof of experience upon Consultant's request.
- .4 Welding:
 - .1 Structural steel fabricator and erector to be certified by the Canadian Welding Bureau to CSA W47.1, Division 1 or 2 and/or CSA W55.3, Division 1 or 2 for resistance welding of structural steel components, and to have CWB approved procedure for welding rebar (Grade 400W) to structural steel in accordance with CSA W186.
 - .2 Welders to be appropriately qualified, working under direction of a qualified welding supervisor.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials of this Section in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Storage and Handling procedures:
 - .1 Check available storage space at the Place of the Work before submitting a bid.
 - .2 Handle and store Products in a manner to prevent damage to other materials, to any existing building or property, and to the Work.
 - .3 Store Products off ground, free from dirt accumulation.
 - .4 Maintain fabricated shapes.
 - .5 Store Products to avoid disruption in the progress of the Work.

2 PRODUCTS

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Design, detail, and supply connections to CAN/CSA S16 to resist the forces indicated on the drawings, including plates, stiffeners, and accessory materials. Consider load effects due to fabrication, erection, and handling.

- .2 Connection design to include consideration of all pass-through forces, including tension, compression, moment, and shear. Provide local reinforcement at connection or joint as required.
- .3 For connection design assume all bolt threads are intercepted by the shear plane.
- .4 Follow conceptual details if shown on structural drawings. If bolt or weld information is called in conceptual details, this is the minimum requirement and may need to be increased per the connection design.
- .5 Design bolted connections as bearing type shear connections unless noted otherwise.
- .6 Beams:
 - .1 Design beam end connections for factored shears given on Drawings.
 - .2 Where shears are not indicated on the Drawings:
 - .1 Select or design beam end connections as standard connections per CISC 'Handbook of Steel Construction' for simply supported beams.
 - .2 For non-composite beams, design beam end connections to resist 50% of the total uniformly distributed factored load capacity for laterally supported beams in bending.
 - .3 For composite beams, design beam end connections to resist 75% of the total uniformly distributed factored load capacity of the non composite beam section in bending.
 - .4 Where concentrated loads are applied adjacent to end connections, the concentrated load is to be included with the end connection design.
 - .5 In all cases, the connections shall be adequate to resist the reactions indicated or produced by the framing or load conditions presented on the drawings.
 - .3 Typical beam to column and beam to spandrel connections to be two-sided connection or end plate connection.
 - .4 Provide all spandrel beams and any beam not braced by floor construction with top and bottom flange connections for torsional restraint.
 - .5 For beam to column connections, if no axial force is given, design connection to resist a minimum of 2% of the column axial force (in addition to other connection requirements).
 - .6 Where concentrated loads occur on beams, or beams are continuous over columns, provide one 10mm stiffener plate on each side of the beam's web as a minimum, and as required according to CAN/CSA-S16 to support the loading imposed.
 - .7 With the exception of moment frames, where axial forces are noted for beams framing into opposite sides of a supporting member, design the pass-through force for the smaller of the two values. If beam sizes differ, centre the axial force on the smaller member.
 - .8 For axial forces shown within moment frames, design both end connections for the forces given.
 - .9 Where studs for composite beams are not connected directly to the beam flange and are connected to a plate or other another steel element, ensure the welded connection of the plate/steel member is sufficient to transfer the full shear capacity of the stud.
- .7 Columns:

- .1 In addition to all other loads and requirements, connect columns to base plates for:
 - .1 A horizontal force not less than 2% of the column axial load.
 - .2 A tensile force not less than the capacity of the anchor rods.
- .2 For support of steel joists (coordinate with joist supplier):
 - .1 Provide seat angles to the sides of columns which are continuous above.
 - .2 Provide connection for tie joist bottom chord for all columns supporting joists.
- .3 For wall openings requiring lintels adjacent to steel columns:
 - .1 Unless otherwise noted on drawings, provide 102 x 102 x 9.5 seat angles attached to sides of columns to support masonry lintels. Length of seat to equal width of lintel minus 25 mm.
 - .2 Provide connection of steel lintels to the column.
- .4 Provide cap plate at the top of columns where required for support of deck/slab, beams, or anchors.
- .5 Provide cantilevered angles at sides of column to support deck/slab edge.
- .6 Where masonry walls are in-plane and connected to the columns, provide anchors to the masonry walls per the typical details.
- .8 Moment Connections
 - .1 Where moment connections are called for in the drawing, but values are not indicated, design moment connection for the capacity of the smaller member.
 - .2 Provide web and flange stiffeners as required per the connection design. Reinforce the web if required.
- .9 Pretension high strength bolts for connections used in the following conditions:
 - .1 Elements resisting seismic loads
 - .2 Any elements with cyclic loading.
 - .3 Connections where bolts are subject to tensile loading.
 - .4 Connections with oversized holes/slots, unless they are specifically designed to accommodate movement.
 - .5 Slip-critical connections.
- .10 Holes:
 - .1 Provide 13mm diameter weep holes at the top and bottom of HSS columns.
 - .2 Provide 16mm vent holes in HSS sections where required for the galvanizing process.
 - .3 Provide 19mm vent holes in the centre of cast in plates which are supporting columns.
 - .4 Where required for attached wood or other materials, coordinate and provide punches holes from 10 mm (3/8") to 32 mm (1 1/4") in diameter.

- .5 Holes for lagging shall be 16 mm (5/8") spaced at 600 mm (24") OC. Stagger holes where they occur on both sides of flange.
- .6 Holes shall be provided for pipes and ducts only if indicated and reinforced in the structural drawings.
 - .1 At any time before the detailed drawings are completed and approved, punched holes shall be provided from 10 mm (3/8") to 32 mm (1 1/4") in diameter for the convenience of other Sections in attaching wood or other materials.
 - .2 Holes for lagging shall be 16 mm (5/8") ID spaced at 600 mm (24") OC. Stagger holes where they occur on both sides of flange.
- .11 Connect together axially loaded built-up members in accordance with the requirements of CSA S16. In addition, interconnect compression members for trusses and bracing at least at the one-third points.
- .12 For all wall supporting elements (shelf angles, hangers) which are connected to floor/roof beams, provide adjustable connections to account for beam deflection.
- .13 For anchor rod holes, follow sizes recommended in the CISC Handbook of Steel Construction. Do not oversize holes for site tolerances.
- .14 Connect new steel members to existing concrete using drilled concrete anchors. Do not field weld at connections with adhesive anchors.
- .15 Provide a minimum 6.4mm cap plate for all exposed and for all exterior HSS members.

2.2 MATERIALS

- .1 Structural Steel: to CSA G40.20 and CSA G40.21
 - .1 Grade 350W for rolled W and WWF shapes.
 - .2 Grade 350W for angles and channels.
 - .3 Grade 350W, Class C or H for hollow structural sections.
 - .4 Grade 300W for plates, rods, and bars.
- .2 High Strength Bolts: to ASTM F3125 grade A325.
- .3 Nuts and Washers: to ASTM F3125 grade A325.
- .4 Anchor Rods: to CSA G40.20/G40.21, Grade 300W.
- .5 Headed Studs: to CSA W59, Type B, min. $F_y=350$ MPa.
- .6 Welding: to CSA W48 and CSA W59. For members in seismic force resisting system, refer to CSA S16 for additional brittleness requirements.
- .7 Weldable reinforcing steel: to CSA G30.18, deformed bars.
- .8 Grating: Galvanized safety grating. Minimum thickness of material 2 mm (0.079"). Banded ends. Bolted connections. Capacity 4.8 kPa (100 psf) unless noted otherwise on drawings. Maximum deflection 1/180th of span.
- .9 Shop Paint: CISC/CPMA 1-73a

- .10 Shop Primer: CISC/CPMA 2-75, compatible with specified topcoat.
- .11 Zinc-rich Coating: SSPC Paint Specification No.20, compatible with topcoat (if specified).
- .12 Epoxy Coating: pre-mixed, 2 components, high-solids (volume of solids 87 ±3%), self-priming.
- .13 Galvanizing: to ASTM A123, min zinc coating of 600g/m².
- .14 Coating of fasteners: to ASTM F2329, ASTM B695, or ASTM F1136 as required.
- .15 Joint filler for exposed steelwork: Epoxy resin.
- .16 Galvanizing vent hole plug: Grade 6061 Aluminum circular plug.
- .17 Fabrication:
 - .1 Fabricate structural steel to CAN/CSA-S16.
 - .2 Mark materials in accordance with CSA G40.20/G40.21.
 - .3 Weld in accordance with CSA W59 and CSA W186.
 - .4 Continuously seal joined members by intermittent welds and plastic filler.
 - .5 Grind exposed welds smooth.
 - .6 Complete welded shop connections prior to galvanizing.
 - .7 HSS members which require galvanizing to either be per CSA G40.21, grade 350W, Class H, or to be stress relieved prior to galvanizing.
 - .8 Fabricate AESS with tolerances and surface quality consistent with AESS category.
 - .9 Mill column bearing plates as required to provide full contact bearing and develop column bearing strength.
 - .10 Do not shop weld shear studs to composite beams supporting slab on deck.
- .18 Finishes:
 - .1 Cleaning:
 - .1 Clean all members to SSPC-SP1 – Solvent Cleaning. Clean structural steel by scraping, wire brushing or other effective means to remove loose mill scale, rust, grease, oil, dirt, and other foreign matter.
 - .2 For members receiving shop primer paint also clean steel to minimum SSPC-SP 7 Brush-Off Blast Cleaning.
 - .3 For members receiving intumescent coating also clean steel to SSPC-SP 6 Commercial Blast Cleaning.
 - .4 For member receiving a zinc rich coating also clean steel to SSPC-SP 10 Near White Blast Cleaning.
 - .2 Shop Painting:

- .1 Apply one coat of shop paint CISC/CPMA 1-73a to steelwork in the shop except for the following conditions:
 - .1 Members to receive a finish coat, in which shop primer CISC/CPMA 2-75 is required in lieu of CISC/CPMA 1-73a.
 - .2 Members to be protected by sprayed fire proofing.
 - .3 Members to receive intumescent coating, in which a compatible primer is required.
 - .4 Members to receive a zinc-rich coating.
 - .5 Members to be galvanized.
 - .6 Shear connectors and top flanges of composite beams to received field welded headed studs.
 - .7 Surfaces of steel members in contact with cast in place concrete.
 - .8 Surfaces for a distance of at least 50 mm (2") on all sides of a field welded joint.
 - .9 Faying surfaces in slip critical connections.
- .2 Apply one coat of compatible primer paint (CISC/CPMA 2-75) in the shop to steelwork to receive a finish coat of paint on site.
- .3 Apply one coat of compatible primer in the shop to steelwork to receive intumescent coating on site.
- .4 Apply all paint under cover, on dry surfaces and when air temperatures are above 5C. Maintain dry condition and 5C temperature until paint is dry.
- .3 Galvanizing:
 - .1 Apply galvanizing to all exterior steel (all steel beyond vapour barrier). This includes steel elements such as: shelf angles and hangers in exterior walls, spandrel angles supporting cladding, lintels in exterior walls, exposed anchor rods, and any other steel noted on the drawings.
 - .2 If galvanized steel is to be painted, use only non passivated galvanizing process (without chromate coating).

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Prior to fabrication, verify existing conditions and take field measurements necessary to ensure proper erection of Products.
 - .2 Examine all work of other Sections upon which the Work of this Section depends.
 - .3 Prior to erection, examine areas designated to receive work of this Section and report any deficiencies and misalignments for correction.
 - .4 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.

- .5 Commencement of work implies acceptance of existing conditions and work by others.

3.2 INSTALLATION

.1 Site Welding:

- .1 Perform site welding to CSA W59 and CSA W186.
- .2 Make Good welds showing inclusions, porosity, lack of fusion penetration beyond the tolerances set out in CSA W59.1.
- .3 Do not perform welding in rain, snow, sleet, or direct wind. All moisture shall be evaporated from the surface before welding commences.
- .4 Minimum preheat and interpass temperature within 75 mm (3") of the location of the weld deposits shall conform to CSA W59.
- .5 Between passes and upon completion, thoroughly clean welds of slag with a descaling tool and wire brush.
- .6 Do not weld in an ambient temperature below -18°C. Preheat material adjacent to welding areas when ambient temperature is between -18°C and 0°C.
- .7 When welding after galvanizing is in place, grind away galvanizing at areas to be welded.
- .8 Weld beams to bearing plates unless otherwise noted on drawings.

.2 Erection:

- .1 Erect structural steel to CAN/CSA-S16.
- .2 Do not site modify any members without approval.
- .3 Make adequate provision for erection stresses and for sufficient temporary bracing to keep the structural steel frame plumb and in true alignment until completion of erection. Bracing members shown on the drawings are those required in design for the finished structure and are not to be taken as necessarily adequate for construction purposes. Any failure to make proper and adequate provision for erection stresses shall be the sole risk and responsibility of this Contractor.
- .4 Steel framing to be plumb at a temperature of 20 C. If erection takes place at a temperature significantly different than 20 C, make adequate provisions in the erection to ensure it will be plumb at 20 C.
- .5 Set base plates to the proper elevation on steel shims or screeds, ready for grouting by Section 03 30 00. Do not use wood wedges or levelling plates.
- .6 Grout columns as soon as steelwork is completed.
- .7 Do not make permanent connections until steelwork is properly aligned.
- .8 Install bolts which are not pre-tensioned to be snug tight.
- .9 Install bolts in pre-tensioned connections using turn-of-nut method.
- .10 Where slotted connections are shown on structural drawings, finger tighten bolts snug fit and burr threads to prevent nuts from working loose.

- .11 Adjust and finalize connections at wall supporting elements affected by floor beam deflections after concrete is poured.
- .12 AESS members:
 - .1 Erect using softened slings or other methods to prevent damage.
 - .2 Provide padding as required to protect while rigging and aligning.
 - .3 Weld tabs for temporary bracings and safety cabling only at points concealed from view in the complete structure or where approved by the Architect.
 - .4 Remove all field connection aids added to allow alignment, fit up and welding.
 - .5 Plug weld holes for erection bolts.
- .3 Tolerances:
 - .1 Conform to the fabrication and erection tolerances of CAN/CSA S16.
 - .2 Comply with more stringent tolerances if specified elsewhere to suit interfacing materials or AESS members.
 - .3 Plumb and level individual pieces of the structural steel frame to a tolerance of not less than 1 in 500 except exterior columns, which are to be set to a tolerance of not less than 1 in 1000.
- .4 Field Painting:
 - .1 Paint in accordance with Section 09 91 00 – Painting.
 - .2 Touch up damaged surfaces with the same paint as the shop coat.
 - .3 Repair any galvanized or zinc rich painted surfaces which have been damaged, or field welded in accordance with SSPC Technology Guide No.14.
 - .4 Clean and prepare surfaces of bolts, which will receive a finished coat of paint in the same manner as the connected steelwork.

3.3 SITE QUALITY CONTROL

- .1 Conduct field inspection and testing as specified in Section 01 40 00.
- .2 An Inspection and Testing Agency (certified to CSA W178.1 & 2) will be appointed to carry inspection and testing of all structural steel.
- .3 Work will be inspected in shop and when erected. Cooperate with Agency, permitting access to inspection and do not commence fabrication until detail of inspection have been worked out.
- .4 Submit testing and inspection reports to WalterFedy and Contractor. Provide details of errors or deficiencies observed
- .5 Welding Inspection:
 - .1 Welding inspection to be conducted in shop and on site.
 - .2 The Inspector will check welders' CWB qualification.

- .3 The Inspector will review welding procedures for conformance with CWB requirements and standard practices.
- .4 Arrange for the Inspector to be present during welding of %10 of moment connections and butt welds in direct tension.
- .5 The inspector will visually check 100% of welds at plate girders, butt welds (including cranks and splices), moment connections, crane columns and crane girders, roof anchors to the base structure, hanger connections, and 20% of all other welds for:
 - .1 Size, length, profile
 - .2 Weld preparation, fit-up, and alignment
 - .3 Slag removal
 - .4 Distortion, porosity, cracks.
- .6 Non destructive testing will be conducted at the following connections: general 10% of all welded connections
- .7 Test results will be evaluated in accordance with CSA W59.
- .6 Shop Inspection:
 - .1 Confirmation that all materials meet the specification, mill tests conform with the specified grades, fabricator is meets qualification requirements, and cambering procedure follows CSA W59.
 - .2 General Inspection including:
 - .1 Dimensions and cross section meet specified member sizes.
 - .2 Fabrication tolerances.
 - .3 Cambers.
 - .4 Location, size, and reinforcement of holes/openings.
 - .5 Splices.
 - .6 Compliance with AESS requirements.
 - .3 Upon request provide test coupons to the Inspection and Testing Agency at approved locations to be tested for mechanical properties and chemical composition. Make good the locations if requested at no extra cost.
 - .4 For crane supporting structures, perform radiographical or ultrasonic inspection for:
 - .1 100% of web and flange splices in tension for crane runway beams.
 - .2 25% of flange and web splices in compression for crane runway beams.
 - .3 100% of complete joint penetration welds between plate girder flange and web.
- .7 Field Inspection:
 - .1 Coordinate and arrange for Inspection to begin as the Work is being completed when the steel is plumbed, bolts tightened, field welding complete.

- .2 The Inspector will review general fit-up and tolerance. A minimum of 10% of columns will be measured for plumbness, alignment and elevation.
- .3 Field Inspection to include:
 - .1 Checking individual members for orientation, sweep/camber, and local damage.
 - .2 Checking levelling plates, grouting of base plates, and bearing conditions on steel, masonry, and cast-in plates.
 - .3 Inspection of bolting, shear studs and post-installed anchors, per below requirements.
 - .4 Checking installation of bracing, including any tensioning requirements.
 - .5 Inspection of approved field cutting and reinforcing of openings.
 - .6 Field painting and touch ups.
- .8 Bolting Inspection:
 - .1 Inspector to visually check all bolts in bearing connections.
- .9 Shear Stud Inspections:
 - .1 The Inspector will visually check all shear studs on composite steel beams.
 - .2 Bent test 1 in every 150 studs by bending 30 degrees towards the nearest support as specified in CSA-W59. Bent studs that show no sign of failure will be accepted and shall remain in the bent position. Studs that crack in weld, base metal or shank will be rejected and removed/replaced.
 - .3 Studs with end welds covering less than 85% of the perimeter will be rejected and replaced even if they pass the bend test.
- .10 Post-Installed Anchor Inspection:
 - .1 The Inspector will sample check drilled concrete and masonry anchors.
 - .2 The Inspector will randomly select and pull test 5% of all types and sizes of post installed anchors installed on a weekly basis, but not less than one anchor of each type, size, and orientation. Pull test to twice the allowable tensile load, or 1.5 times the factored resistance of the anchor given by the manufacturer.
- .11 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.

3.4 CLEANING

- .1 Clean and make good surfaces soiled or otherwise damaged as a result of Work of this Section at no additional cost to the Owner.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified, or required to complete the work of this Section including but not limited to the following:
 - .1 All open-web steel joists, bridging and accessories to complete the building as shown in the Structural Drawings and in accordance with these Specifications.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 03 30 00 - Cast in Place Concrete.
 - .2 Section 05 12 23 – Structural Steel for Buildings.
 - .3 Section 05 31 00 – Steel Decking.
 - .4 Section 05 50 00 – Metal Fabrications.
 - .5 Section 07 81 00 – Applied Fireproofing.
 - .6 Section 09 90 00 – Painting.

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 Canadian Standards Association (CSA):
 - .1 CSA G40.20 G40.21: General Requirements for Rolled or Welded Steel Structural Quality Steel.
 - .2 CAN/CSA-S16: Limit States Design of Steel Structures.
 - .3 CAN/CSA-S136: North American Specification for the Design of Cold-Formed Steel Structural Members.
 - .4 CSA W47.1: Certification of Companies for Fusion Welding of Steel Structures.
 - .5 CSA W48: Filler Metals and Allied Materials for Metal Arc Welding.
 - .6 CSA W55: Certification of Companies for Resistance Welding of Steel and Aluminum.
 - .7 CSA W59: Welded Steel Construction (Metal Arc Welding).
 - .8 CSA W186: Welding of Reinforcing Bars in Reinforced Concrete Construction.
 - .2 American Society for Testing and Materials (ASTM):

- .1 ASTM A123/A123M: Standard Specification for Zinc (Hot Dip Galvanized) coating on Iron and Steel Products.
- .2 ASTM A36/A36M: Standard Specification for Carbon Structural Steel.
- .3 ASTM F3125/F3125M: Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 830 MPa and 1040 MPa Minimum Tensile Strength.
- .4 ASTM A1011/A1011M: Standard Specifications for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability and Ultra High Strength.
- .3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA):
 - .1 CISC: Handbook of Steel Construction.
 - .2 CISC/CPMA Standard 1-73a: A Quick-drying One-coat Paint for Use on Structural Steel.
 - .3 CISC/CPMA Standard 2-75: Quick-drying Primer for Use on Structural Steel.
 - .4 CISC Code of Standard Practice, Appendix I: Architecturally Exposed Structural Steel (AESS).
- .4 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International:
 - .1 SSPC-SP 1: Solvent Cleaning.
 - .2 NACE No. 3 / SSPC-SP 6: Commercial Blast Cleaning.
 - .3 NACE No.4 / SSPC-SP 7: Brush Off Blast Cleaning.
 - .4 NACE No.2 / SSPC-SP 10: Near White Blast Cleaning.
 - .5 SSPC Technology Guide No.14: Guide for the Repair of Imperfections in Galvanized, Organic or Inorganic Zinc-Coated Steel Using Organic Zinc Rich Coating.
 - .6 SSPC Paint Specification No. 20: Zinc Rich Coating, Type I – Inorganic and Type II – Organic.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordination under this Section shall be in accordance with General Conditions and Division 01.
 - .2 Coordinate with other work having a direct bearing on the Work of this Section.
 - .3 Coordinate the Work with structural steel fabricator and erector.

1.5 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 01 33 00 – Submittals.
- .2 Provide all submittals a minimum 4 weeks prior to the start of fabrication.
- .3 Product Data:

- .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
- .4 Shop Drawings:
 - .1 Provide drawings stamped and signed by the Professional Engineer responsible for steel joist design.
 - .2 Shop Drawings to indicate: material specifications, loading, attachments, joist geometry, joist spacing, joist camber, member sizes, connections, net weld lengths, section splices, bearing details, surface preparation, shop painting/galvanizing, leg extensions, and bridging including anchorage at ends.
 - .3 Submit joist design engineer's calculations to show that the joists conform to the Contract Documents.
- .5 Source Quality Control Submittals:
 - .1 Provide mill test reports to show chemical and physical properties and other details of steel to be used for steel joists.
- .6 Site Quality Control Submittals:
 - .1 Submit testing and inspection reports from the appointed Independent Inspection and Testing Agency.

1.6 CLOSEOUT SUBMITTALS

- .1 Upon completion of steel joist and bridging installation, submit a letter signed and sealed by the Professional Engineer responsible for steel joists certifying that the work has been completed in accordance with all contract documents.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Fabricator/Erector:
 - .1 Must be a company specializing in fabricating open-web steel joist framing to CAN/CSA-S16 and a member of the Canadian Institute of Steel Construction.
 - .2 Fabricator shall have a minimum of 5 years' continuous Canadian experience successfully fabricating materials specified herein for projects similar in size and complexity as the Work of this Section.
 - .3 Steel joist fabricator and erector to be certified by the Canadian Welding Bureau under the requirements of CSA W47.1, Division 1 or 2 for fusion welding and/or CSA W55.3, Division 1 or 2 for resistance welding of structural steel components and to have CWB approved procedure for welding rebar (Grade 400W) to structural steel in accordance with CSA W186 (if applicable). Welders to be appropriately qualified, working under direction of a qualified welding supervisor.
 - .2 Fabricator's Engineer:
 - .1 Fabricator to engage a Professional Engineer, experienced in structural steel design of open-web steel joist framing and licensed in the Place of the Work, to be responsible for design, detailing and installation of all steel joists.

- .2 The Professional Engineer designing connections to hold a Certificate of Authorization, and to carry min. \$1,000,000.00 in liability insurance (per occurrence).

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials of this Section in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Storage and Handling procedures:
 - .1 Check available storage space at the Place of the Work before submitting a bid.
 - .2 Handle and store Products in a manner to prevent damage or distortion to other materials, to any existing building or property, and to the Work.
 - .3 Store Products off ground, free from dirt accumulation.
 - .4 Maintain fabricated shapes.
 - .5 Store Products to avoid disruption in the progress of the Work.
 - .6 Clearly tag steel joists for identification purposes.

2 PRODUCTS

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Design and detail steel joist framing and connections to CAN/CSA-S16 and CSA 136 to carry the loads and requirements indicated on the Structural Drawings. Consider load effects due to fabrication, erection, and handling.
- .2 If a wind load diagram is not shown on the Structural Drawings, increase the minimum design wind uplift value indicated in the drawings (which is applicable in the zones away from roof edges) for the corner and edge condition in accordance with the User's Guide to NBC – Structural Commentaries (Part 4 of Division B).
- .3 Apply unbalanced live loads and concentrated loads in accordance with CSA S16.
- .4 Design joist chords for additional axial forces from horizontal bracings connected to them.
- .5 Submit calculations for strength and deflection. Show design loads, member forces and utilizations.
- .6 Coordinate joist arrangement with mechanical and electrical drawings to allow ductwork and other services to pass through where required.
- .7 Design and detail joists to be statically determinate truss.
- .8 Design steel joists with deflections not to exceed the following:
 - .1 $1/360^{\text{th}}$ of the span under specified live load.
 - .2 $1/240^{\text{th}}$ of the span under total load.
- .9 Unless otherwise noted, design long span joists; adjacent to walls, adjacent to much shorter beams or joists, or adjacent to other lines of increased stiffness, to avoid abrupt changes in deflection. Minimum stiffness requirements for these types of long span steel joists are summarized as follows:
 - .1 The total load deflection for the first joist adjacent lines with increased stiffness shall not exceed the max of 50mm or $s/50$, where 's' is the distance between the joist and the stiff element.

- .2 Each subsequent joist adjacent to lines with increased stiffness may deflect an additional 20mm under total loads until the deflection criteria govern the joist stiffness requirements.
- .10 Centre reaction of joist framing from one side only over centroid of supporting beam. Where necessary, increase shoe depths as required for the first diagonal to clear the supporting structure. Coordinate the required supporting steel elevation with steel trade.
- .11 Design joist shoe connections to supporting members to be able to resist uplift and to transfer axial force into joist top chord equal to 10% of the joist reaction (but not less than 25 kN).
- .12 Design joist shoes for rollover forces where shown on structural drawings.
- .13 Design bridging to distribute concentrated design loads, to CAN/CSA-S16.
- .14 If bearing plates not shown on drawings, design joist bearing plate connections. Design end plates and post installed anchors for connection of bridging to concrete and masonry walls.

2.2 MATERIALS

- .1 Steel: to CSA G40.20 and CSA G40.21.
- .2 Cold Roll-formed Components: to CAN/CSA-S136.
- .3 High Strength Bolts: High tensile bolts, nuts, and washers to ASTM A325M; nuts to be heavy hexagon type.
- .4 Anchor rods: CSA G40.21 or ASTM F1554, refer to drawings.
- .5 Welding: to CSA W48 and CSA W59.
- .6 Shop paint: to CISC/CPMA 1-73a
- .7 Shop Primer: quick drying primer paint, to CPMA 2-75.
- .8 Zinc-rich coating: to SSPC Paint Specification No.20, compatible with top coat (where specified).
- .9 Hot dip galvanizing: to ASTM A123/A123M, minimum zinc coating of 600 g/m².
- .10 Fabrication:
 - .1 Fabricate steel joists to CAN/CSA-S16.
 - .2 Compose joists of straight members arranged to form a statically determinate truss in which the stresses do not exceed those allowed by CAN/CSA-S16 or CAN/CSA-S136. Minimum thickness of material shall be as follows:
 - .1 Flats and Rolled Sections: 3 mm (0.12").
 - .2 Rods: 10 mm (0.39") diameter.
 - .3 Cold Formed Steel: 2.0 mm (0.08").
 - .4 Members supporting steel deck 3.15 mm (0.125").
 - .3 Provide camber to CAN/CSA-S16. Maximum camber shall not exceed 1.5 times the dead load deflection.
 - .4 Where the steel joists are to receive steel deck, provide a flat surface for adequate bearing and welding of the deck with a total width summarized as follows:

- .1 38mm Deck: 102mm (4").
- .2 76mm Deck: 152mm (6").
- .5 Provide bottom/top chord extensions and joist shoe extensions as indicated.
- .6 Frame special sized openings in joist chord framing as detailed.
- .7 Provide tie joists at all columns and as indicated on Drawings.
- .8 Stagger chord member splices.
- .11 Finishes:
 - .1 Clean steel joists to SSPC-SP 1; by scraping, wire brushing or other effective means to remove loose mill scale, rust, grease, oil, dirt, and other foreign matter. In addition:
 - .1 For joists receiving shop primer paint, clean to SSPC-SP 7.
 - .2 For joists receiving zinc-rich coating, clean to SSPC-SP 10.
 - .2 Apply one coat of primer (CISC/CPMA 1-73a), except for:
 - .1 Surfaces to be field welded.
 - .2 Surfaces to receive a finish coat on site, in which CISC/CPMA 2-75 primer is required.
 - .3 Surfaces to receive zinc-rich coating.
 - .4 Galvanized members.
 - .5 Surfaces to receive sprayed fireproofing.
 - .3 If areas to be welded are painted, remove paint for a distance of at least 50mm (2") on all sides of the welded joint.
 - .4 Use shop primers that are compatible with fire spray material. Do not shop prime surfaces designated to receive intumescent coatings.
 - .5 Galvanize all exterior exposed joists and other joists if indicated on drawings.
 - .6 Strip paint from bolts, nuts, sharp edges, and corners before prime coat is dry.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Prior to fabrication, verify existing conditions and take field measurements necessary to ensure proper erection of Products.
 - .2 Examine all work of other Sections upon which the Work of this Section depends.
 - .3 Prior to erection, examine areas designated to receive work of this Section and report any deficiencies and misalignments for correction.
 - .4 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.

- .5 Commencement of work implies acceptance of existing conditions and work by others.

3.2 INSTALLATION

.1 Site welding:

- .1 Perform welding to CSA W59 and CSA W186.
- .2 Make good welds showing inclusions, porosity, lack of fusion penetration beyond the tolerances set out in CSA W59.1.
- .3 Do not perform welding in rain, snow, sleet or direct wind. All moisture shall be evaporated from the surface before welding commences.
- .4 Do not perform site welding when the air temperature is below -18 degrees C. Preheat material adjacent to welding when temperature is between -18 degree C and 0 degree C.
- .5 Minimum preheat and interpass temperature within 75mm (3") of the location of the weld deposits shall conform to CSA W59.
- .6 Between passes and upon completion, thoroughly clean welds of slag with a descaling tool and wire brush.

.2 Erection:

- .1 Erect steel joists to CAN/CSA-S16.
- .2 Make adequate provision for erection stresses and for sufficient temporary bracing to keep the structural steel frame plumb and in true alignment until completion of erection. Bracing members shown on the drawings are those required in design for the finished structure and are not to be taken as necessarily adequate for construction purposes. Any failure to make proper and adequate provision for erection stresses shall be the sole risk and responsibility of this Contractor.
- .3 Steel joists bearing on walls shall be erected and set level and true and secured with anchor plates as to remain in place during the pouring of the concrete or placing of the steel deck. All joists shall be set accurately including extra joists under parallel partitions as indicated on the drawings.
- .4 Where joists bear on steel member or plates, fasten joists by bolting or welding according to the uplift requirements of CAN/CSA- S16.
- .5 The end of each joist shall project a required distance but not less than 60 mm (2½") beyond the inner edge of the steel member. Where joists frame into columns, shoes shall bear on either a seat angle or column cap plate. The bottom chord of the joist shall also be tied to the column to resist lateral force.
- .6 Install bridging to CAN/CSA-S16. Each line of bridging shall be adequately anchored at each end to walls or to main components of the structural frame. If not practical, diagonal and horizontal bridging shall be provided in combination between adjacent joists near the ends of bridging lines.
- .7 Where bottom chord bridging is terminated by connection to steel beam, bring it up and connect to beam top flange.
- .8 The ends of joists designed to bear on the bottom chords shall be held in position by connections to the supporting wall or structural frame or by bridging located at the supports.
- .9 Protect installed products from damage during construction.
- .10 Do not make permanent connections until structure has been properly aligned.

- .11 AESS joists: erect using softened slings or other methods such that they are not damaged. Provide padding as required to protect while rigging and aligning.

.3 Field Painting:

- .1 Paint in accordance with Section 09 91 00 Painting.
- .2 After erection, make good shop primer that has been scraped or chipped, plus rivets, bolt heads, welds, etc., with application of one coat of specified paint/primer.
- .3 Repair any galvanized or zinc rich painted surfaces which have been damaged or field welded.

3.3 SITE QUALITY CONTROL

- .1 Conduct field inspection and testing as specified in Section 01 40 00.
- .2 An Inspection and Testing Agency (certified to CSA W178.1 & 2) will be appointed to carry inspection and testing of all steel joists.
- .3 Work will be inspected in shop and when erected. Cooperate with Agency, permitting access to inspection and do not commence fabrication until details of inspection have been worked out.
- .4 Submit testing and inspection reports to WalterFedy and Contractor. Provide details of errors or deficiencies observed
- .5 Welding Inspection:
 - .1 Welding inspection to be conducted in shop and on site.
 - .2 The Inspector will check welders' CWB qualification.
 - .3 The Inspector will review welding procedures for conformance with CWB requirements and standard practices.
 - .4 The inspector will visually check 20% of welds for:
 - .1 Size, length, profile
 - .2 Weld preparation, fit-up, and alignment
 - .3 Slag removal
 - .4 Distortion, porosity, cracks.
 - .5 Non destructive testing will be conducted at the following connections: general 10% of all welded connections
 - .6 Test results will be evaluated in accordance with CSA W59.
- .6 Shop Inspection:
 - .1 Confirmation that all materials meet the specification, mill tests conform with the specified grades, fabricator is meets qualification requirements, and cambering procedure follows CSA W59.
 - .2 General Inspection including:
 - .1 Dimensions and cross section meet specified member sizes.
 - .2 Fabrication tolerances.

- .3 Cambers.
- .4 Splices.
- .7 Field Inspection:
 - .1 Coordinate and arrange for Inspection to begin as the Work is being completed when the steel joist work is plumbed, bolts tightened, field welding complete.
 - .2 Field Inspection to include:
 - .1 Inspect all erected joists to check their correct spacing, location, bearing and anchorage, and verify freedom from damage or distortion
 - .2 Inspection of anchors, bolting and post-installed anchors.
 - .3 Checking installation of bridging.
 - .4 Inspection of approved field cutting and reinforcing of openings.
 - .5 Field painting and touch ups.
 - .8 Bolting Inspection:
 - .1 Inspector to visually check all bolts in bearing connections.
 - .9 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.

3.4 CLEANING

- .1 Clean and make good surfaces soiled or otherwise damaged as a result of Work of this Section at no additional cost to the Owner.
- .2 Leave surfaces clean and ready for subsequent Work.

END OF SECTION

1 GENERAL

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

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified, or required to complete the work of this Section including but not limited to the following:
 - .1 All steel decking and accessories to complete the building as shown in the Structural Drawings and in accordance with these Specifications.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 03 20 00 – Concrete Reinforcing.
 - .2 Section 03 30 00 – Cast-in-Place Concrete.
 - .3 Section 05 12 23 – Structural Steel for Buildings.
 - .4 Section 05 21 00 – Steel Joist Framing.
 - .5 Section 05 50 00 – Metal Fabrications.
 - .6 Section 07 81 00 – Applied Fireproofing.
 - .7 Section 09 90 00 – Painting.

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 Canadian Standards Association (CSA):
 - .1 CAN/CSA-S16: Limit States Design of Steel Structures.
 - .2 CAN/CSA-S136: North American Specification for the Design of Cold-Formed Steel Structural Members.
 - .3 CSA W47.1: Certification of Companies for Fusion Welding of Steel Structures.
 - .4 CSA W48: Filler Metals and Allied Materials for Metal Arc Welding.
 - .5 CSA W55: Certification of Companies for Resistance Welding of Steel and Aluminum.
 - .6 CSA W59: Welded Steel Construction (Metal Arc Welding).
 - .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A108/108M: Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - .2 ASTM A653/A653M: Standard Specification for Sheet Steel Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

ASTM A792/A792M: Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.3 Canadian Sheet Steel Building Institute (CSSBI):

.1 CSSBI 10M: Standard for Steel Roof Deck.

.2 CSSBI 12M: Standard for Composite Steel Deck.

.4 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC-S102 – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Coordination under this Section shall be in accordance with General Conditions and Division 01.

.2 Coordinate with other work having a direct bearing on the Work of this Section.

.3 Coordinate the Work with the structural steel sub-trade.

1.5 SUBMITTALS

.1 Submittals under this Section shall be in accordance with Section 01 33 00 – Submittals.

.2 Product Data:

.1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements.

.2 Submit manufacturer's data sheets for each deck type.

.3 Submit product data confirming capacity of mechanical fasteners to resist uplift, shear, and corrosion.

.4 Upon request, provide data to substantiate deck load capacity, including diaphragm shear capacity.

.3 Shop Drawings:

.1 Shop Drawings must be stamped, signed, and dated by a professional Engineer responsible for the design of steel decking.

.2 Deck shop drawings to include:

.1 Deck layout and support locations.

.2 Deck profile and sheet thickness.

.3 Type of deck coating. Indicate if deck is to be painted on site.

.4 Indicate the loading the deck has been designed for: gravity and uplift loads, diaphragm shear, and deflection requirements.

- .5 Deck edge conditions.
- .6 Type and spacing of connections/fastening patterns to supports and between sheets.
- .7 Openings.
- .8 Reinforcement details and accessories.
- .9 Layout, size, type, and welding requirements for welded stud shear connectors.
- .3 Provide clear instruction on shop drawings for deck fastening to shear collector members or perimeter angles at members parallel to the deck span as applicable.
- .4 Site Quality Control Submittals:
 - .1 Submit testing and inspection reports from the appointed Independent Inspection and Testing Agency.
 - .2 Submit evaluation reports for fastening of steel deck to structural members, which indicate how the fastening was performed at shear collector elements parallel to the deck span.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Supplier/Erector:
 - .1 Deck supplier and erector shall have a minimum of 5 years' experience having successfully supplied products required for the Work of this Section for other projects of similar size and complexity.
 - .2 Deck supplier and erector to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel and/or CSA W55.3 for resistance welding.
 - .3 Welders to be CWB approved for deck welding.
 - .2 Suppliers Engineer:
 - .1 Engage a Professional Engineer licensed in the place where the project is located to be responsible for design, detailing and installation of all decking.
 - .2 The Professional Engineer designing steel decking to hold a Certificate of Authorization, and to carry min. \$1,000,000.00 in liability insurance.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials of this Section in accordance with Section 01 61 00 – Common Product Requirements.
- .2 Storage and Handling procedures:
 - .1 Handle and store Products in a manner to prevent damage to other materials, to any existing building or property, and to the Work.
 - .2 Store Products off ground, free from dirt accumulation.

2 PRODUCTS

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Design steel roof deck, floor deck and all associated connections and details to CAN/CSA-S136, CSSBI 10M, CSSBI 12M and to satisfy requirements of any Fire Rated Assembly Design specified for the project.
- .2 Design loads, deck depth and minimum nominal thickness are shown in the Structural Drawings.
- .3 If a wind load diagram is not shown on the Structural Drawings, increase the minimum design wind uplift value indicated in the drawings (which is applicable in the zones away from roof edges) for the corner and edge condition in accordance with the User's Guide to NBC – Structural Commentaries (Part 4 of Division B).
- .4 Unless otherwise noted on drawings, floor deck to carry weight of wet concrete and appropriate construction load allowance without shoring.
- .5 Design steel deck to span continuously over at least three spans where the supporting steel layout permits.
- .6 Increase the deck gauge as required to support the loads noted on the drawings
- .7 The steel deck shall have a suitable profile and gauge to support the loads shown on the drawings and deflections not to exceed the following:
 - .1 Roof Deck:
 - .1 $1/360^{\text{th}}$ of the span under specified live load.
 - .2 $1/240^{\text{th}}$ of the span under total load.
 - .2 Floor Deck:
 - .1 $1/360^{\text{th}}$ of the span under specified live load.
 - .2 $1/480^{\text{th}}$ of the span under total long-term load (live load, superimposed dead load, shrinkage, and creep).
- .8 Design reinforcement for roof deck openings up to 450 mm (18") wide across flutes.
- .9 The basis of design for the steel deck layout shown on the structural drawings are the following profiles. Alternative suppliers or profiles to have equivalent or greater structural capacities:
 - .1 Roof Deck (non composite):
 - .1 38 mm (1 1/2") steel deck: P-3615/3606 by Canam.
 - .2 Floor Deck (composite):
 - .1 38 mm (1 1/2") steel deck: P-3615/3606 by Canam.
- .10 Steel Deck: to ASTM A653/A653M, structural quality Grade 230, with zinc-iron alloy (ZF) coating to ZF75 designation; or to ASTM A792/A792M, structural quality Grade 230, with aluminum-zinc alloy (AZ) coating to AZM150 designation.
- .11 Types of Decking:

- .1 Roof Deck: to have interlocking or overlapping side joints. Ensure deck profile is compatible with specified fastening pattern. Centre to centre rib spacing:
 - .1 152 mm (6") for 38 mm (1 ½") deck.
- .2 Composite Floor deck: with embossment pattern on flutes; to have interlocking or overlapping side joints, profiles to match to following parameters:
 - .1 Centre to centre rib spacing:
 - .1 152 mm (6") for 38 mm (1 ½") composite deck.
 - .2 Average width of concrete ribs:
 - .1 51 mm (2") for 38 mm (1 ½") composite deck.
 - .2 102 mm (4") for inverted 38 mm (1 ½") composite deck.
- .3 Only use overlapping side joints where the side lap connection needs to be screwed.
- .12 Shear Stud Connectors: to CSA W59, Type B, min Fy=350 MPa.
- .13 Sound Attenuating Insulation: mineral fibre sound attenuating insulation batts, custom-shaped to snugly fit and fill acoustic flutes.
- .14 Cover plates, closures, pour stops, edge strips, flashings, and deck reinforcing: steel sheet; 0.91 mm thick; finish/coating to match deck material.
- .15 Closures to External Walls: neoprene or polyvinyl chloride, closed cell type.
- .16 Fasteners for galvanized deck and prefinished deck: stainless steel, hex head, self-tapping screws with EPDM bonded washers.
- .17 Fasteners for deck to wood supports: galvanized screws with flat seal washers.
- .18 Powder-actuated fasteners (PAF): Hilti Decking Fastening System.
- .19 Sealant: as specified in Section 07 92 00.
- .20 Fabrication:
 - .1 Conform to CSA S136 and CSA W59.
 - .2 Fabricate sections from steel sheets by rolling. Form integral ribs which will bear on supports and form interlocking male and female side laps.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Verify that field conditions are acceptable and are ready to receive work.
 - .2 Examine all work of other Sections upon which the Work of this Section depends.
 - .3 Prior to erection, examine areas designated to receive work of this Section and report any deficiencies and misalignments for correction.

.4 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.

.5 Commencement of work implies acceptance of existing conditions and work by others.

3.2 ERECTION

.1 Erect steel deck in accordance with CSA S136, CSSBI 10M, CSSBI 12M, and reviewed shop drawings.

.2 Welding: in accordance with CSA W59, except where specified otherwise.

.3 Do not overload structure during erection. Place deck bundles near columns.

.4 Place steel deck on supporting structure and adjust to final position before fastening. Each unit shall be brought to the proper bearing on the supporting member. Provide required packing to ensure continuous support between deck and supporting members.

.5 Align deck end to end to provide an accurate fit with the corresponding sections. All interlocking male and female side laps shall be properly positioned. Sections shall be parallel, even and straight. End laps shall only take place over supporting members and shall be uniform with a minimum of 50 mm (2") in length and a maximum of 100 mm (4") in length.

.6 Exercise particular care in erection of exposed deck. Sections which are dented, damaged, or perforated by welding will be rejected.

.7 For exposed deck end laps, do not extend lower deck sheet past the face of the supports.

.8 Connections:

.1 Follow connections indicated on reviewed shop drawings to suit the corrosion requirements, uplift, diaphragm shear and any Fire Rated Assembly Design requirement.

.2 Connect deck to all supporting beams, perimeter beams, and shear collectors. Interconnect sheets at side laps.

.3 Minimum requirements for deck connections are as follows:

.1 Secure deck to supporting structure by one of the following options: 19mm (3/4") diameter puddle welds, power actuated fasteners, or screws; spaced at not more than 300 mm (12") or 400mm (16") where the deck supplied has flutes spaced at 203mm (8").

.2 Secure deck to members both parallel and perpendicular to the deck span which are at the perimeter/edge conditions and all shear collectors; spaced at not more than 150 mm (6").

.3 Side laps fastening of adjacent units shall be by one of the following methods: button-punch, welds, or screws; spaced at intervals not exceeding 600-mm (24"). Side lap fastening shall be sufficient to transfer all design loads from one sheet to another without slippage.

.4 Predrill holes for screws connecting deck to timber beams. Screws shall tap metal and extend into wood, clamping deck to wood.

.5 Fasten stud shear connectors to composite beams by welding to beams (through deck where necessary) with a full 360 degrees weld capable of developing 120% of the shear values listed in CAN/CSA S16. Fastening procedure to conform to the recommendations of the stud manufacturer. Test the first two studs installed each day in accordance with CSA W59. Maintain record of the studs tested. Replace studs rejected by Inspection and Testing Agency.

- .9 After erection and anchorage, all welds, reinforcement, etc. and all areas from which the protective zinc coating has been removed shall receive one heavy coat of zinc rich paint.
- .10 For composite decks, prior to concrete placement, steel deck to be free of soil, debris, standing water, loose mill scale and other foreign matter.
- .11 Closures
 - .1 Provide all required edge stiffeners, closures, reinforcing sheet steel and flashing.
 - .2 Reinforce edge of free spanning deck with channel shaped edge strip.
 - .3 Provide pour stops for concrete slabs over deck. Fasten to deck.
 - .4 Provide flashing at columns and points of discontinuity to prevent leakage when concrete is placed over deck.
 - .5 Where the exposed steel deck rests on exterior masonry walls or spandrel beams, the hollow spaces between webs on the underside of the deck shall be filled with neoprene closures. In addition, a sufficient quantity of Fiberglass pads will be turned over the Roofing Contractor to close off all topside flutes directly over the exterior face of the wall.
 - .6 Where flutes of the exposed steel deck run at right angles to interior partitions and the latter extend upward to the underside of the deck, hollow spaces between webs shall be filled with a double run of steel closures. In cases where the flutes of steel deck are parallel to interior partitions, suitable steel flashings shall be installed to provide a neat juncture between the two materials. No closures will be required between interior partitions and the underside of the steel deck in areas having a suspended ceiling.
- .12 Openings
 - .1 Structural drawings do not show all openings. Refer also to Architectural, Mechanical, and Electrical drawings and corresponding sleeving drawings.
 - .2 Cut all openings shown in the Structural Drawings and as required by other trades.
 - .3 Maximum size of unreinforced openings not to exceed 150 mm (6") square.
 - .4 Reinforce roof deck openings up to 450mm (18") across flutes. Reinforcing to consist of steel angles fastened to the deck, framing across the width of the opening in the direction perpendicular to the flutes.
 - .5 When 2 adjacent small openings occur in the deck with less than 450 mm (18") between such openings, the 2 openings shall be considered as one and the total dimension over the 2 openings used to establish deck reinforcement.
 - .6 Refer to Structural Drawings for minimum spacing requirements between deck openings.

3.3 SITE QUALITY CONTROL

- .1 Conduct field inspection and testing as specified in Section 01 40 00.
- .2 An Inspection and Testing Agency (certified to CSA W178.1 & 2) will be appointed to carry out inspection and testing of steel decks and check conformance with Contract documents and reviewed shop drawings.
- .3 Cooperate with the Inspection and Testing Agency, permitting access to inspection.

- .4 Submit testing and inspection reports to WalterFedy and Contractor. Provide details of errors or deficiencies observed.
- .5 Work will be inspected when erected and fastened to the structure
- .6 Inspection to include:
 - .1 Checking deck materials, deck types, gauge, and coating thicknesses.
 - .2 Checking welding, fastening, and button punching.
 - .3 Checking deck reinforcement at holes cut in the deck.
 - .4 Checking deck bearing lengths on supporting members.
 - .5 Checking appearance of exposed deck.
 - .6 Inspect and test field welded shear stud connectors as follows:
 - .1 The Inspector will visually check all stud shear connectors on composite steel beams.
 - .2 At least one stud in every 150 and all studs in which a repair to the weld has taken place will be bent 15 degrees from their axis towards the nearest support, as specified in CSA-W59.
 - .3 Bent studs that show no sign of failure will be accepted and shall remain in the bent position. Studs that crack in weld, base metal or shank will be rejected and need to be replaced.
 - .4 Studs with end welds covering less than 85% of the perimeter will be rejected even if they pass the bend test.
- .7 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.

3.4 CLEANING

- .1 Clean and make good surfaces soiled or otherwise damaged as a result of Work of this Section at no additional cost to the Owner.
- .2 Leave surfaces clean and ready for subsequent Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section Includes
 - .1 Provide lightweight steel framing including wind bearing studs.
 - .2 Wind bearing studs includes:
 - (1) Wall studs subjected to lateral loads (no axial load other than self-weight and the weight of applied finish.)
 - (2) Steel bridging.
 - (3) Top and bottom track.
 - (4) Head and sill members and jamb studs for wall openings.
 - (5) Stud, bridging and track connections.
 - (6) Top and bottom track connections to main structure including detailing to accommodate floor and roof deflections.
- .2 Related Sections
 - .1 Section 06 10 00 – Rough Carpentry: Wood support systems.
 - .2 Section 09 21 16 – Gypsum Board Assemblies: non-loadbearing metal support systems, and gypsum sheathing boards.
 - .3 Section 09 51 00 – Acoustical Ceilings: Acoustic ceilings and related suspension systems.

1.3 REFERENCES

- .1 ANSI/AWS D1.3: Structural Welding Code — Sheet Steel.
- .2 ASTM A307-00: Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- .3 ASTM A325M-05: Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric).
- .4 ASTM A653/A653M-04a: Standard Specification for Sheet Steel Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .5 ASTM A792/A792M-99: Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .6 ASTM A879/A879M-04: Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
- .7 CAN/CSA-S16-01: Limit States Design of Steel Structures.

- .8 CAN/CSA-S136-01: North American Specification for the Design of Cold-Formed Steel Structural Members.
- .9 CSA W47.1-03: Certification of Companies for Fusion Welding of Steel Structures.
- .10 CSA W59-03: Welded Steel Construction (Metal Arc Welding).
- .11 CAN/CGSB-1.181-99: Ready-Mixed Organic Zinc-Rich Coating.
- .12 CAN/CGSB-7.1-M86: Cold-Formed Steel Framing Components.
- .13 CAN/ULC-S101-04: Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.4 QUALITY ASSURANCE

- .1 Retain a Professional Engineer registered in the Place of the Work to design the Lightweight Steel Framing System; to prepare, seal and sign all shop drawings; and to perform field review. Shop drawings shall show both design and installation requirements.
- .2 Installers: company specializing in installing lightweight steel framing systems. Must be able to provide proof of qualification based on past work similar in material, design, and extent to that indicated for this Project, and whose work has resulted in construction with a record of successful in-service performance.
- .3 Welders: Companies certified by the Canadian Welding Bureau to CSA W47.1, and having welders qualified for the base material types and thicknesses that are to be welded.

1.5 PROJECT CONDITIONS

- .1 Cooperate in coordinating work of other Sections with work of this Section, in order that the work may proceed in an orderly and effective manner.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Manufacturers of cold-formed metal framing and accessories having Products considered acceptable for use:
 - .1 Bailey Metal Products
 - .2 MiTek Canada Inc.

2.2 DESIGN REQUIREMENTS

- .1 Design shall be based on Limit States Design principles using factored loads and resistances.
- .2 Loads and load factors shall be in accordance with applicable codes.
- .3 Resistances and resistance factors shall be determined in accordance with applicable codes and CAN/CSA-S136.
- .4 Conform to the requirements of specified fire rated assemblies.

- .5 Design bridging to prevent member rotation and member translation perpendicular to the minor axis. Provide for secondary stress effects due to torsion between lines of bridging. Collateral sheathing may be used to help restrain member rotation and translation perpendicular to the minor axis for wind-bearing studs. Provide bridging at 1500 mm OC maximum for wind bearing studs.
- .6 Sheathing materials that may lose their structural integrity when subject to a moist environment or when subjected to a sufficient number of load cycles will not be considered to provide structural bracing.
- .7 Maximum deflections under specified loads shall conform to the following:
 - .1 Wall studs supporting masonry veneer, L/720.
 - .2 Wall studs supporting other finishes L/360.
- .8 Design components or assemblies to accommodate specified erection tolerances of the structure.
- .9 The spacing of members shall not exceed the following:
 - .1 Wall studs 410 mm OC.
- .10 Allow for movement of the structure. Design wind bearing stud end connections to accommodate floor/roof deflections such that the studs are not loaded axially.
- .11 Connections between lightweight steel framing members shall be by bolts, welding or sheet metal screws.
- .12 Resistances for sheet metal screws shall be based on the manufacturer's lowest bound test values multiplied by the appropriate resistance factor, given in CAN/CSA-S136.

2.3 MATERIALS

- .1 Steel: to CAN/CSA-S136, identified as to specification, type, grade and mechanical properties; finished to ASTM A653/A653M, Z275 or ASTM A792/A792M, AZM150.
 - .1 Roof and wall members forming part of the exterior building envelope shall have a minimum coating of Z180 galvanizing in accordance with ASTM A653/A653M. Other coatings (e.g. aluminum-zinc alloy) providing equal or better corrosion protection may be used.
 - .2 Interior members not forming part of the exterior building envelope shall have a coating of Class C electrogalvanizing to ASTM A879. Other coatings, providing equal or better corrosion protection may be used.
- .2 Bolts and Nuts: to ASTM A307 or ASTM A325M; hot-dipped galvanized, c/w washers.
- .3 Screws: Sheet metal type, minimum zinc coating of .008 mm. Other coatings providing equal or better corrosion protection may be used.
- .4 Welding electrodes shall be of the 480 MPa minimum tensile strength series (e.g. E480XXX, E480S-X).
- .5 Touch-up Paint: Zinc rich paint for touching up welds and damaged metallic coatings, to CAN/CGSB-1.181.

2.4 FABRICATION

- .1 Except as noted herein, fabricate components to CAN/CGSB-7.1.
- .2 Where specified, provide cut-outs centred in the webs of members to accommodate services. Unreinforced cut-outs shall be limited to the dimensions as specified by the manufacturer. The effect of cut-outs on the strength and stiffness of the member shall be considered.
- .3 The distance from the centreline of the last unreinforced cut-out to the end of the member shall be not less than 300 mm.
- .4 The minimum steel thickness exclusive of coating shall be as follows:
 - .1 Wall studs 0.91 mm.
 - .2 Wall studs at curved wall locations to be minimum 0.91 mm.
 - .3 Thicker material may be required to satisfy structural requirements.
- .5 Mark the steel thickness, exclusive of coating, on each member by embossing, stamping with indelible ink or by colour coding.

3 EXECUTION

3.1 EXAMINATION

- .1 Thoroughly examine all surfaces scheduled to receive work of this Section to see that they are secure, rigid, true and not liable to impair performance or appearance of this Trade's work.
- .2 Commencement of work implies total acceptance of surface and site conditions.

3.2 WELDING

- .1 Welding: to CSA W59 and/or ANSI/AWS D1.3, whichever is applicable.
- .2 For material less than 3 mm thick, shop drawings may show nominal weld leg sizes. For such material, the effective throats of welds shall not be less than the thickness of the thinnest connected part.
- .3 Touch-up welds with zinc rich paint.

3.3 SCREWS

- .1 Steel screws shall equal or exceed the minimum diameter indicated on the Drawings.
- .2 Penetration beyond joined materials shall be not less than 3 exposed threads.
- .3 Thread types and drilling capability shall conform to the manufacturer's recommendations.
- .4 Screws covered by sheathing materials shall have low profile heads.

3.4 ERECTION

- .1 Methods of construction may be either piece by piece (stick-built) or by fabrication into panels (panelized) either on or off site.

- .2 Lightweight steel framing shall be erected true and plumb within the specified tolerances. Temporary bracing shall be employed wherever necessary to withstand all loads to which the structure may be subject during erection and subsequent construction. Temporary bracing shall be left in place as long as required for the safety and integrity of the structure. The Erector shall ensure that during erection a margin of safety consistent with the requirements of the applicable code and CAN/CSA-S136 exists in the uncompleted structure.
- .3 Make all field measurements necessary to insure the proper fit of all members.
- .4 Cutting of members may be by saw or shear. Torch cutting is not permitted.
- .5 Field cut holes into lightweight steel framing members as described above.
- .6 Insulation equal to that specified shall be placed in all jamb and header assemblies that will be inaccessible after their installation into the wall. Insure that insulation is kept dry and not compressed.
- .7 Handling and lifting of prefabricated panels shall not cause permanent distortion to any member or collateral material.

3.5 ERECTION TOLERANCES

- .1 For the purposes of this section, camber is defined as the deviation from straightness of a member or any portion of a member with respect to its major axis, and sweep is defined as the deviation from straightness of a member or any portion of a member with respect to its minor axis.
- .2 For wind bearing studs, out of plumbness shall not exceed 1/500th of the member length. Out of straightness (camber and sweep) shall not exceed 1/1000th of the member length.
- .3 For track, camber shall not exceed 1/1000th of the member length.
- .4 Studs shall seat into top and bottom tracks. The gap between the end of the stud and the web of the track shall not exceed 4 mm for wind bearing studs.
- .5 Align adjacent prefabricated panels to provide surface continuity at the interface.
- .6 Spacing of studs shall not be more than ± 3 mm from the design spacing. The cumulative error in spacing shall not exceed the requirements of the finishing materials.

3.6 FIELD QUALITY CONTROL

- .1 The lightweight steel framing Design Engineer, responsible for the production of the shop drawings, shall provide periodic field review during construction and shall submit reports.
 - .1 The cost of this field review shall be paid for by the Contractor.
- .2 Defective materials or quality of work whenever found at any time prior to acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight and error.
- .3 Remove and replace defective materials and work of other Sections affected by this replacement, at no additional cost to the Owner.

3.7 ADJUSTING

- .1 Touch-up welds and coatings damaged by welding with zinc rich paint.
- .2 Prior to touch-ups, prepare surface in accordance with paint manufacturer's recommendations.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section Includes: Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.
 - .1 Provide all miscellaneous metal items as detailed on the Architectural drawings, specified herein or required for the proper execution of the project including those listed below. Provide each item complete with all the required anchorage and such accessories as are necessary for the proper installation and for correlation with the adjoining work.
 - .2 Itemized List
 - (1) Stainless steel guards and handrails.
 - (2) Painted steel guards and handrails.
 - (3) Steel framing not shown on structural drawings but required by architectural details.
- .2 Related Sections
 - .1 Section 04 20 00 – Unit Masonry
 - .2 Section 05 12 00 – architecturally Exposed Structural Steel
 - .3 Section 09 90 00 – Painting and Coating.

1.3 REFERENCES

- .1 ASTM A167-99 (2004): Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .2 ASTM A269-04: Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- .3 ASTM A325M-05: Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric).
- .4 ASTM B36/B36M-06: Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar.
- .5 ASTM B101-02: Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction.
- .6 ASTM B209M-06: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
- .7 ASTM A101-066: Standard Specification for Steel, Sheet, and Strap.

- .8 ASTM B221M-06: Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- .9 ASTM B370-03: Standard Specification for Copper Sheet and Strip for Building Construction.
- .10 CSA G40.21-04: General Requirements for Rolled or Welded Structural Quality Steel.
- .11 CAN/CSA-G164-M92 (R2003): Hot Dip Galvanizing of Irregularly Shaped Articles.
- .12 CAN/CSA-S136-01: North American Specification for the Design of Cold-Formed Steel Structural Members.
- .13 CSA W47.1-03: Certification of Companies for Fusion Welding of Steel Structures.
- .14 CSA W59-03: Welded Steel Construction (Metal Arc Welding).

1.4 SUBMITTALS

- .1 Submit Shop Drawings and erection drawings as specified in Section 01 33 00.
- .2 Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
- .3 Shop drawings must be stamped, signed and dated by the fabricator's design engineer.

1.5 QUALITY ASSURANCE

- .1 Fabricator's Design Engineer: a professional Structural Engineer experienced in design of steel stairs, guards and railings, and licensed in the Place of the Work.
- .2 Fabricator: company specializing in fabricating metal fabrications with a minimum of five years documented experience.
- .3 Welders: individual or organization certified by the Canadian Welding Bureau to CSA W47.1.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Handle and store Products in a manner to prevent damage to other materials, to any existing building or property, and to the Work.
- .3 Store Products to avoid disruption in the progress of the Work.

2 PRODUCTS

2.1 MATERIALS

- .1 Sheet Steel: to CSA G40.20, Grade 300W.
- .2 Steel Sections and Plates: to CSA G40.21, Grade 300W.
- .3 High Strength Bolts: to ASTM A325M, including suitable nuts and plain hardened washers; hot dipped galvanized for exterior members.

.4 Welding Materials: to CSA W59.

.5 Shop Primer: to CPMA 2-75.

2.2 FABRICATION

.1 Fabricate components to CAN/CSA-S136 and in accordance with the approved Shop Drawings.

.2 Fit and shop assemble components for delivery in largest practical sections.

.3 Continuously seal joined pieces by continuous welds. Conform to CSA W59.

.4 Grind exposed joints flush and smooth with adjacent finish surface.

.5 Make exposed joints butt tight, flush and hairline.

.6 Exposed Mechanical Fastenings: Flush countersunk screws or bolts; except where specifically noted otherwise.

.7 Supply components required for anchorage of fabrications.

.8 Quality of work shall be the best grade of modern shop and field practice known to recognized fabricators specializing in this work. Accurately fit joints and intersecting members and make in true planes with adequate fastening. All work shall be plumb, true, square, straight, level, accurate to sizes detailed and free from distortion or defects detrimental to appearance and/or performance.

.9 After fabrication, clean and scrape all surfaces to remove rust, mill scale, oil and grease of extraneous material.

2.3 SHOP FINISHES

.1 Do not prime surfaces in direct contact with concrete or where field welding is required.

.2 Prime paint items with two coats.

.3 Galvanizing: to CAN/CSA-G164-M, hot dipped method, minimum 0.9 oz/ft² zinc coating.

.4 Stainless Steel: No.4- Brushed. Locations outlined in drawings.

3 EXECUTION

3.1 EXAMINATION

.1 Prior to fabrication, verify all existing conditions which may affect the work of this Section and take any field measurements necessary to ensure a perfect fit of all miscellaneous metal items.

.2 Report deficiencies and misalignments to the Consultant for correction.

3.2 PREPARATION

.1 Supply items to be built into the work for the anchorage of miscellaneous metal work including templates or information required for sleeves or openings to the Trade involved at the proper time.

3.3 ERECTION

.1 Install miscellaneous metal items as required by welding, bolting or lagging to the building structure.

- .2 Erect all items square, plumb, straight and true, accurately fitted with tight joints and intersections.
- .3 Field weld components to CSA W59.
- .4 Field bolt and weld to match shop bolting and welding.
- .5 Supply necessary anchor bolts, washers, nuts, lag screws, expansion shields, toggles, straps, sleeves, brackets etc. required to complete the installation to the satisfaction of the Consultant. Secure items to be screwed with sufficient self-tapping "shake-proof" screws with flat countersunk heads.
- .6 Mechanically fasten joints butted tight, flush, and hairline.
- .7 Grind welds smooth and flush.
- .8 Carry out all cutting and drilling of concrete and masonry required for the installation of miscellaneous metal items. All making good after shall be carried out by the Trade whose work was affected at the expense of this Contractor.

3.4 FIELD QUALITY CONTROL

- .1 Defective materials or quality of work whenever found at any time prior to final acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error.
- .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

3.5 ADJUSTING

- .1 Upon completion of erection, all areas from which shop paint has been scraped or chipped, bolts, nuts, welds, etc. shall receive one coat of primer as previously specified.
- .2 Touch-up galvanized materials with zinc-rich paint.
- .3 Grind smooth and prime paint field welded connections.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 1.

1.2 SUMMARY

- .1 Section Includes:
 - .1 Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.
 - .2 Rough Carpentry, including:
 - (1) Wood nailers and blocking.
 - (2) Exterior plywood sheathing.
 - (3) Hardware for anchoring rough carpentry to masonry, concrete, steel, etc.
 - (4) Preparation of openings for window installation.
- .2 Related Sections:
 - .1 Section 06 20 00 – Finish Carpentry.

1.3 REFERENCES

- .1 CSA B111-1974 (R2003): Wire Nails, Spikes and Staples.
- .2 CSA O80 Series-97 (R2002): Wood Preservation.
- .3 CAN/CSA-O86-01: Engineering Design in Wood.
- .4 CSA O121-M1978 (R2003): Douglas Fir Plywood
- .5 CSA O141-05: Softwood Lumber.
- .6 CSA O151-04: Canadian Softwood Plywood.
- .7 CSA O437 Series-93 (R2001): Waferboard and Strandboard.
- .8 National Lumber Grades Authority: Standard Grading Rules for Canadian Lumber.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Store Products under waterproof cover both in transit and at the Place of the Work in such a manner as to prevent damage to other materials, to any existing building or property or to the Work.
- .3 Coordinate delivery schedule of Products with Suppliers.

2 PRODUCTS

2.1 MATERIALS

- .1 Lumber: well seasoned stock, free from shakes, splits, dry rot, mildew or other defects which would impair strength and durability; SPF species, NLGA No. 2 and Better Grade Mix; S-Dry; sizes as indicated on Drawings.
- .2 Plywood Sheathing: DFP to CSA 0121, Grade "C" veneer; laminated using waterproof glue; thicknesses as indicated on Drawings; exterior grade for exterior applications.
- .3 Nails: to CSA B111, Type 304 or 316 stainless steel, common wire type for general use and spiral type for structural connections.
- .4 Anchors: toggle bolt type for anchorage to hollow masonry, expansion shield and lag bolt type for anchorage to solid masonry or concrete, or bolts or ballistic fasteners for anchorages to steel.
- .5 Mineral Fibre Wool Insulation: by Roxul or Fibrex.

2.2 SHOP-TREATMENT OF WOOD

- .1 Wood Preservative - Pressure Treatment: to CSA O80; using alkaline copper quaternary (ACQ) preservative.
- .2 Wood Preservative - Surface Application: to CSA O80, brush-applied.

3 EXECUTION

3.1 CO-OPERATION WITH OTHER TRADES

- .1 Give sufficient notice to Section 09 90 00 so that untreated or unprimed carpentry items or material can be primed immediately upon delivery to the Place of the Work.
- .2 Supply fastenings with installation locations and necessary templates to other trades to which wood is to be secured.

3.2 SITE-APPLIED WOOD PRESERVATIVE

- .1 Treat wood nailers, blocking, wood sills, etc. in contact with concrete or masonry with green Pentox to ensure full protection against rot and decay.
- .2 Apply two coats of preservative to new surfaces when treated lumber is cut or sawn for fabrication or drilled and countersunk for bolts etc.
- .3 Treat all wood curbs and blocking for roof ventilators, Electrical and Mechanical equipment on the roof.

3.3 INSTALLATION

- .1 Erect wood framing members level and plumb. Place horizontal members laid flat, crown side up. Construct framing members full length without splices.
- .2 Install plywood to two-span continuous.
- .3 Provide wood blocking required for attachment of fitments and equipment by other Sections

- .4 Provide blocking where indicated on Drawings and as required for attachment of windows, fitments and equipment by other Sections.
- .5 Provide 19mm thick plywood backer board on wood blocking for mounting electrical equipment where indicated on drawings.
- .6 Provide wood copings, nailing strips, etc. as specified in Section 07 51 00. Construct curb and cant members of single pieces per location. Curb roof openings except where prefabricated curbs are provided.
- .7 Form corners by lapping side members alternately.
- .8 Provide mineral fibre wool insulation where required at curbs, parapets then in locations as shown on the architectural drawings and details.
- .9 Fastenings to solid masonry or concrete surfaces shall be with expansion shields and lag screws, unless otherwise specified, and to steel with bolts and nuts. Wood or inorganic fibre plugs shall not be permitted. Powder activated fasteners and staples shall not be used unless permitted by the Consultant.
- .10 Accurately fit all work to sit level and true and securely fastened.

3.4 FIELD QUALITY CONTROL

- .1 Defective materials or quality of work whenever found, at any time prior to final acceptance of the work, shall be rejected.
- .2 Inspection will not relieve this Contractor of responsibility, but is a precaution against oversight or errors.
- .3 Defective materials shall be removed and replaced by this Contractor at his own expense, and he shall be responsible for the cost of the work of other trades affected by this replacement.

3.5 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.
- .2 Remove all excess materials from site as Work proceeds and at completion.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy satisfactory to the Owner.
- .4 Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage. Replace damaged and broken panels. Do not use attic stock, use new panels.
- .5 Leave surfaces clean and ready for use.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with Instructions to Bidders, the General Conditions of the Contract as amended by the Supplementary Conditions including all Sections outlined in Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 SECTION INCLUDES

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.
- .2 Finish Carpentry as shown on Drawings, including but not limited to:
 - .1 Accept delivery, store and install the following:
 - (1) Hollow Metal Doors and Frames
 - (2) Wood Doors
 - (3) Finishing Hardware
 - (4) Plastic Laminate Window Sills
 - (5) Interior Door Signs
 - (6) Washroom Accessories
 - (7) Interior Specialties including White boards, Tackboards
- .3 Related Sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 04 20 00 – Unit Masonry.
 - .2 Section 06 10 00 – Rough Carpentry.
 - .3 Section 08 11 00 - Metal Doors and Frames.
 - .4 Section 08 14 00 - Wood Doors.
 - .5 Section 08 70 00 – Hardware.
 - .6 Section 10 20 00 – Interior Specialties.

1.3 REFERENCES

- .1 ANSI A208.1-99: Particleboard.
- .2 ANSI A208.2-2002: Medium Density Fiberboard.
- .3 ANSI / NEMA LD 3-2000: High Pressure Decorative Laminate.
- .4 Architectural Woodwork Manufacturers Association of Canada (AWMAC): Architectural Woodwork Quality Standards Illustrated.

- .5 CSA B111-1974 (R2003): Wire Nails, Spikes and Staples.
- .6 CSA O80 Series-97 (R2002): Wood Preservation.
- .7 CSA O115-M1982: Hardwood and Decorative Plywood.
- .8 CSA O121-M1978: Douglas Fir Plywood
- .9 CSA O141-05: Softwood Lumber.
- .10 CSA O151-04: Canadian Softwood Plywood.
- .11 CAN/CGSB-11.3-M87: Hardboard.
- .12 National Lumber Grades Authority: Standard Grading Rules for Canadian Lumber.

1.4 QUALITY ASSURANCE

- .1 Installer: company specializing in custom carpentry work with three years documented experience.
- .2 Perform finish carpentry to AWMAC Quality Standards, Custom grade.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Store Products under waterproof cover both in transit and at the Place of the Work in such a manner as to prevent damage to other materials, to any existing building or property or to the Work.
- .3 Co-ordinate delivery schedule of Products with Suppliers.

2 PRODUCTS

2.1 MATERIALS (NOT APPLICABLE)

3 EXECUTION

3.1 CO-OPERATION WITH OTHER TRADES

- .1 Give sufficient notice to Section 09 90 00 so that untreated or unprimed carpentry items or material can be primed immediately upon delivery to the Place of the Work.
- .2 Supply fastenings with installation locations and necessary templates to other trades to which wood is to be secured.

3.2 MISCELLANEOUS INSTALLATIONS

- .1 Install finishing hardware, interior door signage and washroom accessories as specified in Section 08 70 00.
- .2 Install wood doors as specified in Section 08 14 00.
- .3 Install metal doors and frames as specified in Section 08 11 00.
- .4 Install interior door signage and washroom accessories supplied under Work of other Sections.

3.3 FINISHING HARDWARE

- .1 Finishing hardware shall be supplied by the Hardware Supplier under the work of Section 08 70 00 and installed by this Contractor.
- .2 Mortise and neatly fit finishing hardware. Cut mortises straight and sharp without ragged edges and size accurately to accommodate the hardware. Where mortising and application have not been done in a first class workmanlike manner such work shall be replaced.
- .3 Install hardware in accordance with the manufacturer's recommendations.
- .4 Examine and adjust as required all doors and other moveable parts prior to completion of the building.
- .5 Hang doors 1½ pairs of butts, unless otherwise shown in the hardware list to be provided under Section 08 70 00. Neatly and accurately fit all finishing hardware.

3.4 FIELD QUALITY CONTROL

- .1 Defective materials or quality of work whenever found at any time prior to final acceptance of the work, shall be rejected. Inspection will not relieve this Contractor of responsibility but is a precaution against oversight or errors. Defective materials shall be removed and replaced by this Contractor at his own expense, and he shall be responsible for the cost of the work of other trades affected by this replacement.

3.5 CLEANING

- .1 Remove Kraft paper protective coating.
- .2 Visually inspect each installed item, wash and polish thoroughly all surfaces and remove debris from work site and dispose.

3.6 PROTECTION

- .1 Protect exposed and finished woodwork after installation until Substantial Performance of the Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified or required, to complete the work of this Section including but not limited to the following:
 - .1 Provide millwork and casework as shown on the Drawings, including but not limited to the following:
 - (1) Provide prefinished millwork where shown on Drawings as specified herein and as needed for a complete and proper installation.
 - (2) Provision of rough hardware, including fastening devices required to secure in place items of carpentry and millwork.
 - (3) Installation of finishing hardware for millwork by this Millwork Contractor Section 06 40 00.
 - (4) Supply and installation of miscellaneous trims, scribes, filler panels, plastic laminate windowsills.
 - (5) Provide cut-outs in the millwork for the sinks, gas outlets, electrical outlets and all other necessary cut-outs regarding the millwork.
 - .2 The intent of this Section is that casework shall be manufactured and finished at the plant, delivered to the site and immediately installed by this Section, including provision of necessary strapping, backers, bearers, rough hardware and finish hardware and miscellaneous support metals and stainless steel metal components. Touch-up finish immediately prior to completion of the work and leave in perfect condition.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 04 20 00 – Unit Masonry.
 - .2 Section 06 20 00 – Finish Carpentry.
 - .3 Section 07 92 00 – Joint Sealants.
 - .4 Section 08 70 00 – Hardware.
 - .5 Section 08 90 00 – Louvres and Vents.
 - .6 Section 09 21 16 – Gypsum Board Assemblies.
 - .7 Section 09 30 00 – Porcelain Tiling.
 - .8 Section 09 65 00 – Resilient Flooring.

.9 Section 09 90 00 – Painting and Coating.

.10 Divisions 21, 22 and 23 – Mechanical.

.11 Division 26 – Electrical.

1.3 REFERENCES

- .1 Architectural Woodwork Manufacturers Association of Canada (AWMAC): Architectural Woodwork Quality Standards Illustrated.

1.4 SUBMITTALS

- .1 Submit Shop Drawings as specified in Section 01 33 00.
- .2 Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, finishes, accessories, locations of outlets, anchorage, and hardware to a minimum scale of 1:10. Incorporate plans, elevations, sections and details for all architectural woodwork included in this Section.

1.5 SAMPLES

- .1 Submit samples as specified in Section 01 33 00.
- .2 Samples:
- .1 Submit two (2) samples of each casework finish including plastic laminate and finished Birch Plywood for Owner and Consultant review.
- .2 Submit samples of all hardware including products data, information and specifications for the Consultant's review.
- .3 Do not commence work until reviewed samples have been returned.

1.6 QUALITY ASSURANCE

- .1 Perform work to latest edition of Architectural Woodwork Manufacturers' Association of Canada (AWMAC), Custom Grade.
- .2 Fabricate millwork by a manufacturer that is a recognized millwork supplier, well experienced in the manufacturing techniques of a millwork shop.
- .3 Employ fully trained mechanics who are regularly employed in this field.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Give Painter sufficient notice so that untreated or unprimed carpentry items or materials can be primed immediately upon delivery to site.
- .3 No equipment shall be delivered to the site until portion of the building in which it is to be installed is completely ready for equipment as approved by Consultant.
- .4 Store finished work properly and keep under cover both in transit and at site. Finish woodwork shall not be delivered to site until concrete and masonry work has dried out.

- .5 Cover all plastic laminate and prefinished top surfaces at shop with heavy Kraft paper.
- .6 Carefully protect from damage of any kind.

1.8 PROJECT CONDITIONS

- .1 Prior to fabrication, verify any field measurements necessary to ensure a perfect fit.
- .2 Co-operate in co-ordinating work of related Sections in order that the work may proceed in an orderly and effective manner.

1.9 MAINTENANCE

- .1 Provide Owner with printed instructions for "Care and Maintenance of Plastic Laminate" and millwork finishes.

1.10 WARRANTY

- .1 Warranty all workmanship against manufacturing defects, including warpage or delamination, for a period of five (5) years from date of Substantial Completion. Make good or replace work showing defects in this period, as requested, at no expense to the Owner.

2 PRODUCTS

2.1 MATERIALS

- .1 Hardwood Lumber Edging: AWMAC Premium Grade; maximum moisture content of 7 percent, White Birch, with vertical grain, of quality capable of transparent finish.
- .2 Hardwood Plywood: to CSA O115-M, AWMAC Premium Grade, Architectural SEL TF appearance, lumber core material; plain sliced White Birch species, of clear grain capable of receiving transparent finish.
- .3 Particle Board: to ANSI A208.1, Grade M-3, minimum 700 kg/m³ density; 4.5 - 8.0 percent maximum moisture content; sanded faces.
- .4 Medium Density Fiberboard: to ANSI A208.2, Grade MD, minimum density of 740 kg/m³ density; 4.5 - 8.0 percent maximum moisture content.
- .5 Hardboard Panel: to CAN/CGSB-11.3-M, 6 mm thick, c/w ANSI/NEMA LD 3, Grade VGL decorative laminate thermo-fused to one side; colours and patterns as selected by Consultant.
- .6 Plastic Laminate: to ANSI/NEMA LD 3, velour or satin finish, solid colour; as follows:
 - .1 General Purpose Type: Grade HGS; 1.2 mm thick.
 - .2 Vertical Surface Type: Grade VGS; 0.7 mm thick.
 - .3 Postforming Type: Grade HGP; 1.0 mm thick.
 - .4 Vertical Postforming Type: Grade VGP; 0.7 mm thick.
 - .5 Backing Type: Grade BKL; 0.5 mm thick
 - .6 Acceptable Manufacturers: Formica, Wilsonart, Arborite, Nevamar or Abet Laminati.

- (1) Plastic Laminate: 476 SEI by Abet Laminati or equal.

2.2 ACCESSORIES

- .1 Adhesive for Plastic Laminate: water-resistant, pressure bonding type; urea resin to CSA O112.5 or resorcinol to CSA O112.7.
- .2 Fasteners: size and type to suit application, plain finish.
- .3 Lumber for Shimming, Blocking, and Strapping: softwood lumber, as specified in Section 06 10 00.
- .4 Wood Filler: Solvent base, tinted to match surface finish colour.
- .5 Joint Sealants: as specified in Section 07 92 00.
- .6 Millwork Hardware:
 - .1 Hinges: Grass series 1200 or Eyromat 3955 by Hettich or approved equal, self-closing 176 Deg. opening complete with appropriate base plates to suit application. All cupboard doors shall have 2 rubber cushions. Use additional hinges as required. Do not use exposed hinges. Hinge size and type to be according to door weight.
 - .2 Coat Hooks: Manufactured by Henkel
 - (1) Model No. HD003, colour: Snow White.
 - .3 Door Pulls: "D: Pull Hafele. Stainless Steel or prior approved equal.
 - .4 Drawer Slides: Full extension side mounted. Capable of carrying a minimum weight of 23 kg.
 - .5 For larger drawer slides use full extension heavy duty roller/bearing slide capable of carrying a minimum weight of 46 kg.
 - .6 Recessed Stainless Steel Pilasters: Metalwork BZ120 of approved equal.
 - .7 Door or Drawer Locks: Cylinder Lock – All upper and lower cabinets to be lockable to same group.
 - .8 Approved Manufacturers: Grass, Hager, Hafele and Hettich.

2.3 FABRICATION

- .1 Assemble, where practical, all finished woodwork at the mill and deliver ready for installation.
- .2 Machine sand all exposed surfaces of finished woodwork to an even smooth surface ready for finishing; fit all joints and mitres accurately with nail heads set ready for finishing.
- .3 Cover all exposed edges of plywood with a 10 mm solid matching wood strip.
- .4 Apply plastic laminate to Architectural Woodwork Manufacturers Association of Canada (AWMAC) Standards.
- .5 Construction of finished millwork shall be:
 - .1 Plywood core with Birch Veneer and solid edging Birch.

.2 Plastic laminate on all window sills, countertops and control panels detailed on SD-1, SD-2.

.6 Apply plastic laminate to edges first, trim flush with face and apply face laminate lapping edge. Chamfer edge of face laminate 20 degrees, unless otherwise detailed as post formed on Drawings.

.7 Install finishing hardware to manufacturer's specifications. All drawers shall be installed with drawer slides.

3 EXECUTION

3.1 EXAMINATION

.1 Report to the Consultant, in writing, all defects of surfaces or work prepared by other trades and or unsatisfactory site conditions.

.2 Thoroughly examine all surfaces scheduled to receive Architectural Woodwork to see that they are secure, rigid, true and not liable to impair performance or appearance.

.3 Commencement of work implies total acceptance of surface and site conditions.

3.2 INSTALLATION

.1 Set and secure all materials and components in place, rigid plumb and square.

.2 Provide all furring strips and strapping required to fix millwork and casework to walls, etc.

.3 Use draw bolts in counter top joints.

.4 Apply a small bead of mildew-resistant silicone sealant at junction of plastic laminate counter back and adjacent wall finish.

.5 After installation, fit and adjust operating hardware for wood and laminated plastic cabinet door, drawers and shelves.

.6 Provide closers and filler strips in matching finish as required to ensure a neat and complete finished assembly.

3.3 FIELD QUALITY CONTROL

.1 Defective Products and work, whenever found at any time prior to final acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error.

3.4 PROTECTION

.1 Protect adjacent installations from damage.

.2 Make good any resulting damage, to the satisfaction of the Consultant, at no additional cost to the Owner.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified or required, to complete the work of this Section including but not limited to the following:
 - .1 Surface preparation.
 - .2 Application of rolled, self-adhering waterproofing membrane system.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 03 30 00 – Cast-in-Place Concrete
 - .2 Section 07 92 00 – Joint Sealants

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section.
 - .1 American Concrete Institute (ACI):
 - (1) ACI 302.1R.17 – Guide for Concrete Floor and Slab Construction.
 - .2 American Society for Testing and Materials (ASTM):
 - (1) ASTM C836 – Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
 - (2) ASTM D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
 - (3) ASTM D570 – Standard Test Method for Water Absorption of Plastics
 - (4) ASTM D882 – Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
 - (5) ASTM D903 – Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
 - (6) ASTM D1876 – Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
 - (7) ASTM D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - (8) ASTM D3767 – Standard Practice for Rubber - Measurement of Dimensions
 - (9) ASTM D5385: Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.
 - (10) ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 - (11) ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
 - (12) ASTM F2130 - Standard Test Method for Measuring Repellency, Retention, and Penetration of Liquid Pesticide Formulation Through Protective Clothing Materials.
 - .3 International Concrete Repair Institute (ICRI)

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 - Submittals.
 - .1 Product Data:
 - (1) Include product characteristics and limitations. Identify dissolving solvents, fuels and potential destructive compounds. Include WHMIS safety data sheets for reference on Site.
 - .2 Shop Drawings:
 - (1) Submit shop drawings showing locations for waterproofing system components. Show details for each type of substrate, joints, corners, and edge conditions, including flashings, counterflashings, penetrations, transitions, and terminations.
 - (2) Submit shop drawings of the entire sub-grade waterproofing system showing locations and extent of all waterproofing materials, waterstops, and accessories including details of substrate joints, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, integration with air barrier system, penetrations, transitions and other termination conditions.
 - .3 Test and Evaluation Reports:
 - (1) Test data for waterproofing products and waterproofing system, by qualified testing agency, indicating proposed waterproofing meets performance requirements, when requested by Project Manager.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer's:
 - (1) Manufacturer shall have a minimum of 15 years' experience having successfully manufactured and supplied products required for the Work of this Section for other projects of similar size and complexity.
 - .2 Installer's:
 - (1) A manufacturer-approved firm with minimum 5 years' experience in installation of specified products in successful use on similar projects, employing workers trained by manufacturer, including a full-time on-site supervisor with a minimum of three years' experience installing similar work.
 - (2) If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.
- .2 Certifications:
 - .1 Submit certified statement in triplicate, signed by Contractor and waterproofing manufacturer, attesting that the materials furnished conform to the specified requirements, and that all fluid components are manufactured by a single company. Accompany certificates by laboratory test reports for the physical properties specified.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and acceptance requirements:

- .1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

.2 Storage and handling procedures:

- .1 Handle and store materials in a clean, dry area in accordance with manufacturer's written instructions in a weather protected environment, clear of ground and moisture, within temperature ranges recommended by materials manufacturer.
- .2 Store materials in manner to prevent damage to other materials, to any existing building or property, and to the Work.
- .3 Store Products to avoid disruption in the progress of the Work.
- .4 Store materials in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

1.7 PROJECT CONDITIONS

.1 Ambient Conditions:

- .1 Perform Work only when weather conditions as well as ambient and substrate temperatures are within the limits established by the manufacturer of the sheet membrane waterproofing system. Do not apply waterproofing in snow, rain, or mist.

.2 Existing Conditions:

- .1 Ensure substrate is ready to receive waterproofing system. Proceed with installation only when the substrate construction and preparation work is complete and is suitable to support sheet membrane waterproofing.

1.8 WARRANTY

- .1 Provide a written five (5) year material, labour and workmanship warranty, commencing from the date of Substantial Performance, covering the replacement and making good of defects in materials and workmanship. Defects to include but not limited to, adhesive failure, cohesive failure, excessive abnormal wear.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

.1 Acceptable Manufacturers:

- (1) Sika Canada Inc.
- (2) Tremco Inc.
- (3) W.R. Meadows
- (4) Or approved equivalent

.2 Requests for substitutions shall be made in conformance with Section 01 25 00.

.2 Substitution Limitations: Comparable Products from manufacturers listed herein may be accepted provided they meet requirements of this Specification.

.3 Source Limitations: All components of the waterproofing systems including joint sealing and waterstop materials shall be by a single manufacturer.

2.2 MATERIALS

.1 Rolled, Self-Adhering Waterproofing Membrane:

.1 Fully and permanently bonded, self-adhesive, post-applied, polymeric composite sheet membrane waterproofing system. Cold- and post-applied, without heat or open-flames, by a simple peel and stick process on hardened concrete structures.

.2 Waterproofing membrane shall have the following characteristics:

- (1) Nominal Thickness: to ASTM D 3767; 1.2mm
- (2) Lateral Water Migration Resistance: to ASTM D5385; pass at 71m of hydrostatic head pressure.
- (3) Resistance to Hydrostatic Head: to ASTM D5385 modified; 71 m, minimum.
- (4) Low Temperature Flexibility: to ASTM D1970; Pass at -25°C.
- (5) Tensile Strength: to ASTM D412; minimum 1,740 psi(12MPa)
- (6) Elongation: to ASTM D412; 500% minimum.
- (7) Water Absorption: to ASTM D570: 0.03%
- (8) Cracking Cycling: to ASTM C836; Pass at -25°C.
- (9) Peel Adhesion: to ASTM D903; 7,000 N/m.
- (10) Lap Adhesion: to ASTM D1876; 7,000 N/m.
- (11) Water Vapor Permeability: to ASTM E96, Method B; 0.06 perms.
- (12) Puncture Resistance: to ASTM E154; 670N min.

.3 Acceptable Products:

- (1) SikaProof P by Sika Canada
- (2) Mel-Rol by W.R. Meadows
- (3) Equivalent by Tremco

.2 Blind-side, Self-Adhering Waterproofing Membrane:

.1 Multi-layered pre-applied polymeric composite flexible sheet membrane, laminated with an adhesive sealant applied in a fine grid pattern, and a non-woven polypropylene fleece. The membrane shall form a continuous and permanent mechanical bond to poured concrete to prevent lateral water migration between the membrane and structural concrete.

.2 Waterproofing membrane shall have the following characteristics:

- (1) Nominal Thickness: to ASTM D 3767; 1.7mm
- (2) Lateral Water Migration Resistance: to ASTM D5385; pass at 71m of hydrostatic head pressure.
- (3) Resistance to Hydrostatic Head: to ASTM D5385 modified; 71 m, minimum.
- (4) Low Temperature Flexibility: to ASTM D1970; Pass at -25°C.
- (5) Tensile Strength: to ASTM D412; minimum 1,200 psi(8.3MPa)
- (6) Elongation: to ASTM D412; 700% minimum.
- (7) Water Absorption: to ASTM D570: 0.03%

- (8) Cracking Cycling: to ASTM C836; Pass at -25°C.
- (9) Peel Adhesion: to ASTM D903; 7,000 N/m.
- (10) Lap Adhesion: to ASTM D1876; 7,000 N/m.
- (11) Water Vapor Permeability: to ASTM E96, Method B; 0.06 perms.
- (12) Puncture Resistance: to ASTM E154; 670N min.

.3 Acceptable Products:

- (1) SikaProof A by Sika Canada
- (2) Pre-Con by W.R. Meadows
- (3) Equivalent by Tremco

2.3 ACCESSORIES

- .1 Waterstop:** Sika Greenstreak by Sika, Waterstop EC Plus by W.R. Meadows or equivalent by Tremco.
- .2 Re-injectable Injection Hose System:** SikaFuko VT injection hose system used in conjunction with Sika Injection 306 as required, or equivalent by W.R. Meadows or Tremco.
- .3 Protection Board:**
 - .1** For slab on grade: minimum 750g/m2 geotextile on compacted soil or 350g/m2 geotextile on mud slab.
 - .2** For backfill areas where insulation is not already shown on Drawings: 50mm high density insulation board, rigid extruded polystyrene conforming to CAN/ULC S-701, Type IV, "Styrofoam HI-40" by Dow Chemical or "Foamular 400" by Owens Corning Canada.
- .4 Drainage System:** Consists of a polypropylene dimpled drainage core bonded with a non-woven geocomposite fabric on the top side, and a membrane protective film bonded to the bottom side; Sika Drainage Mat 420.
- .5 Detaining Tapes** for fastener, overlap, termination and other details as recommended by the waterproofing membrane manufacturer.
- .6 Preformed L-shaped waterproofing sheet** to form perimeter edge, internal and external corners, and connections of membrane waterproofing system. SikaProof A Edge.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:**
 - .1** Examine all work of other Sections upon which the Work of this Section depends.
 - .2** Report in writing to the Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of this Section.
 - .3** Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .4** Commencement of work implies acceptance of existing conditions and work by others.

3.2 PREPARATION

- .1 Protect adjacent surfaces not designated to receive waterproofing.
- .2 Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
- .3 Do not apply waterproofing to surfaces unacceptable to manufacturer.
- .4 Exposed vertical surfaces:
 - .1 Concrete surfaces must be clean, smooth and free of standing water.
 - .2 Patch all holes and voids and smooth out any surface misalignments.
 - .3 Apply surface conditioner to surfaces that will be covered within one working day according to manufacturer's recommended coverage rates.
 - .4 Install corner tape on all inside and outside corners, including the footing.
 - .5 Apply a 229 mm (9") strip of self-adhering membrane over construction, control and expansion joints and over cracks greater than 1.59 mm (1/16") wide.
 - .6 Seal all terminations with pointing mastic.
- .5 Blind horizontal or vertical surfaces:
 - .1 Inspect all surfaces for any conditions detrimental to the proper completion of the work.
 - .2 Ensures surfaces are structurally sound.
 - .3 Remove debris or any other foreign material that could damage the membrane.

3.3 APPLICATION

- .1 Strictly comply with installation instructions in manufacturer's published literature.
- .2 Ensure all accessory materials are by the membrane manufacturer. Where accessory products are not made by the manufacturer, ensure all products are compatible with membrane and approved by membrane manufacturer.
- .3 Blind-side horizontal applications:
 - .1 Install the pre-formed SikaProof A Edge sheet for the perimeter of the installation area.
 - .2 Form the corners with the same SikaProof A Edge sheet adhering both internally with SikaProof Tape-150 and externally with SikaProof ExTape-150.
 - .3 Install the SikaProof A membrane fleece side up, adhering the joints with the self-adhesive strip longitudinally. Adhere transverse joints externally with SikaProof ExTape-150 and internally with SikaProof Tape-150.
 - .4 Accurately position succeeding sheets to overlap the self-adhesive strip by a minimum of 90mm (3.5 in.) along the marked edge. Ensure the underside of the succeeding sheet is clean, dry, and free from contamination before removing the protective release liner.

- .5 Remove the protective release liner exposing the self-adhesive strip from between the overlaps as the two layers are adhered together. Ensure a continuous bond is achieved without creases.
- .6 Install detail areas, such as pipe penetrations, pits, connections, expansion joints, and any other special details using the appropriate accessory products and in strict accordance with the manufacturer's installation instructions.
- .4 Blind-side vertical applications:
 - .1 Install leveling layer based on existing jobsite conditions.
 - .2 Mechanically fasten the membrane using fasteners appropriate to the substrate with the fleece side facing towards the concrete placement. The membrane may be installed in either horizontal or vertical orientation in any convenient length.
 - .3 Accurately position succeeding sheets to overlap the self-adhesive strip by a minimum of 90mm (3.5 in.) along the marked edge. Ensure the underside of the succeeding sheet is clean, dry, and free from contamination before removing the protective release liner.
 - .4 Remove the protective release liner exposing the self-adhesive strip from between the overlaps as the two layers are adhered together. Ensure a continuous bond is achieved without creases.
- .5 Post-applied vertical applications:
 - .1 Remove release paper on edge and position the membrane.
 - .2 Pull balance of release paper off, running the roll vertically over the top of the corner tape at the footing.
 - .3 Immediately hand-rub the membrane firmly to the surface, removing any bubbles or wrinkles, then pressure roll the complete surface to assure positive adhesion.
 - .4 Overlap all seams and stagger end laps at least 63.5 mm (2 ½").
 - .5 Seal all terminations with pointing mastic.
 - .6 Inspect membrane before covering and repair as necessary. Cover tears and inadequate overlaps with membrane. Seal edges of patches with pointing mastic.
- .6 Drainage panels at locations as shown on Drawings:
 - .1 Place drainage panel directly against membrane, butt joints, place to encourage drainage downward.
 - .2 Adhere drainage panel, scribe and cut boards around projections, penetrations, and interruptions.
- .7 Protection Board at locations where insulation is not shown on Drawings:
 - .1 Pre-applied application: Place protection board on top of acceptable substrate before placement of membrane.
 - .2 Post-applied application: Place protection board directly against membrane or drainage panel where applicable; butt joints.
 - .3 Adhere protection board to substrate as per manufacturer's recommended instructions. Scribe and cut boards around projections, penetrations, and interruptions.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Conduct third party field inspection and testing as specified in Section 01 40 00.
- .2 Non-Conforming Work:
 - .1 Defective materials or quality of work whenever found at any time prior to final acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error.
 - .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.
- .3 Manufacturer's Site inspections:
 - .1 Have manufacturer's technical representative inspect the Work at suitable intervals during application, and at conclusion of the Work of this Section, to ensure the Work is correctly installed. Submit manufacturer's inspection reports and verifications that the Work of this Section is correctly installed.

3.5 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.
- .2 Remove all excess materials from site as Work proceeds and at completion.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy satisfactory to the Owner.
- .4 Clean and make good surfaces soiled or otherwise damaged as a result of Work of this Section at no additional cost to the Owner.
- .5 Leave surfaces clean and ready for subsequent Work.

3.6 PROTECTION

- .1 For Blindside Waterproofing:
 - .1 Protect membrane in accordance with the manufacturer's recommendations until placement of concrete. Inspect membrane for damage just prior to concrete placement and make repairs in accordance with manufacturer's recommendations.
- .2 For direct applied sheet waterproofing:
 - .1 Protect membrane on vertical and horizontal applications with immediate application of waterproofing protection course, rolled matrix drainage board.
 - .2 Backfill immediately using care to avoid damaging waterproofing membrane system.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section Includes: Provide all labour, materials, equipment and services necessary for the complete and proper installation of the insulation Work throughout project except where specified by other including but not limited to:

- .1 Rigid Insulation
- .2 Semi-rigid Insulation
- .3 Batt Insulation
- .4 Loose Insulation
- .5 Foam in Place Insulation (gap filler)
- .6 Related accessories for installation

- .2 Related Sections The following description of work is included for reference only and shall not be presumed complete:

- .1 Section 03 30 00 – Cast-in-Place Concrete
- .2 Section 04 20 00 – Unit Masonry
- .3 Section 07 21 29 – Sprayed Insulation
- .4 Section 07 27 00 – Air Barrier Membrane
- .5 Section 07 51 30 – Built-up Bituminous Membrane Roofing
- .6 Section 07 84 00 – Firestopping
- .7 Section 07 92 00 – Joint Sealants
- .8 Section 09 21 16 – Gypsum Board Assemblies
- .9 Mechanical and Electrical Divisions

1.3 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 LTTR: Long Term Thermal Resistance.
 - .2 NRCC: National Research Council of Canada; www.nrc-cnrc.gc.ca

- .2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section.
 - .1 American (ASTM):
 - (1) ASTM C165 – Standard Test Method for Measuring Compressive Properties of Thermal Insulations
 - (2) ASTM C1303/C1303M – Standard Test Method for Predicting Long-Term Thermal Resistance of Closed Cell Foam Insulation
 - (3) ASTM C1338 – Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
 - (4) ASTM D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 - (5) ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
 - (6) ASTM E96/E96M – Standard Test Methods for Water Vapor Transmission of Materials
 - (7) ASTM E283 – Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
 - .2 Canadian General Standards Board (CGSB):
 - (1) CAN/CGSB-51.34 – Vapour Barrier, Polyethylene Sheet for Use in Building Construction
 - (2) CGSB 71-GP-24M - Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation
 - .3 Underwriters Laboratory of Canada (ULC):
 - (1) CAN/ULC-S102 – Test Method of Surface Burning Characteristics of Building Materials and Assemblies
 - (2) CAN/ULC-S114 – Standard Method of Test for Determination of Non-Combustibility in Building Materials
 - (3) CAN/ULC-S701 – Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering
 - (4) CAN/ULC-S702 – Standard for Mineral Fibre Thermal Insulation for Buildings
 - (5) CAN/ULC-S704 – Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced
 - (6) CAN/ULC-S710.1 – Standard for Thermal Insulation - Bead Applied One-Component Polyurethane Air Sealant Foam, Part 1: Material Specification
 - (7) CAN/ULC-S710.2 – Standard for Thermal Insulation - Bead Applied One-Component Polyurethane Air Sealant Foam, Part 2: Application
 - (8) CAN/ULC-S711.1 – Standard for Thermal Insulation - Bead Applied Two-Component Polyurethane Air Sealant Foam, Part 1: Material Specification
 - (9) CAN/ULC-S711.2 – Standard for Thermal Insulation - Bead Applied Two-Component Polyurethane Air Sealant Foam, Part 2: Application
 - (10) CAN/ULC-S770 – Standard Test Method for Determination of Long-Term Thermal Resistance of Closed Cell Thermal Insulating Foams
 - .4 Provincial and Federal Building Codes as applicable.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordination under this Section shall be in accordance with General Conditions and Division 01.
 - .2 Coordinate with other work having a direct bearing on the Work of this Section.

- .3 Coordinate installation of insulation with completion of other work requiring interface with insulation.

1.5 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 - Submittals.
- .2 Product Data:
 - .1 Include product characteristics and limitations. Identify dissolving solvents, fuels and potential destructive compounds. Include WHMIS safety data sheets for reference on Site.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer's:
 - (1) Manufacturer shall have a minimum of 15 years' experience having successfully manufactured and supplied products required for the Work of this Section for other projects of similar size and complexity.
 - .2 Installer's:
 - (1) A manufacturer-approved firm with minimum 5 years' experience in installation of specified products in successful use on similar projects, employing workers trained by manufacturer, including a full-time on-site supervisor with a minimum of three years' experience installing similar work.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and acceptance requirements:
 - .1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- .2 Storage and handling procedures:
 - .1 Handle and store materials in a clean, dry area in accordance with manufacturer's written instructions in a weather protected environment, clear of ground and moisture, within temperature ranges recommended by materials manufacturer.
 - .2 Store materials in manner to prevent damage to other materials, to any existing building or property, and to the Work.
 - .3 Store Products to avoid disruption in the progress of the Work.
 - .4 Store materials in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

1.8 PROJECT CONDITIONS

- .1 Ambient Conditions:
 - .1 Maintain ambient and substrate temperatures during application and curing of adhesive at temperature limits established by the manufacturer of adhesive
- .2 Existing Conditions:
 - .1 Ensure substrate is ready to receive insulation system. Proceed with installation only when the substrate construction and preparation work is complete.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 CertainTeed Corporation; www.certainteed.com
 - .2 Dow Chemical Canada Inc.; www.dow.com
 - .3 Johns Manville.; www.jm.com
 - .4 Owens Corning; www.owenscorning.ca
 - .5 Rockwool International.; www.rockwool.com
 - .6 Thermafiber Inc, by Owens Corning.; www.thermafiber.ca
 - .7 Substitution Limitations: Comparable Products from manufacturers not listed herein may be acceptable provided they meet requirements of this Specification.
- .2 Single source responsibility: Obtain each type of insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 High Density Underslab Insulation:
 - .1 High strength, extruded polystyrene, closed-cell, smooth skin, conforming to CAN/ULC S-701, Type IV, minimum 275kPa (40psi) compressive strength.
 - .2 Thicknesses as indicated on drawings.
 - .3 LTTR shall be minimum RSI (R) value or 0.88 (5.0) per 25mm (1") in conformance with CAN/ULC S770.
 - .4 Products:
 - (1) 'Styrofoam Highload-40' by Dow Chemical
 - (2) "Foamular 400' by Owens Corning Canada.

.2 Below-grade Insulation:

- .1 High strength, extruded polystyrene, closed-cell, smooth skin, conforming to CAN/ULC S-701, Type IV, minimum 210kPa (30psi) compressive strength.
- .2 Thicknesses as indicated on drawings.
- .3 LTTR shall be minimum RSI (R) value or 0.88 (5.0) per 25mm (1") in conformance with CAN/ULC S770.
- .4 Products:
 - (1) 'Styrofoam SM' by Dow Chemical
 - (2) "Foamular C-300" by Owens Corning Canada.
 - (3) Approved equivalent from manufacturer's listed above in Article 2.1.

.3 Rigid and Semi-Rigid Stone Wool Board Insulation:

- .1 Stone wool rigid or semi-rigid board insulation a minimum nominal density of 64 kg/m³ (4 pcf). Ensure deformation of rigid board does not exceed 10% when tested at 1.2 kPa (25 psf) in accordance with CAN/ULC-S702, Type 1 and ASTM C165.
- .2 Thickness as indicated on Drawings.
- .3 LTTR shall be minimum RSI (R) value or 0.704 (4.0) per 25mm (1").
- .4 Products:
 - (1) "CurtainRock" by Rockwool International A/S.
 - (2) "FireSpan 40" by Thermafiber.
 - (3) "JM CladStone" by Johns Manville

.4 Batt Insulation:

- .1 Insulation to CAN/ULC S702 Type 1; preformed glass fibre batt min 20 % recycled content; friction fit, conforming to the following:
 - (1) Thermal Resistance: minimum RSI of 2.1 per 100 mm.
 - (2) Batt Size: 400 mm x 1220 mm & 610 mm x 1220 mm to suit framing
 - (3) Facing: Unfaced.
 - (4) Flame/Smoke Properties: 10 / 10 in accordance with ASTM E84..
 - (5) Thicknesses as shown on Drawings.
- .2 Products:
 - (1) "EcoTouch Pink" by Owens Corning
 - (2) Equivalents by listed manufacturers

.5 Foam in Place Polyurethane Foam Insulation:

- .1 One-component foam, slow rise, Compressive Strength: 34 kPa (5 psi), Shear Strength: 83 kPa (12 psi); Closed Cell ULC classified sealant for insulating, sealing, bonding, filling, preventing air infiltration. Ensure 1 component foams meet CAN/ULC-S102 and ASTM E84 flame spread requirements for caulks and sealants, flame Spread 25, cure in place within 24 hours to densities between 16.02 to 32.04 kg/m³ (1.0 to 2.0 lb/cu ft) and carry R-value of 0.03 w/m•k (4 to 5 per inch). Cured foam can be trimmed, sanded and/or painted.
- .6 Spray Insulation:
 - .1 Refer to Section 07 21 29
- .7 Roof Insulation:
 - .1 Refer to Section 07 52 00.
- .8 Acoustical Insulations for interior wall and ceiling applications:
 - .1 Refer to Section 09 21 16 Gypsum Board Assemblies.

2.3 ACCESSORIES

- .1 Insulation Adhesives:
 - .1 As recommended by insulation manufacturer.
- .2 For polystyrene rigid insulation: Polymer modified liquid applied membrane, compatible with insulation, type manufactured for the attachment of insulation. Acceptable product: 230-21 by Henry Company Canada.
- .3 Mechanical Fasteners:
 - .1 Insulation Clips: Impale type, perforated 50 mm x 50 mm (2" x 2") cold rolled steel adhesive back, spindle of length to suit insulation plus 25 mm (1") with speed washers. Acceptable Product: "Self-Stick Insul-Anchors" by Continental Studwelding Ltd.; www.constud.ca.
 - .4 Strip Impalement Clips: 25 mm (1") wide strip of "Insul Hold Clips" by Insul Hold Canada Ltd., fabricated from galvanized sheet in rolls with punch out insulation securement arrows.
 - .5 Nails: Galvanized steel, length 25 mm (1") longer than insulation thickness.
 - .6 Staples: Galvanized wire, 13 mm (1/2") minimum.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of this Section depends.
 - .2 Report in writing to the Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of this Section.
 - .3 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.

- .4 Commencement of work implies acceptance of existing conditions and work by others.

3.2 INSTALLATION

- .1 Install materials in accordance with manufacturer's written instructions.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces as indicated on Drawings.
- .3 Fit insulation tight to electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other projections or openings.
- .4 Install attachment at rate as required to prevent displacement of insulation during and after construction operations.
- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation panels free from ripped backs or chipped or broken edges. Ensure integrity and continuity of insulation at juncture with different types of materials and seal in acceptable manner. Stagger joints in row.
- .6 Ensure continuity of insulation at juncture with different materials and seal with compatible materials acceptable to the manufacturer.
- .7 Do not cover insulation and air/vapour barrier installed under this Section or other Sections until it has been reviewed by Project Manager.
- .8 Below grade insulation:
 - .1 Horizontal surfaces: Loose lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation boards.
 - .2 Vertical surfaces: Adhere insulation boards on surfaces, set in manufacturer recommended adhesive. Apply adhesive at rate as per manufacturer's written instructions. Butter edges of boards and fit tightly to form continuous seal.
- .9 Foam in Place Polyurethane Foam Insulation:
 - .1 Install foam in place insulation materials to OBC requirements in accordance with manufacturer's instructions and acceptable to authorities having jurisdiction to provide required air seal.
 - .2 Apply sealants within recommended application temperature ranges. Consult manufacturer when sealants cannot be applied within specified ranges.
 - .3 Apply foam in place insulation materials to fill gaps where indicated

3.3 FIELD QUALITY CONTROL

- .1 Non-Conforming Work:
 - .1 Defective materials or quality of work whenever found at any time prior to final acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error.
 - .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

3.4 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.
- .2 Remove all excess materials from site as Work proceeds and at completion.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy satisfactory to the Owner.
- .4 Clean and make good surfaces soiled or otherwise damaged as a result of Work of this Section at no additional cost to the Owner.
- .5 Leave surfaces clean and ready for subsequent Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified or required, to complete the work of this Section including but not limited to the following:
 - .1 Spray applied polyurethane insulation.
 - .2 Cementitious fire protective coating.
 - .3 Related accessories for installation
- .2 Related Sections The following description of work is included for reference only and shall not be presumed complete:
 - .1 Section 03 30 00 – Cast-in-Place Concrete
 - .2 Section 07 84 00 – Firestopping
 - .3 Section 07 92 00 – Joint Sealants
 - .4 Section 08 44 00 – Curtain Wall and Glazed Assemblies
 - .5 Section 09 21 16 – Gypsum Board Assemblies

1.3 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 LTTR: Long Term Thermal Resistance.
 - .2 NRCC: National Research Council of Canada; www.nrc-cnrc.gc.ca
- .2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C411 – Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .2 ASTM C518 – Standard Test Method for Steady-State Thermal Transmission
 - .3 ASTM C1338 – Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
 - .4 ASTM D1621 – Standard Test Method for Compressive Properties Of Rigid Cellular Plastics.

- .5 ASTM D1622 – Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- .6 ASTM D1623 – Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics (Type C sample).
- .7 ASTM D2126 – Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- .8 ASTM D2369 – Standard Test Method for Volatile Content of Coatings.
- .9 ASTM D2842 – Standard Test Method for Water Absorption of Rigid Cellular Plastics.
- .10 ASTM D6226 – Standard Test Method for Open Cell Content of Rigid Cellular Plastics.
- .11 ASTM E96/E96M – Standard Test Methods for Water Vapor Transmission of Materials.
- .2 Canadian Construction Materials Centre (CCMC):
 - .1 Evaluation Report CCMC for each spray foam insulation product.
- .3 Provincial and Federal Building Codes as applicable.
- .4 Underwriters Laboratory of Canada (ULC):
 - .1 CAN/ULC S102-10: Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC S127-07: Standard Corner Wall Method of Test for Flammability Characteristics of Non-Melting Building Materials.
 - .3 CAN/ULC S705.1-01, including amendment 1 & 2: Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material - Specification, includes Amendments 1, 2.
 - .4 CAN/ULC S705.2-05: Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Application.
 - .5 CAN/ULC-S742: Standard for Air Barrier Assemblies - Specification.
 - .6 CAN/ULC S770-09: Standard Test Method for Determination of Long-term Thermal Resistance of Closed-Cell Thermal Insulating Foams.
 - .7 CAN/ULC S774-03: Standard Laboratory Guide for the Determination of Volatile Organic Compound Emissions from Polyurethane Foam.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordination under this Section shall be in accordance with General Conditions and Division 01.
 - .2 Coordinate with other work having a direct bearing on the Work of this Section.
 - .3 Coordinate installation of insulation with completion of other work requiring interface with insulation.

1.5 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 30 00.
- .2 Product Data:
 - .1 Submit manufacturer's technical product data for each type of product required, including product description, insulation properties, preparation requirements and overcoat properties. Include safety data sheets for reference on Site.
 - .2 Include product characteristics and limitations. Identify dissolving solvents, fuels and potential destructive compounds. Include WHMIS safety data sheets for reference on Site.
- .3 Certificates:
 - .1 Sprayed Polyurethane Foam (SPF) Installer Certificate: Submit name of SPF installer with copy of certification card verifying that the SPF installer is licensed by the source manufacturer.
 - .2 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements as evidenced by a current CCMC Evaluation Report.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer's:
 - .1 Manufacturer shall have a minimum of 15 years' experience having successfully manufactured and supplied products required for the Work of this Section for other projects of similar size and complexity.
 - .2 Installer's:
 - .1 Company specializing in installation of specified products in successful use on similar projects with minimum 10 years' experience, employing workers trained by manufacturer, including a full-time on-site supervisor with a minimum of three years' experience installing similar work.
 - .2 Installers must be certified by the Product manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and acceptance requirements:
 - .1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- .2 Storage and handling procedures:
 - .1 Handle and store materials in a clean, dry area in accordance with manufacturer's written instructions in a weather protected environment, clear of ground and moisture, within temperature ranges recommended by materials manufacturer.
 - .2 Store materials in manner to prevent damage to other materials, to any existing building or property, and to the Work.

.3 Store Products to avoid disruption in the progress of the Work.

.4 Store materials in original, undamaged containers or wrappings with manufacturer's seals and labels intact.

1.8 PROJECT CONDITIONS

.1 Ambient Conditions:

.1 Maintain ambient and substrate temperatures during application and curing of adhesive at temperature limits established by the manufacturer of adhesive

.2 Existing Conditions:

.1 Ensure substrate is ready to receive insulation system. Proceed with installation only when the substrate construction and preparation work is complete.

2 PRODUCTS

2.1 MANUFACTURERS

.1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

.1 Acceptable spray applied insulation manufacturers:

.1 BASF Canada Inc; www.basf.com

.2 Carboline; www.carboline.com

.3 Carlisle Spray Foam Insulation; www.carlislesfi.com

.4 Genyk Polyurethane; www.genyk.com

.5 Huntsman Building Solutions; www.huntsmanbuildingsolutions.com

.2 Acceptable cementitious fire protective coating manufacturers:

.1 GCP Applied Technologies Inc; <https://ca.gcpat.com/>

.3 Request for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.

.4 Substitution Limitations: Comparable Products from manufacturers not listed herein may be acceptable provided they meet requirements of this Specification.

.2 Single source responsibility: Obtain Products from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 Spray Polyurethane Insulation:
 - .1 Polyurethane Foam: to CAN/ULC S705.1, including amendment 1 and 2 closed cell, spray-applied rigid cellular polyurethane foam air barrier and thermal insulation, medium density.
 - .2 Performance Requirements:
 - .1 Water Vapour Permeance in accordance with ASTM E96: Maximum of 60 ng/Pa-s-sq m (1 Perm).
 - .2 Density in accordance with CAN/ULC S705.1: Minimum 28 kg/m³ (1.75 lb/cu ft).
 - .3 Long Term Thermal Resistance (LTTR) in accordance with CAN/ULC S770: Minimum RSI-0.98 (R-5.6/inch).
 - .4 Hot Surface Performance ASTM C411: Passed when exposed to 93 degrees C for 96 hours.
 - .5 Fungi Resistance ASTM C1338: No fungal growth after 28 day incubation.
 - .6 Air Leakage Classification CAN/ULC-S742: A1 (≤ 0.05 L/(s·m²) at a pressure difference of 75 Pa).
 - .3 Equipment:
 - .1 Comply with CAN/ULC S705.2 and the equipment manufacturer's recommendations for specific type of application.
- .2 Cementitious fire protective coating:
 - .1 MONOKOTE Z-3306 by GCP Applied Technologies Inc.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of this Section depends.
 - .2 Report in writing to the Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of this Section.
 - .3 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .4 Commencement of work implies acceptance of existing conditions and work by others.

3.2 PREPARATION

- .1 Mask and protect adjacent surfaces from overspray or dusting.
- .2 Apply primer in accordance with manufacturer's written instructions.

- .3 Prime all metal and non-porous surfaces when required by polyurethane foam manufacturer's written instructions.

3.3 INSTALLATION

- .1 Apply insulation to CAN/ULC-S705.2 and manufacturer's written instructions.
- .2 Apply insulation by spray method, to a uniform monolithic density without voids, in lifts not exceeding 50 mm (2 inch) thickness in a single pass.
- .3 Finished surface of foam to be free of voids and imbedded foreign objects.
- .4 Remove masking materials and overspray from adjacent areas immediately after foam surface has hardened.
- .5 Repair damaged areas in accordance with SPF manufacturer's application guidelines for insulation.
- .6 Surfaces to receive cementitious fire protection coating must be free of dirt, oil, grease or other substances which may impair adhesion to the foamed plastic. Adhesive may be required for high humidity environments and on horizontal surfaces.
- .7 Cementitious fire protective coating is to be applied only by applicators authorized by the manufacturer.
 - .1 Mix as per manufacturers written instructions to form a slurry.
 - .2 Spray apply slurry using a fireproofing/plaster pump.

3.4 FIELD QUALITY CONTROL

- .1 Non-Conforming Work:
 - .1 Defective materials or quality of work whenever found at any time prior to final acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error.
 - .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

3.5 CLEANING

- .1 Clean work area daily.
- .2 Remove all excess materials from site as Work proceeds and at completion.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy satisfactory to the Owner.
- .4 Clean and make good surfaces soiled or otherwise damaged as a result of Work of this Section at no additional cost to the Owner.
- .5 Leave surfaces clean and ready for subsequent Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section Includes: Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required to complete the work of this Section including but not limited to:
 - .1 Below-grade vapour retarder under slab on grade.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 03 10 00 Concrete Forming and Accessories
 - .2 Section 03 30 00 Cast in Place Concrete

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American Concrete Institute (ACI):
 - .1 ACI 302.1R: Guide for Concrete Floor and Slab Construction.
 - .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM D1709: Standard Test methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
 - .2 ASTM E96: Standard Test Methods for Water Vapor Transmission of Materials.
 - .3 ASTM E154: Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
 - .4 ASTM E1643: Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 - .5 ASTM E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordination under this Section shall be in accordance with General Conditions and Division 01.
 - .2 Coordinate with other work having a direct bearing on the Work of this Section.
- .2 Pre-installation Meetings:
 - .1 Conduct a pre-installation meeting in accordance with Section 01 10 00.
 - .2 The Independent Inspection and Testing Company shall attend the pre-installation meeting.

1.5 SUBMITTALS

- .1 Submit required submittals as specified in Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this Section.
- .3 Samples:
 - .1 Submit samples of Products for the work of this Section for review by Consultant in accordance with Section 01 33 00.
- .4 Vapour barrier test results and certification:
 - .1 Provide certification prepared by accredited testing company for test procedures listed in Table 1 and paragraphs 7.1.2, 7.1.3, 7.1.4, and 7.1.5 of ASTM E1745, providing for each test, the date of the most recent test, and the test results.
 - .1 Accompany certification letter specified above with letter signed by Product manufacturer attesting that material to be Provided is of the same formulation and manufacture as the Product tested.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer's:
 - .1 Manufacturer shall have a minimum of 5 years' experience having successfully supplied products required for the Work of this Section for other projects of similar size and complexity.
 - .2 Installer's:
 - .1 Provide work of this Section, executed by competent installers having a minimum of 5 years' continuous Canadian experience successfully completing projects similar in size and complexity as the Work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials to site in manufacturer's original unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- .2 Store materials in clean, dry area in accordance with manufacturer's instructions.
- .3 Stack membrane on smooth ground or wood platform to eliminate warping.
- .4 Protect materials during handling and application to prevent damage or contamination.
- .5 Ensure membrane is stamped manufacturer's name, product name, and membrane thickness at intervals of no more than 85" (220cm).

1.8 ENVIROMENTALL REQUIREMENTS

- .1 Product not intended for uses subject to abuse or permanent exposure to the elements.
- .2 Do not apply on frozen ground.

2 Products

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Stego Industries
 - .2 W.R. Meadows
 - .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .2 Substitution Limitations:
 - .1 Comparable Products from manufacturers not listed herein may be accepted provided they meet requirements of this Specification.
- .3 Single source responsibility: Obtain all Work of this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.2 MATERIALS

- .1 Vapour Retarder:
 - .1 Vapour retarder membrane shall meet or exceed requirements of ASTM E1745 Classes A, B and C.
 - .2 Maximum Water Vapour Transmission Rate: ASTM E96, 0.014 Grains/ft²/hr.
 - .3 Maximum Permeance: ASTM E96, 0.034 Perms.
 - .4 Resistance to Organisms and Substrates in Contact with Soil: ASTM E154, Section 13, 0.051 Perms.
 - .5 Tensile Strength: ASTM E154, Section 9, 9 N/mm (52 lbf/Inch).
 - .6 Puncture Resistance: ASTM D1709, Method B, 3770 grams.
 - .7 Water Vapour: ASTM E1745, meets or exceeds Class A.
 - .8 Thickness of Plastic: ACI 302.1R-96, not less than 10 mils.
 - .9 Acceptable Products:
 - .1 'PERMINATOR', 10 mil by W.R. Meadows.
 - .2 'Stego-Wrap', 10 mil, by Stego Industries.

2.3 ACCESSORIES:

- .1 Seam Tape: High density polyethylene tape, pressure sensitive, minimum 4 in. wide.
 - .1 Acceptable products: W.R. Meadows 'SEALTIGHT PERMINATOR Tape' or equivalent by Stego.

- .2 Pipe boots: Construct pipe boots from vapour retarder material and pressure sensitive tape per manufacturer's instructions.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of this Section depends.
 - .2 Report in writing to the Consultant any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of this Section.
 - .3 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .4 Commencement of work implies acceptance of existing conditions and work by others.

3.2 PREPARATION

- .1 Prepare surfaces in accordance with manufacturer's instructions.
- .2 Material beneath the slab base shall be level, tamp, or rolled earth or granular material.

3.3 INSTALLATION

- .1 Use sheets of largest practical size to minimize joints.
- .2 Inspect sheets for continuity. Repair punctures and tears with sealing tape before work is concealed.
- .3 Overlaps joints 6 in. minimum and tape seal.
- .4 Installation shall be in accordance with manufacturer's instructions and ASTM E1643.
- .5 Unroll vapour barrier with longest dimension parallel with direction of pour.
- .6 Lap vapour barrier over footings and to foundation walls a minimum of 6 in. and tape seal.
- .7 Centre tape over laps and joints. Keep area of tape adhesion free of dust, dirt and moisture.
- .8 No penetration of the vapour barrier is allowed except for reinforcing steel and permanent utilities.
- .9 Seal penetrations (including pipes) with manufacturer's pipe boot.
- .10 Repair damaged areas by cutting patches of vapour barrier, overlapping damaged area 6" and taping all four (4) sides with tape.

3.4 SITE QUALITY CONTROL

- .1 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.

3.5 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.
- .2 Remove all excess materials from site as Work proceeds and at completion.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy satisfactory to the Owner.
- .4 Clean and make good surfaces soiled or otherwise damaged as a result of Work of this Section at no additional cost to the Owner.
- .5 Leave surfaces clean and ready for subsequent Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section includes: Provide air barrier system including but not limited to:
 - .1 Adhesives/Primers
 - .2 Sheet Applied Self-Adhesive Air/Vapour Barrier Membrane
 - .3 Transition Membranes
 - .4 Sealant
 - .5 Thru-wall flashing
 - .6 Insulation Adhesive

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Conduct a pre-installation meeting in accordance with Section 01 11 00.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.4 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Compatibility statement:
 - .1 Submit manufacturer's compatibility statement validating compatibility of air barrier system materials with substrates and adjacent materials.
- .4 Samples:
 - .1 Submit 305 mm (12") square samples of each type of air barrier membrane.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers: Provide the work of this section, executed by competent installers with minimum 5 years experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Package materials and identify on attached labels the manufacturer, contents and material specification number.
- .2 Store flammable solvent-base liquids away from excessive heat and open flame. Primer contains solvent. Do not use near open flame.
- .3 Store surface conditioner at temperature above 5°C to facilitate handling.
- .4 Store roll materials on end.

1.7 FIELD CONDITIONS

- .1 Provide forced air circulation during curing period for enclosed applications.
- .2 Low temperature application:
 - .1 Perform adhesion test for membrane when ambient temperature is below -5°C.
 - .2 Proceed with work when temperature is (or predicted) to fall below -5°C ambient temperature only with the mutual documented agreement of inspection and testing company, manufacturer and applicator.
- .3 Do not perform installation during rainy or inclement weather or on wet or frost covered surfaces.
- .4 Provide temporary protection of the applied membrane to prevent mechanical damage or damage from spillage of oil or solvents.

1.8 EXTENDED WARRANTY

- .1 Warrant work of this section in accordance with Section 00 73 00 for a period of 2 years.
- .2 The work of this section shall meet the specified building envelope performance requirements during the warranty period.

2 PRODUCTS

2.1 PERFORMANCE/DESIGN REQUIREMENTS

- .1 Air barrier system shall perform as continuous air barrier and as liquid-water drainage plane flashed to discharge to exterior of building envelope incidental condensation or water penetration.
- .2 At wall and roof cladding transitions, air barrier system shall perform as continuous air barrier and as liquid-water drainage plane flashed to discharge to exterior of building envelope incidental condensation or water penetration by creation of unobstructed drainage plane that extends across the cladding transition or by flashing to discharge to exterior of building envelope incidental condensation or water penetration.
- .3 Air barrier system shall accommodate substrate movement, construction material changes, and transitions at perimeter conditions without deterioration which permits air and water leakage exceeding the following specified limits and requirements, or interruption of the drainage plane:
 - .1 Air permeance of air barrier material: Maximum 0.02 L/s.m² at 75 Pa (0.004 cfm/ft² at 1.57 psf) to ASTM E2178-13.

- .2 Rate of air leakage of air barrier system: Maximum 0.15 L/s.m² at 75 Pa (0.030 cfm/ft² at 1.57 psf) to ASTM E283-04(2012).
- .3 Water vapour transmission for air / vapour barriers: Maximum 5.7 ng/Pa.m².s. (0.1 perms).
- .4 Water vapour transmission for vapour permeable air vapour barriers: Minimum 1,021 ng/Pa.m².s.
- .5 Air barrier system structural performance while maintaining air barrier performance for air leakage: Air barrier system shall transfer wind loads to structure and shall resist design wind load in accordance with the building code.
- .6 Low temperature performance: Minimum -30°C (-22°F).
- .7 Compatibility: Air barrier system materials shall be compatible with substrate and adjacent materials with material manufacturers and show no performance deterioration during service conditions.
- .8 Self-sealability: ASTM D1970/D1970M-15A.
- .9 Adhesion: ASTM D4541-09E1, 110 kPa (16 psi) minimum performance for site tested adhesion.
- .4 Air barrier system shall be joined in an airtight and flexible manner to air barrier material of adjacent building envelope air barrier systems, allowing for relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between the following unless otherwise applicable:
 - .1 Walls and openings (windows, doors and other wall penetrations).
 - .2 Wall and roof systems.

2.2 MATERIALS

- .1 Materials shall be sourced from one manufacturer including sheet membranes, air barrier sealants, primers, mastics and adhesives.
- .2 Sheet-Applied, Vapour Impermeable Self-Adhesive Air / Vapour Barrier Membrane System:
 - .1 Description: Composite preformed modified bituminous membrane system consisting of SBS modified asphalt for low temperature flexibility and polyethylene scrim reinforcing, with physical properties as follows:
 - (1) Thickness: 1.0 mm (40 mils).
 - (2) Application temperature: in accordance with product installation instructions.
 - (3) Primer: in accordance with product installation instructions.
 - (4) Termination and penetration sealing mastic: in accordance with product installation instructions.
 - .2 Acceptable product systems:
 - (1) Henry Company 'Blueskin SA' and 'Blueskin SA LT'.
 - (2) Carlisle Coatings & Waterproofing 'CCW 705'.
 - (3) Grace Construction Products 'Perm-A-Barrier Wall Membrane'.
 - (4) IKO 'AquaBarrier AVB' and AquaBarrier AVB Low Temp'.
 - (5) Soprema 'Sopraseal Stick 1100 Summer Grade' and Sopraseal Stick 1100 Winter Grade'.
 - (6) Tremco 'ExoAir 110 and 110LT'.

(7) W.R. Meadows 'Air Shield' and 'Low Temperature Air Shield'.

.3 Auxiliary Materials

.1 Transition Membranes:

(1) Liquid applied flashings:

- (a) Moisture-curing one component elastomeric liquid applied flashing membrane using a highly advanced STPe (Silyl-Terminated Polyether) polymer, having the following properties:
- (i) Basis of design: Air-Bloc LF
 - (ii) Color: Blue
 - (iii) Air leakage (ASTM E2178): <0.004 L/s/m² @ 75Pa
 - (iv) Water Vapor Permeance (ASTM E96, Method B): 21.8 perms @25 mils
 - (v) Air Leakage of Air Barrier Assemblies (ASTM E2357): Pass
 - (vi) Water Resistance (AC212/ASTM D2247): Pass
 - (vii) Nail Sealability (AMMA 711): Pass
 - (viii) Surface Burning Characteristics (ASTM E84):
 - a Class A
 - b Flame Spread/Smoke Development (ASTM E84): 20/5
 - (ix) Tensile Strength (ASTM D412-modified): 132 psi
 - (x) Elongation (D412): 264%

(2) Self-Adhering flashings:

- (a) Non-vapor permeable, self-adhered water resistive air and vapor barrier membrane consisting of an SBS rubberized asphalt compound, which is integrally laminated to a blue engineered thermoplastic film, having the following properties:
- (i) Basis of design: Blueskin SA
 - (ii) Color: Blue
 - (iii) Water Vapor Permeance (ASTM E96, Method A): .86 perms
 - (iv) Air Leakage of Air Barrier Assemblies (ASTM E2357): Pass
 - (v) Air leakage (ASTM E2178): <0.0005 L/s/m² @ 75Pa
 - (vi) Water Tightness (CAN/CGSB-37.58-M86): Pass.
 - (vii) Nail Sealability (ASTM D1970): Pass.
 - (viii) Tensile Strength:
 - a Membrane (ASTM D412-modified): 500 psi minimum
 - b Film (ASTM D828): 5000 psi minimum
 - (ix) Elongation (ASTM D412-modified): 200% minimum

(3) Self-Adhering Sheathing Joint Membrane:

- (a) Vapor permeable, self-adhered water resistive air barrier membrane consisting of an engineered film and patented, permeable adhesive technology with split-back poly-release film, having the following properties:
- (i) Basis of design: Blueskin VP160
 - (ii) Color: Blue
 - (iii) Air leakage (ASTM E2178): <0.02 L/s/m² @ 75Pa
 - (iv) Water Vapor Permeance (ASTM E96, Method A): 29 perms
 - (v) Air Leakage of Air Barrier Assemblies (ASTM E2357): Pass
 - (vi) Resistance to Water Penetration (ICC-ES AC 38): Pass.
 - (vii) Nail Sealability (ASTM D1970): Pass
 - (viii) Surface Burning Characteristics (ASTM E84):
 - (ix) Class A
 - (x) Flame Spread/Smoke Development (ASTM E84): 0/105
 - (xi) Tensile Strength (ASTM D828): 182N MD/129N CD

- (xii) Cycling and Elongation (ICC-ES AC48): Pass
- (4) Contact manufacturer for a complete list of authorized transition membranes.

.2 Adhesives and Primers:

- (1) Spray adhesive, and having the following properties:
 - (a) Basis of Design Product: Blueskin Spray Prep
 - (b) Color: Clear amber
 - (c) Solids Content (By Weight): 35%
 - (d) Aerosol
- (2) Synthetic rubber based adhesive type, quick setting, having the following physical properties:
 - (a) Basis of Design Product: Blueskin Adhesive
 - (b) Color: Blue.
 - (c) Solids Content (By Weight): 35%.
 - (d) Solvent based
- (3) Polymer emulsion based adhesive type, quick setting, low VOC content, having the following physical properties:
 - (a) Basis of Design Product: Blueskin LVC Adhesive
 - (b) Color: Aqua.
 - (c) Solids Content (By Weight): 53%.
 - (d) Water based: no solvent odors.
- (4) Polymer emulsion based primer for self-adhered membranes, and having the following properties:
 - (a) Basis of Design Product: Aquatac Primer
 - (b) Color: Aqua.
 - (c) Solids Content (By Weight): 58%. (approx.)
 - (d) Water based: Maximum VOC: 50 g/l

.3 Sealants:

- (1) Building Envelope Sealant:
 - (a) Moisture cure, medium modulus polymer modified sealing compound, having the following physical properties:
 - (i) Basis of Design Product: HE925 BES Sealant
 - (ii) Complies with Fed. Spec. TT-S-00230C, Type II, Class A.
 - (iii) Complies with ASTM C920, Type S, Grade NS, Class 35.
 - (iv) Elongation: 450 – 550%.
 - (v) Remains flexible with aging.
 - (b) Sheathing Joint Sealants:
 - (i) As recommended by manufacturer
 - (c) Contact manufacturer for a complete list of authorized sealants.

.4 Self-Adhesive Thru-Wall Flashing Membrane:

- (1) Non-vapor permeable, self-adhered water resistive air and vapor barrier membrane consisting of an SBS rubberized asphalt compound, which is integrally laminated to a blue engineered thermoplastic film, having the following properties:
 - (a) Basis of Design Product: Blueskin TWF
 - (b) Color: Yellow
 - (c) High Temperature Stability - Flow Resistance (ASTM D5147): Pass
 - (d) Air leakage (ASTM E283): 0.005 L/s.m² @ 75 Pa
 - (e) Water vapor permeance (ASTM E96, Method B): 0.03 perms
 - (f) Low temperature flexibility (CGSB 37-GP-56M): Pass

3 EXECUTION

3.1 EXAMINATION

- .1 Before commencing work of this section, ensure that surfaces are acceptable to receive and maintain concrete finishing, and that specified installation will be achieved.
- .2 Report in writing to the Consultant any defects of surfaces or work prepared by others which affect the quality or dimensions of the work of this Section.
- .3 Commencement of Work implies complete acceptance of existing conditions and previous work performed by others.

3.2 INSTALLATION – GENERAL

- .1 Surfaces to receive air barrier systems shall be smooth, dry and free from conditions that will adversely affect execution, permanence, or quality of the work of this section.
- .2 Air barrier system shall be continuous in the building envelope. Lap and seal air barrier systems in accordance with product manufacturer's installation instructions to construction, control, and expansion joints, across junctions between different building assemblies, and around penetrations through the building assembly.
- .3 Wrap into jamb, head and sill of building envelope window openings, door openings, and other openings with air barrier system membrane by returning membrane to inside face of opening unless otherwise indicated.
 - .1 Coordinate air / vapour barrier terminations of work of this section with air / vapour barrier membrane in Section 08 44 00.

3.3 FIELD QUALITY CONTROL

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Independent inspection and testing company shall perform inspection of completed work.
 - .2 Perform pull adhesion tests for project substrates in accordance with ASTM D4541-09E1.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.
- .3 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.

3.4 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.
- .2 Remove all excess materials from site as Work proceeds and at completion. Remove all excess cuttings, ends, tapes, etc.

- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy satisfactory to the Owner.
- .4 Leave surfaces clean and ready for use.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 SUMMARY

- .1 Section Includes: Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.
 1. Prefinished metal cladding, including, but not limited to:
 - (1) All metal wall cladding including flashings, liner, Z girts, insulation, closure strips and sealant as detailed.
- .2 Related Sections
 1. Section 04 20 00 – Unit Masonry.
 2. Section 05 10 00 – Structural Metal Framing.
 3. Section 06 10 00 – Rough Carpentry
 4. Section 08 44 00 – Curtain Wall and Glazed Assemblies.

1.3 DESIGN REQUIREMENTS

- .1 Design insulated wall panels to support maximum wind load of 98 kg/sq.m. at a deflection not exceeding L/180.
- .2 Submit test data to the Consultant verifying the above structural and thermal characteristics of the panel, if requested.

1.4 REFERENCES

- .1 ASTM A653/A653M-04a: Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM C79/C79M-01: Standard Specification for Treated Core and Nontreated Core Gypsum Sheathing Board.
- .3 ASTM C1177/C1177M-01: Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .4 ASTM C1278/C1278M-01: Standard Specification for Fiber-Reinforced Gypsum Panel.
- .5 ASTM C1280-99: Standard Specification for Application of Gypsum Sheathing.
- .6 CAN/CSA-G40.21-04: Structural Quality Steels.
- .7 CAN/CSA-S136-01: North American Specification for the Design of Cold-Formed Steel Structural Members.

- .8 CAN/ULC-S702-97: Standard for Thermal Insulation, Mineral Fibre for Buildings.
- .9 CAN/ULC-S702.2-03: Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.

1.5 SUBMITTALS

- .1 Submit Shop Drawings as specified in Section 01 33 00.
- .2 Product Data:
 - 1. Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
- .3 Shop Drawings: Indicate dimensions, profiles, attachment methods, schedule of elevations, trim and closure pieces, soffits, fascia and related work.
 - 1. Shop drawing review is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the reviewer approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or his responsibility for meeting all requirements of the Contract documents. The Contractor is responsible for dimensions to be confirmed & correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction & installation & for co-ordination of the work of all trades.
 - 2. Do not commence work until reviewed drawings have been returned.

1.6 SAMPLES

- .1 Submit samples as specified in Section 01 33 00.
- .2 Samples: duplicate samples of prefinished material for colour selection.

1.7 QUALITY ASSURANCE

- .1 Fabricator and Erector: company specializing in the work of this Section with five years documented experience, and a recognized member of the Canadian Sheet Steel Building Institute (CSSBI).

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver and store Products in a manner intended to avoid staining and mechanical damage.
- .3 Stack bundles on wood blocking, tilted to one side to ensure that no water is allowed to lie.
- .4 Open bundles on the underside to allow drainage from leaks or condensation.
- .5 Deliver Products when erection can commence.

1.9 WARRANTY

- .1 Submit an extended warranty in accordance with the General Conditions of the Contract.
- .2 Extended Warranty: for a period of two years from substantial completion - material and labour, covering damage to building and contents resulting from failure to resist penetration of water.

2 PRODUCTS

2.1 GENERAL

- .1 Provide new materials in perfect condition, free from defects impairing physical appearance or performance.

2.2 MANUFACTURERS

- .1 Manufacturers of metal roof and wall panels having Products considered acceptable for use:
 1. Agway Metals Inc.
 2. Flynn Canada Limited.
 3. VicWest Steel Inc.
- .2 Substitutions: Refer to Section 01 25 00.

2.3 METAL SIDING

- .1 Exterior Sheet
 1. Prepainted steel 0.65 mm, conforming to ASTM Specification A446, Grade "A" with G90 galvanized coating and Metallic Series paint, QC2624 Bright Silver.
 2. Cladding formed in 13 mm deep x 745 mm wide panel sections with corrugated ribs at 63 mm O.C. installed horizontally as manufactured by Vicwest or similar profiles by approved manufacturers. Colour shall be Metallic Series QC-2624 – Bright Silver.
 3. Soffit: Prefinished, galvanized steel 0.76 mm (0.030 in.) base thickness.
 - (1) Profile: AD300-R as manufactured by Vicwest (Profile # 01521), perforated with 1/8 in. diameter holes where venting indicated on Drawings. Finish and colour to be selected by Consultant from manufacturer's standard colour palette.
- .2 Liner Sheet
 1. Pre-painted steel interior liner 0.65 mm, with G90 galvanized coating and Stelco or Dofasco Series 5000 paint.
- .3 Channel and Z-Bar Sub-grits
 1. Shapes to suit spans required and sizes to suit insulation thickness and as shown on the drawings. Material thickness shall be 1.22 mm.
- .4 Fasteners
 1. Pre-painted type to suit material and applications.
- .5 Sealant
 1. Multi-component dymeric manufactured by Tremco Ltd. Colour to match cladding material where exposed.
- .6 Flashing and Closures
 1. Flashings to be manufactured from same material and gauge as exterior sheet.

.7 Unifoam Closure

1. Closed cell neoprene and approved adhesive.

.8 Metal Closures

1. Notched metal closures to be manufactured from same material and gauge as exterior sheet.

2.4 ACCESSORIES

- .1 Trim and Flashings: 0.65 mm thick, prefinished, hot dipped galvanized sheet steel; to ASTM A653/A653M, Grade 230; colour to match cladding.
- .2 Joint Sealant: as specified in Section 07 92 00.
- .3 Thermal Breaks: butyl tape or neoprene on steel girt at installation of liner panel.
- .4 Closure Strips: preformed rubber on neoprene. Closures where materials are in continuous contact will be butyl pressure sensitive tape.
- .5 Insulation: refer to Section 07 21 00 – Thermal Insulation.

2.5 AIR BARRIER MEMBRANES AND TRANSITIONS

- .1 Air Barrier Membrane: Liquid air/vapour barrier (thick system type): Air-Bloc 06 as manufactured by Bakor, a one component elastomeric bitumen, trowel or spray applied to a wet film thickness of 3mm and having the following characteristics:
 1. Air leakage 0.002 L/s m² @ 75Pa., 0.005 L/s m² @500Pa., 0.017 L/s m² @ 3000Pa and resists suction pressure of 3000Pa maintained for 5 seconds with no increase in air leakage rate when tested at 75Pa.
 2. Water Vapour Permeance: 2.8ng/Pa.m² .s. (0.05 perms)
 3. Elongation: 1200% to ASTM D 412
 4. Recovery: 75% to CAN/CGSB-37.58-M.
- .2 Transition membrane (self-adhering): Blueskin SA as manufactured by Bakor, an SBS modified bitumen, self-adhering sheet membrane complete with a cross-laminated polyethylene film. For application temperatures down to minus12 deg C use Blueskin SA LT. Membrane shall have the following physical properties:
 1. Thickness 1.0 mm (40 mils)
 2. Air leakage: <0.005 L/s m² @75 Pa to ASTM E283-91
 3. Water vapour permeance: 2.8ng/Pa.m².s (0.05perms) to ASTM E96
 4. Low temperature flexibility: -30°C to CGSB 37-GP-56M
 5. Elongation: 200% to ASTM D412-modified

3 EXECUTION

3.1 EXAMINATION

- .1 Report to the Consultant, in writing, all defects of surfaces or work prepared by other Sections and on unsatisfactory site conditions.

- .2 Thoroughly examine the surface scheduled to receive work of this Section to ensure that they are secure, rigid, true and not liable to impair performance or appearance.
- .3 Verify structural steel girt spacing and alignment. Provide a finished job true to plan and perfectly aligned in all respects.
- .4 Prior to fabrication, verify field measurements necessary to ensure perfect fit.
- .5 Commencement of work implies acceptance of existing conditions.

3.2 PREPARATION

- .1 Protect adjacent portions of the Work from damage.
- .2 This Contractor to complete a thermal scan of the roof membrane before and after installation of the siding panels to ensure integrity of the roof membrane is maintained.
- .3 Make Good damage to adjacent portions of the Work.

3.3 APPLICATION

- .1 Metal Siding
 - 1. Erect all materials plumb and true in accordance with the manufacturer's recommendations.
 - 2. Apply a continuous bead of sealant to the face of structural supports and at all liner joints to provide a weathertight seal.
 - 3. Fasten liner panels to the structural support framing in accordance with the manufacturer's recommendations for fastener size and spacing.
 - 4. Install insulation on to the face of the liner and the sub-girts fasten to the legs of the liner with self tapping screws.
 - 5. Align exterior panels and fasten to the sub-girts.
 - 6. Install all flashings and secure according to the manufacturer's recommendations.
 - 7. Install all sealants and closures to ensure a weathertight installation.

3.4 FLASHING INSTALLATION

- .1 Use concealed fasteners where appropriate. Exposed fasteners to be of same colour as roof sheet.
- .2 Lock end joints and seal weathertight.

3.5 FIELD QUALITY CONTROL

- .1 Defective materials or quality of work whenever found at any item prior to final acceptance of the work shall be rejected regardless of previous acceptance.
- .2 Inspection does not relieve responsibility but is a precaution against oversight and error.
- .3 Remove and replace defective work, including adjacent portions of the Work affected by this replacement.
- .4 Waviness, warp, distortion or oil canning of the finished panels will be considered defective work.

3.6 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.
- .2 Remove all excess materials from site as Work proceeds and at completion.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy satisfactory to the Owner.
- .4 Leave surfaces clean and ready for subsequent Work.

3.7 ADJUSTING

- .1 Upon completion, clean marks from panel surfaces.
- .2 Touch up minor abrasions with matching paint.

END OF SECTION

1 GENERAL

1.1 SCOPE OF WORK

- .1 Supply all labour and materials necessary for the roof replacement specified in the Scope of Work as per the drawings and specifications

1.2 JOB CONDITIONS

- .1 Ensure the substrate is solid, clean, dry and free of any contaminants prior to commencing any roofing work.
- .2 Follow the manufacturers recommendations with respect to minimum and maximum temperatures and humidity during the application.
- .3 Do not apply any roofing materials during inclement weather.
- .4 All roofing materials must be dry when installed. Materials that have become damaged due to moisture will be rejected.
- .5 Protect the existing and new roofing from damage with a minimum 18mm plywood runway.
- .6 Ensure that the Owner's property is protected from damage at all times. Cover walls with clean tarps and protect windows with plywood sheeting. The ground under kettles and garbage bins shall also be protected from damage.
- .7 Access to the roof shall be by a contractor supplied engineered staircase complete with security fencing at the ground level.
- .8 The ground staging area shall be enclosed with Insta-Fence security fencing.
- .9 Open flame roof torches are not permitted on the subject project.
- .10 See structural drawings and specifications for structural services associated with roofing project

1.3 DELIVERY AND STORAGE:

- .1 Store materials in designated areas elevated off the ground and protected from weather and construction activities.
- .2 Materials stored on the roof shall be located so as not to overload the structure and shall be secured to prevent movement due to wind.
- .3 Do not use broken or damaged materials. Broken or damaged materials shall be removed from the site and replaced with new materials.

1.4 ROOFING INSPECTOR:

- .1 The Owner has appointed an independent Roofing Consultant / Inspector to inspect the roofing materials and installation for conformance with the Contract requirements:

Joel Dandele, Dantech Building Technologies,
145 Renfrew Drive, Suite 120, Markham, ON L3R 9R6, telephone: (905) 415-8880, email:
joel@dantechbuildingtech.com

- .2 Inspections, reviews and/or approvals given by the Consultant / Inspector or a failure to inspect shall not relieve the Roofing Contractor of contractual obligations.

- .3 Defective or improper work or materials must be removed, replaced and/or rectified to the satisfaction of the Consultant / Inspector.

1.5 ROOFING CONTRACTOR QUALIFICATIONS:

- .1 Provide documentation, if requested, demonstrating a minimum of 10 years experience, under the current business name, in the specified roofing system.
- .2 Provide a list of five projects of similar nature to this specification that are available for inspection and are within 100 kilometres of the Owner's office.
- .3 Provide evidence to the Owner of acceptability of accreditation by the specified major roofing system manufacturer.
- .4 Produce evidence of membership in good standing with the Ontario Roofing Contractors' Association.
- .5 Contactor shall have in force Commercial General Liability insurance of ten (10) million dollars as all times.
- .6 Contractor shall not have filed for or been part of a bankruptcy during the last ten (10) years.
- .7 Contactor shall be capable of completing all work as specified with its own forces. No sub-contacting of any roofing or sheet metal work shall be permitted.

1.6 WARRANTY:

- .1 Upon successful completion of the Work and after all post installation procedures have been completed, furnish to the Owner:
 - .1 Two (2) year OIRCA Standard Form of Warranty with all associated fees paid by the contractor; and
 - .2 Principal Manufacturer's Ten (10) Year Material, Labour and Workmanship Warranty. The warranty shall be a No Dollar Limit and be a term type, without deductibles or limitation on coverage amount, and shall be issued at no additional cost to the Owner. The warranty shall not exclude random areas of ponding from the coverage. All fees associated with the warranty shall be paid by the contractor.
 - .3 Contractor shall carry all costs associated with undertaking thermographic roof scan by the Project Consultant, complete with report documents, at the twenty-two (22) months after substantial completion of the project and prior to the expiration of the Contactor's 2-Year OIRCA warranty.

1.7 MATERIALS

- .1 Deck Overlay:
 - .1 12.7 mm (0.50 inch) Gypsum-Fibre roof board:
 - .2 Securock Gypsum-Fibre roof board by USG Corporation; or DensDeck Prime by Georgia Pacific.
 - .3 Securement: Mechanical fasteners and plates as recommended by board manufacturer.
- .2 Air Barrier:
 - .1 BLUESKIN SA LT, Self-Adhesive Thru-Wall Flashing Membrane as manufactured by Bakor Inc or approved equal.

- .2 Mastic: Air-Bloc 21 or 230-21 adhesive, a synthetic, trowel applied, rubber-based adhesive as manufactured by Bakor Inc. or approved equal.
- .3 Sealant: A polymer modified sealing compound, POLYBITUME! 570-05 as manufactured by Bakor Inc. or approved equal.
- .3 Vapour Retarder:
 - .1 1-Ply Self Adhered
 - (1) Plies: Polyethylene-reinforced, self-adhering SBS modified asphalt vapour barrier as manufactured by IKO Industries Ltd.; Johns Manville; or Soprema Inc.; or approved equal.
 - (a) Primer: As recommended by the membrane manufacturer.
- .4 Thermal Insulation / Overlayment:
 - .1 ASTM C 1289, Type II, Class 2 Grade 3 Polyisocyanurate roof insulation, manufactured with HC blowing agent bonded to glass fibre reinforced facers on top and bottom surfaces. Meeting the requirements of CAN/ULC-S704 Class 2, Type III, evaluated and listed by the current CCMC approval guide and approved and listed by FM Global for Class 1-60/75/90 windstorm classification and meeting FM4450 approval requirements for Class 1A Fire as a component in the roof deck construction.
 - (1) Board Dimensions:
 - (a) 1200 x 2400 mm (4 feet x 8 feet)
 - (b) Base insulation shall be installed in two (2) Layers of 62.50mm (2.5 inch).
 - .2 Engineered Tapered Insulation and Engineered Drain Sumps:
 - (1) Engineered Polyisocyanurate roof insulation panels designed to create a positive 1% slope to promote positive roof drainage. Panels as engineered and manufactured by Posi-Slope Enterprises or Accu-Plane Enterprises or approved equal.
 - (2) Engineered Polyisocyanurate drain sumps 25mm to 0mm. Sump area shall as designated on the drainage plan and as engineered and manufactured by Posi-Slope Enterprises or Accu-Plane Enterprises or approved equal.
 - .3 Overlayment:
 - (1) ASTM C208-72 (1982), asphalt coated – 6-sides, high-density Fibreboard.
 - (a) Board Dimensions: 1200 mm x 1200 mm (4' x 4').
 - (b) Overall Thickness: 12.5 mm (0.50 inch).
 - .4 Insulation / Overlay Attachment (all layers):
 - (1) Low odour asphalt as manufactured by Bitumar or Johns Manville or approved equal.
- .5 Membrane:
 - .1 HOT Applied 1+4 BUR
 - (1) Base Ply: No. 15 asphalt felt meeting CSA 123.3M.
 - (2) Top Plies: Type IV meeting ASTM D 2178, and CAN/CSA A-123.17.
 - (3) Adhesive and Flood Coat: Low odour asphalt as manufactured by Bitumar or Johns Manville or approved equal.
 - (4) Surfacing: Hard, durable, opaque; washed free of clay, loam, sand or other foreign substances. Nominal 9 mm (3/8") pea gravel conforming to ASTM D 1863 size 7a.
- .6 Metal Flashings:

- .1 Galvanized, pre-painted: Twenty-four (24) gage minimum, galvanized steel; commercial quality. All sheet metal to be pre-painted. Finish at underside shall be a wash coat over a coat of corrosion-resistant epoxy-based primer; Series 5000
- .2 Roof Drain Insert complete with U-Flow and Vandal-proof dome: Copper or spun aluminium as manufactured by Thaler Metal Industries Ltd.; or Platinum Plus by Platinum Technologies Ltd.; or approved equal.
- .3 Termination Bar: Flat stainless steel bar, minimum 3 mm x 25 mm (1/8 inch x 1 inch).
- .4 Aluminum Vent Stacks – Vandal-Proof complete with insulating sleeve: Once piece spun aluminum. Minimum of 300mm (12 inches) above finished surface of roofing. Size as dictated by site conditions; as manufactured by Thaler Metal Industries Ltd.; or Platinum Plus by Platinum Technologies Ltd.; or approved equal
- .7 Accessories
 - .1 Sealant: Single component polyurethane caulking to CAN/CGSB 19.13M87, moisture cure polyurethane. Colour to match metal counter flashings.
 - .2 Pourable Sealer: One-part polyether sealant; as manufactured by Johns Manville; or Soprema Inc.; or approved equal.
 - .3 Roofing Mastic: One-part roof elastomer; POLYroof LV as manufactured by Tremco Canada; or approved equal.
 - .4 Gas Line Blocks: As designed and manufactured by Platinum Technologies Inc. or Unistrut Canada; or approved equal.
 - .5 Concrete Paving Stones: 600 x 600 x 37.50mm (24 x 24 x 1.50 inch) concrete paver as manufactured by Brooklin Concrete Products Limited or approved equal.
 - .6 Gas Line Paint: Rust Inhibitive paint: Iron Oxide Tremcote by Tremco Canada or approved equal.
 - .7 Roof Stair and Transition Ladders:
 - (1) Shop drawings for ballasted stair bridge are required.
 - (2) Approved supplied: Skyline Group, or approved equivalent
- .8 Fall protection series double dome skylights and additional fall screen to be installed over the skylight. Interior Lense to be white in colour. Recommended manufacturers and models for the acrylic domes are:
 - .1 Artistic Skylight Domes Ltd.: Model PVCCM – Fixed
 - .2 Velux Canada Inc.: Model FCM – Fixed
 - .3 Slimlite Skylights: Model FBDD-OF-D – Fixed
 - .4 Other equivalent products can be specified when required, after reviewed and approved by the Owner or Project Consultant. Glazing contractor must be a DCDSB approved vendor.
- .9 Approved vendors and models for the skylight fall protection screen are:
 - .1 Artistic Skylight Domes Ltd.: FPS-FS-VE
 - .2 Velux Canada Inc.: STS-540505450
 - .3 W.S. Safety Technologies

- .4 Other equivalent products can be specified when required, after reviewed and approved by the Owner. Screen installer must be a DCDSB approved vendor.
- .5 All skylight domes and fall protection screens shall carry a five (5) year manufacturer's warranty.

1.8 EXECUTION

- .1 Remove areas of rotted and deteriorated wooden blocking and cants and fascia. Replace to match existing.
- .2 Install 18-gauge galvanized metal upstands at exterior edges of the new roof deck as detailed.
- .3 Re-fasten loose decking with screw fasteners where permitted to remain as part of the finished work and to the satisfaction of the Project Consultant.
- .4 Add additional wood blocking to curbs as required to compensate for the thickness of the new roof system. Provide a minimum curb height of not less than 200 mm (8.0 inches) above the finished roof surface.
- .5 Fabricate sleepers, expansion joints as detailed. Maintain a minimum height of 305mm (12") above the finished roof surface for sleepers and curbs.
- .6 Deck Overlay:
 - .1 Firmly butt each insulation board to surrounding boards. Do not jam or deform boards.
 - .2 Minimize elevation variation between boards at joints to provide a level surface to accommodate subsequent roofing.
 - .3 Stagger both side and end joints at least 150 mm (6 inches).
 - .4 Leave no voids at blocking, penetrations, walls, or parapets.
 - .5 Support continuous joints on deck planks.
 - .6 Secure to sub-deck with mechanical fasteners and plates as specified.
 - .7 Tape all joints of the overlay board to ensure no bitumen seeps below the work area.
- .7 Concrete Walls:
 - .1 Asphalt Based Primer: Prime deck with asphalt primer at the rate of 3-5 m²/litre (125 - 210 ft²/gal).
 - .2 Allow to dry
- .8 Vapour Retarder:
 - .1 Self-Adhered
 - (1) Apply membrane in accordance with system manufacturer's instructions and the following requirements.
 - (2) Prime metal, concrete and masonry surfaces with a uniform coating of the specified primer.
 - (3) Once the membrane roll is relaxed, position the roll over the substrate. Once aligned, reroll the membrane from both ends. Peel back one end of the silicone release sheet and roll the membrane into place pulling the release sheet at a 45° angle.
 - (4) Overlap each preceding sheet by 75mm (3") lengthwise following the reference line and by 150mm (6") at each end. Stagger end laps by at least 300mm (12"). Stagger end laps a minimum of 900mm (3 feet).

1.9 THERMAL INSULATION:

- .1 Firmly butt each insulation board to surrounding boards. Do not jam or deform boards.
- .2 Minimize elevation variation between boards at joints to provide a level surface to accommodate subsequent roofing.
- .3 Stagger both side and end joints at least 150 mm (6 inches).
- .4 Leave no voids at blocking, penetrations, walls, or parapets.
- .5 Complete air/vapour retarder where applicable by end wrapping and adhering it to the top surface of the insulation.
- .6 Support continuous insulation joints on deck planks.
- .7 Secure the base layer of insulation to the vapour retarder with adhesive.
- .8 Adhere subsequent layers of insulation ensuring joints are staggered between all courses in both directions a minimum of 300 mm (12 inches).
- .9 Adhere final layer of the assembled layers of insulation.
- .10 Adhere layers with a uniform application of adhesive applied in accordance with the manufacturer's recommendations.
- .11 Immediately after placement, walk insulation boards into adhesive to achieve solid bond.
- .12 Adhesive application rate:
 - .1 Low Rise Foam: As recommended by the product manufacturer.
 - .2 Hot Bitumen: Minimum 1-1.2 Kg/Sq. Metre (20-25 Lbs. per 100 Sq. Ft.).

1.10 ROOF MEMBRANE

- .1 HOT Applied 1+4 BUR:
 - .1 Starting at the low point, install base ply, shingle fashion. Lap base ply ends 150 mm (6 inches) minimum and stagger end laps 900 mm (36 inches) minimum.
 - .2 4 – Ply Membrane
 - .3 Install plies running perpendicular to the insulation's long joint
 - .4 Install four (4) plies of ply sheet, shingle fashion. Overlap starter strips 740 mm (29 inches) with first ply, then overlap each succeeding ply 700 mm (27-1/2 inches). Place ply sheets to ensure water will flow over or parallel to; but, never against exposed edges
 - .5 Use 230, 450, 690 and 900 mm (9, 18, 27 and 36 inch) wide plies to start and finish roof membrane along roof edges and terminations. Immediately after installation, broom and/or roll ply sheet. Ensure complete and continuous seal and contact between adhesive and felts, including ends, edges and laps without wrinkles, fish mouths, or blisters
 - .6 Apply uniform and continuous pressure to exposed edge and end laps to ensure complete adhesion
 - .7 Avoid walking on plies until adhesive has set

- .8 Overlap previous day's work 600 mm (24 inches)
- .9 Roofing ply shall never touch roofing ply, even at roof edges, laps, tapered edge strips, and cants
- .10 Cut out fishmouths/side laps which are not completely sealed and patch with two additional plies of felt and bitumen. Replace all sheets which are not fully and continuously bonded
- .11 Lap ply membrane ends 150 mm (4 inches). Stagger end laps 1 Metre (3 feet) minimum
- .12 Adhesive application rate: Minimum 1-1.2 Kg/Sq. Metre (20-25 Lbs. per 100 Sq. Ft.).
- .2 Base Flashing Membrane
 - .1 Flash parapet walls and curbs using the reinforcing sheet and the flashing membrane.
 - .2 Position flashing sheet to ensure any field lap is centred on the flashing sheet.
 - .3 Position the pre-cut flashing membrane. Peel back 100 mm to 600 mm (4 to 6 inches) of the silicone release paper to hold the membrane in place at the top of the flashing detail.
 - .4 Gradually peel back the remaining release paper, pressing down on the membrane with an aluminum applicator to ensure positive adhesion. Use the aluminum applicator to ensure a perfect transition between the up-stand and the field surface. Smooth the entire membrane surface with a hand roller for full adhesion.
 - .5 Ensure straight line application of membrane flashing along the edge of the roof.
 - .6 Cut off corners at end laps to be covered by the next roll.
 - .7 Install a reinforcing gusset in all inside and outside comers.
 - .8 Always seal overlaps at the end of the workday.
- .3 Cap Flashing Membrane
 - .1 Once membrane base flashing is applied and no defects are apparent, proceed with cap sheet installation.
 - .2 Position flashing sheet to ensure any field lap is centred on the flashing sheet and the lap of the base flashing sheet is centred under the cap sheet.
 - .3 Without adhering, unroll modified bitumen membrane to relax and for alignment.
 - .4 Once relaxed and aligned, peel back 100 mm to 600 mm (4 to 6 inches) of the silicone release paper to hold the membrane in place at the top of the flashing detail.
 - .5 Gradually peel back the remaining release paper, pressing down on the membrane with an aluminum applicator to ensure positive adhesion. Use the aluminum applicator to ensure a perfect transition between the up-stand and the field surface. Smooth the entire membrane surface with a hand roller for full adhesion.
 - .6 Press membrane overlap seams with a roller to ensure a watertight bond, free of wrinkles, air pockets, fishmouths or tears.
 - .7 Unless overlap widths differ between cap and base sheets, make sure joints between the two layers are staggered by at least 305mm (12 inches).
 - .8 Overlap cap sheet side laps by 75mm (3") and end laps by 152mm (6"). Cut off comers at end laps to be covered by next roll. All overlap surfaces must be granule-free or degranulated.

- .9 Seal all edges of the cap sheet with heat gun and roller.
- .10 Once cap sheet is installed, carefully check all overlapped joints for positive seal.
- .11 Complete flashing installation by securing the top edge of the flashing membrane with a metal termination bar, secured at 225mm (9 inches) on centre.

1.11 METAL FLASHINGS

- .1 Installation of metal counter flashings shall be in accordance with the metal flashing section of the Canadian Roofing Contractors' Association (CRCA) manual.
- .2 At the base of the fascia, install a drip edge of like material.
- .3 Maintain equipment in good working order to ensure control of roofing operations and protection of work. Equipment and laying techniques to meet the approval of the Project Consultant.
- .4 Fabrication
 - .1 Shop fabricate flashings and trim in accordance with applicable requirements of SMACNA Architectural Manual and in accordance with Contract Documents. Form sheet metal on a bending brake. Shaping, trimming and seaming on bench.
 - .2 Form sections square, true, and accurate to size, free from distortion, oil canning and other defects detrimental to appearance and performance, and to dimensions indicated / required.
 - .3 Provide a counter flashing and an intermediate vertical flashing where the cap flashing is greater than 610mm (24 in.) above the top of the roofing membrane. Form vertical flashings in 1220mm (4 ft.) maximum lengths.
 - .4 Provide an "S-Lock" joint at all end joints and at all horizontal joints between the cap flashing and the vertical flashing and between the vertical flashing and base counter flashing.
 - .5 Hem all exposed edges at least 13mm (1/2 in.) for appearance and stiffness.
 - .6 Provide a horizontal stiffening "V" on all face metal exceeding 225mm (9 in) in girth. Centre V-break in mid-span of panel. Cross Break metal flashing on all parapet flashings exceeding 450mm (18 in).
 - .7 Mitre and form standing seams at all corners. Make allowance for movement at joints.
- .5 Installation
 - .1 Install cap flashings, counter flashings, starter strips. and other miscellaneous sheet metal work in accordance with the Contract Documents.
 - .2 Provide continuous starter (hook) strips where detailed or required to present a true, non-waving, leading edge. Fasten starter strips to substrate at a maximum of 300 mm (12 inches) on centre.
 - .3 Join sheet metal with evenly spaced flat lock seams 25mm (1") wide to allow thermal movement.
 - .4 End joints where adjacent lengths of metal flashing meet shall be made using an "S-lock" joint. Face nailing of joints will not be permitted.
 - .5 Ensure fasteners are located a minimum of 300 mm (12 inches) above the surface of the roofing membrane, unless otherwise detailed.
 - .6 Where detailed or required, saw cut existing / new reglets into masonry surfaces to receive metal flashings. Reglet is to be a minimum 19mm wide x 13mm deep (3/4 x 1/2 inch).

- .7 Lock seam corners. Do not use pop rivets.
- .8 Install sheet metal with concealed fasteners. Exposed fastening permitted only on Project Consultant's approval.
- .9 Install sheet metal in uniform manner, level, true to line, free of warp or distortions.
- .10 Properly cover the area to be protected with metal flashings lightly touching the gravel pour and firmly secured to prevent movement or stripping by wind.
- .11 No irregular or badly fitted metal work will be accepted. Provide metal strips, cleats, as required.
- .12 Apply sealant to all rain collars and other penetration details as required to form a watertight seal on the detail.

1.12 GAS LINES

- .1 Clean area to receive gas line support.
- .2 Install new appropriately sized supports in accordance with the manufacture 's instructions.
- .3 Spacing of the pipe supports shall be in accordance with TSSA requirements.
- .4 Clean all gas lines of roofing material. Paint all gas lines with Tremclad YELLOW anti-rust paint as manufactured by Tremco Canada.

1.13 PAVERS AT ROOF ACCESS POINTS / HVAC ACCESS PANELS

- .1 Clean area to receive pavers.
- .2 Place 600 x 600 mm x 25.0 mm (24 x 24 x 1.0 inch) polystyrene insulation pads on the membrane to support the four corners and centre of each of the to be installed concrete pavers.
- .3 Place a 600 x 600 mm (24 x 24 inch x 1.5 inch) concrete paver over the insulation pads.

1.14 DEFICIENCY, REPAIR, CLEAN-UP

- .1 Repair of Deficiencies:
- .2 Installations of details noted as deficient during Final Inspection must be repaired and corrected by applicator, at his expense and made ready for re-inspection, within five (5) working days
- .3 Clean-up:
- .4 Immediately upon job completion, roof membrane and flashing surfaces shall be cleaned of debris.
- .5 Clean ground surrounding work area of debris.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required to complete the work of this Section, including but not limited to the following:
 - .1 Prefinished metal (steel) flashings and trims
 - .2 Non-shrink grout
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 06 10 00 – Rough Carpentry
 - .2 Section 07 92 00 – Joint Sealants
 - .3 Division 23 – Heating, Ventilation and Air Conditioning

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 The Aluminum Association Inc. (AAI)
 - (1) AA Aluminum Design Manual - Part VIII Guidelines for Aluminum Sheet Metal Work in Building Construction.
 - (2) AAI DAF45 - Designation System for Aluminum Finishes.
 - .2 American Architectural Manufacturers Association (AAMA)
 - (1) AAMA 611 - Voluntary Specifications for Anodized Architectural Aluminum.
 - (2) AAMA 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Substrates.
 - (3) AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - (4) AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - (5) AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

- .3 American National Standards Institute (ANSI)
 - (1) ANSI/SPRI/FM 4435/ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems, latest edition.
- .4 ASTM International
 - (1) ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - (2) ASTM A606/A606M - Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
 - (3) ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - (4) ASTM A755/A755M - Standard Specification for Steel Sheet, Metallic coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 - (5) ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - (6) ASTM B32 - Standard Specification for Solder Metal.
 - (7) ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - (8) ASTM B 370 - Standard Specification for Copper Sheet and Strip for Building Construction.
 - (9) ASTM D 523 - Standard Test Method for Specular Gloss.
 - (10) ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - (11) ASTM D4587 - Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.
 - (12) ASTM F1667 – Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .5 Canadian General Standards Board (CGSB)
 - (1) CAN/CGSB-51.32 – Sheathing, Membrane, Breather Type.
- .6 Canadian Roofing Contractors Association (CRCA)
 - (1) Roofing Specifications Manual, latest edition.
- .7 Canadian Sheet Steel Building Institute (CSSBI)
 - (1) CSSBI S8 – Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.
 - (2) CSSBI B17 – Barrier Series Prefinished Steel Sheet: Product Performance & Applications.
 - (3) CSSBI Sheet Steel Facts #12 – Fastener Guide for Sheet Steel Building Products.
- .8 Canadian Standards Association (CSA):
 - (1) CSA A123.3 – Asphalt Saturated Organic Roofing Felt.
 - (2) CSA A123.22 – Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- .9 Sheet Metal and Air Conditioning Contractors Association of North America (SMACNA)
 - (1) Architectural Sheet Metal Manual, latest edition.

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 01 33 00.

.2 Shop Drawings:

.1 Submit shop drawings including the following:

- (1) Plans, elevations, sections, and attachment details.
- (2) Detail fabrication and installation layouts, expansion-joint locations, and key details. Distinguish between shop and field assembled work.
- (3) Include identification of material, thickness, weight, and finish for each item and location in the work.
- (4) Include details for forming, including profiles, shapes, seams, and dimensions.
- (5) Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
- (6) Include details of termination points and assemblies.
- (7) Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contracting from fixed points.
- (8) Include details of roof penetrations flashing.
- (9) Include details of edge conditions, including crickets, and counter flashings as applicable.
- (10) Include details of special conditions.
- (11) Include details of connections to adjoining work.

.3 Samples:

- .1 Submit full-size samples of each specified flashing material formed to detailed profile including corner, curb, cap, and parapet flashing, and coping including lock- joints and hold-down clips.
- .2 Submit 2 - 50 mm x 50 mm (2" x 2") samples of each type of sheet metal material, colour and finish.

1.5 QUALITY ASSURANCE

.1 Qualifications:

- .1 Installers: Provide work of this section, executed by competent installers with experience in application of Products, systems and assemblies specified and with approval of Product manufacturers.
 - (1) Sealant shall be applied by a Subcontractor of recognized standing, having experience in this type of work, and who has the necessary equipment and skilled mechanics to carry out the work of this section satisfactorily and can substantiate this to satisfaction of Consultant.

.2 Quality standards:

- .1 Quality of fabrication and installation of sheet metal work shall comply with recommendations published by National Roofing Contractors Association.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials of this Section in accordance with Section 01 61 00.
- .2 Keep materials and equipment free from debris, ice, snow and contaminants. Allow air to circulate around metal components, sheets and break shapes.
- .3 Protect holes, and reglets from water and ice during freezing weather.

2 PRODUCTS

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Design members to withstand wind loads as calculated in accordance with the building code to maximum allowable deflection without permanent deformation.

2.2 MATERIALS

- .1 Sheet Metal Materials
 - .1 Prefinished Steel Sheet: 0.76 mm thick prefinished steel; flat sheet stock; to ASTM A653/A653M, Grade 230; colour as selected by Consultant.

2.3 FINISHES

- .1 Do not prime surfaces in direct contact bond with concrete or where field welding is required.
- .2 Prime paint items with two coats.
- .3 Galvanizing: to ASTM A653/A653M or CAN/CSA-G164-M, hot dipped method, minimum 275 g/m² zinc coating.
- .4 Shop Painted Finish: silicone modified polyester coating, applied to a minimum 0.025 mm dry film thickness; e.g.: WeatherX by Valspar, colour as selected by Consultant from custom range of colours to match adjacent material.

2.4 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Plastic cement: to CAN/CGSB 37.5.
- .3 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.
- .4 Sealants: as per Section 07 92 00.
- .5 Cleats: of same material and temper as sheet metal, minimum 2 in. wide. Thickness same as sheet metal being secured.
- .6 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .8 Solder: to ASTM B32, 50 percent block tin, 50 percent pig lead.
- .9 Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered.
- .10 Touch-up paint: as recommended by prefinished material manufacturer.

2.5 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details as indicated.

- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AA Aluminum Sheet Metal Work in Building Construction.
- .3 Form pieces in 8 ft maximum lengths. Make allowance for expansion at joints.
- .4 Hem exposed edges on underside ½ in. Mitre and seal corners with sealant.
- .5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.6 METAL FLASHINGS

- .1 Form flashings, copings and fascias to profiles indicated of 22 gauge thick prefinished aluminum.

2.7 REGLETS AND CAP FLASHINGS

- .1 Form metal cap flashing of 24 gauge thick sheet metal to be built in to concrete and masonry work for base flashings, as detailed in accordance with CRCA FL series details. Provide slotted fixing holes and steel/plastic washer fasteners. Cover face and ends with plastic tape.

3 EXECUTION

3.1 INSTALLATION

- .1 Install sheet metal work in accordance with CRCAFL series details, as detailed.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal. Secure in place and lap joints 4 in.
- .4 Counter flash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S lock forming tight fit over hook strips, as detailed.
- .5 Lock end joints and caulk with sealant.
- .6 Install surface mounted reglets true and level, and caulk top of reglet with sealant.
- .7 Insert metal flashing into reglets under cap flashing to form weather tight junction.
- .8 Turn top edge of flashing into recessed reglet or mortar joint minimum of 1 in. Lead wedge flashing securely into joint.
- .9 Caulk flashing at reglet cap flashing with sealant.
- .10 Install pans, where shown around items projecting through roof membrane.

3.2 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.
- .2 Remove all excess materials from site as Work proceeds and at completion. Remove all excess cuttings, ends, tapes, etc.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy satisfactory to the Owner.

- .4 Leave surfaces clean and ready for use.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section Includes
 - .1 Sprayed fireproofing.
- .2 Related Sections
 - .1 Section 07 84 00 – Firestopping.
 - .2 Section 09 25 00 – Gypsum Board Assemblies.

1.3 REFERENCES

- .1 ASTM E119-05a: Standard Test Methods for Fire Tests of Building Construction and Materials.
- .2 ASTM E136-04: Standard Test Method for Behaviour of Materials in a Vertical Tube Furnace at 750°C.
- .3 ASTM E605-93(2006): Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.
- .4 ASTM E736-00(2006): Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.
- .5 ASTM E759-92(2005): Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members.
- .6 ASTM E760-92(2005): Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members.
- .7 ASTM E761-92(2005): Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members
- .8 ASTM E859-93(2006): Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members
- .9 ASTM E937-93(2005): Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
- .10 CAN/ULC-S101-04: Standard Methods of Fire Endurance Tests of Building Construction and Materials.
- .11 CAN/ULC-S102-03: Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .12 CAN4-S114-M80 (R1997): Standard Method of Test for Determination of Noncombustibility in Building Materials.

- .13 AWCI Publication: Inspection Procedure for Fire-Applied Sprayed Fire Protection Materials.
- .14 Underwriters Laboratories of Canada List of Equipment and Materials, Volume II Building Construction Directory.
- .15 Underwriters Laboratories Inc. (ULI) Fire Resistance Directory.
- .16 Warnock Hersey certification listings.

1.4 QUALITY ASSURANCE

- .1 Fireproofing work shall be performed by a firm with expertise in the installation of fireproofing or similar materials. This firm shall be licensed or otherwise approved by the fireproofing material manufacturer.
- .2 Before proceeding with the fireproofing work, approval of the proposed materials thicknesses and densities shall be obtained from the Consultant and other applicable authorities.

1.5 SUBMITTALS

- .1 Manufacturer's Data: Submit manufacturer's specifications including certification as may be required to show material compliance with Contract Documents.
- .2 Test Data: Independent laboratory test results shall be submitted for all performance criteria as specified.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver Products in manufacturer's unopened packages, fully identified as to name, type and other identifying data, and bearing the ULC labels for fire hazard and fire-resistance classifications.
- .3 Store Products above ground in a dry location, protected from weather. Damaged packages will be considered un-suitable for use. Remove unsuitable Product from the Place of the Work.

1.7 PROJECT CONDITIONS

- .1 When the prevailing outdoor temperature at the Place of the Work is less than 40 degrees F, substrate and ambient temperature of 40 degrees F shall be maintained for 24 hours after application of the fireproofing. If necessary for job progress, Provide enclosures with heat to maintain temperatures.
- .2 Provide adequate ventilation of not less than 4 air changes per hour to allow for proper drying of the spray-applied fire resistive material fireproofing during and subsequent to its application.

1.8 SEQUENCING AND SCHEDULING

- .1 All fireproofing work on a floor shall be completed before proceeding to the next floor.
- .2 The Contractor shall co-operate in the co-ordination and scheduling of fireproofing work to avoid delays in job progress.
- .3 Do not install board fire protection on structural members until piping and other construction behind the fire protection has been completed, uninterrupted coverage can be provided and the need for subsequent cutting and patching can be eliminated.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Cafco Industries Inc.
- .2 AD Fire Protection Systems.
- .3 Grace Canada Inc.

2.2 PERFORMANCE CRITERIA

- .1 The sprayed fireproofing shall have been tested and reported by Underwriter's Laboratories, or other certified testing agency to CAN/ULC-S101 or ASTM E119.
- .2 Conform to code requirements of authorities having jurisdiction.
- .3 Spray fireproofing material where joist reinforcing has taken place, including onto structural members, the underside of floor decks to other members with proper thickness and density to provide the fire resistive rated as noted on the drawings.
- .4 Provide ULC Design Numbers for site specific situations.
- .5 Adjust thickness of fireproofing to suit alternate beam and column sizes.
- .6 The sprayed on fireproofing shall be factory mixed cementitious material.
- .7 Deflection: When tested to ASTM E759, the material shall not crack or delaminate when the non-concrete topped galvanized deck to which it is applied is subjected to a one-time downward deflection of 1/120 of the span.
- .8 Bond Impact: When tested to ASTM E760, the material shall not crack or delaminate from the concrete topped galvanized deck to which it is applied.
- .9 Cohesion/Adhesion (bond strength): When tested to ASTM E736, the material applied over uncoated or galvanized steel shall have an average bond strength of 80 p.s.f.
- .10 Air Erosion: When tested to ASTM E859, the material shall not be subject to losses from the finished appliance greater than 0.025 g/ft².
- .11 Compressive Strength: When tested to ASTM E761, the material shall not deform more than 10 percent when subjected to a crushing force of 500 psf.
- .12 Corrosion Resistance: Bare, shop-coated and galvanized sheets with applied fireproofing shall be tested to ASTM E937.
- .13 Indentation Hardness: When tested to ASTM E761, the material shall not indent more than 0.50 in.
- .14 Non-Combustibility: When tested to CAN4-S114-M, the material shall be non-combustible.
- .15 Surface Burning Characteristics: When tested to CAN/ULC-S102, the material shall exhibit the following surface burning characteristics:
 - .1 Flame Spread: 0
 - .2 Smoke Developed: 0

- .16 Density: When tested to ASTM E605, the material shall meet the minimum individual and average density values as listed in the appropriate UL design, or as required by the authority having jurisdiction or shall have a minimum average of 208 kg/m³.
- .17 The material shall have been tested and reported by Underwriters' Laboratories of Canada (ULC) or Underwriters Laboratories Inc. (ULI) in accordance with the procedures of CAN/ULC-S101 or UL 263 (ASTM E119).
- .18 Sprayed fireproofing materials shall be applied at the required thickness and density to achieve the following ratings:
 - .1 Floor Assembly: 1 hour.
 - .2 Roof Assembly: Not required.
 - .3 Beams: 1 hour.
 - .4 Girders: 1 hour.
 - .5 Columns: 1 hour.
- .19 Potable water shall be used for the application of sprayed fireproofing materials.
- .20 Sprayed fireproofing materials shall be free of all forms of asbestos and asbestos contamination, including actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite. Material manufacturer shall provide certification of such, upon request.
- .21 Spray-applied fire resistive coating shall be tinted blue.

2.3 MATERIALS

- .1 Sprayed Fireproofing: Minimum applied dry density of 256 kg/m³; Monokote MK-6, cementitious type, ULC labeled under guide No. 40U18.3 and formulated without asbestos, as manufactured by Construction Products Division, W.R. Grace & Co. of Canada Ltd. or its processing distributors or Cafco Industries Ltd.
- .2 Mixing Water: clean, fresh and suitable for domestic consumption and free from such amounts of mineral organic substances as would affect the set of the fireproofing materials.

3 EXECUTION

3.1 EXAMINATION

- .1 Report to the Consultant, in writing, all defects of surfaces or work prepared by other trades and on unsatisfactory site conditions.
- .2 Thoroughly examine all surfaces scheduled to receive fireproofing to see that they are secure, rigid, true and not liable to impair performance or appearance.
- .3 Commencement of work implies total acceptance of surface and site conditions.

3.2 PREPARATION

- .1 Protect work of other trades from damage resulting from work of this Section.

- .2 Make good any resulting damage, to the satisfaction of the Consultant, at no additional cost to the Owner.
- .3 Maintain uniform temperature in work area, adequate for work being performed, as recommended by materials manufacturer.
- .4 All surfaces to receive fireproofing shall be free of oil, grease, loose mill scale, dirt, paints/primers (other than those listed and tested), or other foreign materials which would impair satisfactory bonding to the surface. Any cleaning of surfaces to receive sprayed fireproofing shall be the responsibility of the Contractor and paid by the Owner.
- .5 Clips, hangers, supports, sleeves and other attachments to the substrate are to be placed by others prior to the application of sprayed fireproofing.
- .6 The installation of ducts, piping, conduit, or other suspended equipment shall not take place until the application of sprayed fireproofing is complete in an area.

3.3 APPLICATION

- .1 Equipment, mixing and application shall be in accordance with the manufacturer's written application instructions.
- .2 Sprayed fireproofing shall not be applied to steel floor decks prior to the completion of concrete work on that deck.
- .3 Temperature and enclosure conditions shall be as required by the fireproofing manufacturer.
- .4 Maintain an air and substrate temperature of 42 degrees F for 24 hours before and 24 hours after application of the fireproofing.
- .5 Provisions shall be made for ventilation to properly dry the fireproofing after application. In enclosed areas lacking natural ventilation, air circulation and ventilation must be provided. Provide ventilation rates to meet manufacturer's requirements.
- .6 For the application of fireproofing material to exposed galvanized supporting structure, follow manufacturer's guidelines precisely.
- .7 Provide masking, drop cloths or other suitable coverings to prevent overspray from resting on surfaces not intended to be sprayed.
- .8 Adhesive shall be applied as per the appropriate UL fire resistance design and manufacturer's written recommendations. Typical surfaces requiring adhesives are roof deck (without concrete), cellular floor deck, bottomless trench headers, and other electrified floor units.
- .9 Topcoat materials shall be the type recommended and approved by the manufacturer of each spray-applied fire resistive material required for the applications indicated.
- .10 The application of sprayed fire-proofing shall not commence until certification has been received by the General Contractor indicating that surfaces to receive sprayed fireproofing have been inspected by the applicator and are acceptable to receive sprayed fireproofing.
- .11 Install mineral wool board fire protection to comply with requirements for thicknesses, number of layers, construction of joints and corners, and fastening methods referenced in the appropriate fire resistance design indicated.

- .12 Coordinate installation of board fire protection with other construction to minimize cutting into, or removal of, already installed board material.

3.4 FIELD QUALITY CONTROL

- .1 Defective materials or quality of work, whenever found at any time prior to final acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error.
- .2 Remove and replace defective materials and work of other Sections affected by this replacement.
- .3 The Consultant will select an independent testing laboratory to sample and verify the thickness and density of the fireproofing to ASTM E605 covered under the testing and inspection allowance.
- .4 The sprayed fireproofing shall be tested for thickness and density in accordance with one of the following procedures:
 - .1 ASTM E605 - Standard Test Method for Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members.
 - .2 AWCI - Inspection Procedure for Field-Applied Sprayed Fire Protection Materials.
 - .3 U.B.C. Standard No. 43-8 - Thickness and Density Determination for Spray-Applied Fireproofing.

3.5 CLEANING

- .1 All patching of and repair to sprayed fireproofing, due to damage by other trades, shall be performed under this Section and paid for by the trade responsible for the damage.
- .2 After the completion of the work of this section in an area, equipment shall be removed from that area, and all surfaces not to be sprayed shall be cleaned of all deposits of sprayed fireproofing material. All floor areas shall be broom cleaned.
- .3 After completion of the fireproofing work, remove all equipment and clean all exposed wall and floor areas of deposits of fireproofing material.
- .4 Promptly, as the work proceeds and upon completion, clean-up and remove from the site all rubbish and surplus material resulting from work of this trade.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 1.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 SUMMARY

- .1 Section includes: Provide firestopping system, including but not limited to the following:
 - .1 Firestopping and smoke seals is a complete and integrated system. Propose as a separate work scope and include all firestopping and smoke seal requirements as specified herein and shown on the drawings.
 - .2 Provide firestopping and smoke seals within mechanical (ie: inside ducts, dampers) and electrical assemblies (ie: inside bus ducts) as part of the work of Divisions 21, 22, 23, 25, 26, 27 and 28 respectively. Firestopping and smoke seals around the outside of such mechanical and electrical assemblies where they penetrate rated fire separations shall be part of the work of this Section.
 - .3 Firestopping Materials: tested to ULC-S115 to achieve the required fire rating in accordance with ULC or Warnock Hersey Design Numbers.
 - .4 Work of this Section comprises firestopping and smoke seal materials and systems to provide closures to fire and smoke at openings around penetrations, at unpenetrated openings, at projecting or recessed items, and at openings and joints within fire separations and assemblies having a fire-resistance rating, including openings and spaces at perimeter edge conditions.
 - .5 Provide seals to form draft tight barriers to retard the passage of flame and smoke.
 - .6 The installed seal shall provide and maintain a fire resistance rating equivalent to the rating of the adjacent floor, wall or other fire separation assembly to the requirements of and acceptable to the authorities having jurisdiction, and the Consultant.
 - .7 ULC systems used must provide a flame, temperature in cable and cable tray penetrating and hose stream rating in accordance with those outlined in the applicable codes and provide an effective barrier against the passage of flame, smoke and gases.
 - .8 All firestopping seals except for wall joints in visible areas must be of an easily identifiable colour, to be clearly distinguished from other building materials.
 - .9 For firestopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control, use an elastomeric seal. Do not use a cementitious or rigid seal at such locations, unless penetrant is isolated by firestop pipe insulation or mechanical movement isolators.

- .10 Firestopping and smoke seals at joints and spaces designed and required to allow movement: A flexible, elastomeric seal suitable to withstand the required movement and capable of returning to original configuration without damage to the seal and without adhesive or cohesive failure; do not use a cementitious or rigid seal at building movement joints, sway joints, deflection spaces, control joints, expansion joints, and other such locations, unless used to minimize non-moving part of seal (ie: firestop mortar deck flute fill).
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 04 20 00 – Unit Masonry: penetrations in rated masonry assemblies.
 - .2 Section 07 92 00 - Joint Sealants: non-rated joint sealants.
 - .3 Section 08 44 00 – Curtain Wall and Glazed Assemblies
 - .4 Section 09 21 16 - Gypsum Board Assemblies: penetrations in rated gypsum board assemblies.
 - .5 Section 21 05 00 – Common Work Results for Fire Suppression: service penetrations in rated assemblies.
 - .6 Section 26 05 00 – Common Work Results for Electrical: service penetrations in rated assemblies.
 - .7 Section 27 05 00 – Common Work Results for Communications: service penetrations in rated assemblies.
 - .8 Section 28 05 00 – Common Work Results for Electronic Safety and Security: service penetrations in rated assemblies.

1.3 REFERENCES

- .1 ASTM E84-05: Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 ASTM E119-05a: Standard Test Methods for Fire Tests of Building Construction and Materials.
- .3 ASTM E814-02: Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- .4 ASTM E2174-04: Standard Practice for On-Site Inspection of Installed Fire Stops.
- .5 CAN/CGSB-19.13-M87: Sealing Compound, One Component, Elastomeric, Chemical Curing.
- .6 CAN/CGSB-19.24-M90: Multicomponent, Chemical Curing Sealing Compound.
- .7 CAN/ULC-S102-03: Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .8 ULC-S115-95 (R2001): Standard Method of Fire Tests of Firestop Systems.
- .9 CAN/ULC-S702-97: Standard for Thermal Insulation, Mineral Fibre, for Buildings.
- .10 Underwriters' Laboratories of Canada: List of Equipment & Materials.

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 01 33 00.

- .2 Product Data:
 - .1 Submit sealant manufacturer's installation instructions and standard drawings, indicating ULC or WHI test designations.
- .3 Shop Drawings:
 - .1 Indicate sizes of openings, nature of penetrations, and tested method of firestop and smoke seal protection being proposed.
 - .2 Shop Drawings are to be sealed, signed and dated by manufacturer's design engineer.
 - .3 Submit shop drawings to Consultant and to the authority having jurisdiction for their review and approval.
- .4 Certificates:
 - .1 Certificate: sealant manufacturer's letter of certification verifying that Products meet or exceed specified requirements.
- .5 Test Reports:
 - .1 Test Reports: certified laboratory reports, indicating that Products proposed for use conform to ASTM E814 and ULC-S115, and are so classified by the Underwriter's Laboratories of Canada or Warnock-Hersey International.

1.5 QUALITY ASSURANCE

- .1 Manufacturer's Design Engineer: a registered professional engineer licensed to practice in the Place of the Work and having a minimum of 10 years documented experience designing firestop and smoke seal systems.
- .2 Applicator: approved and acceptable to sealant material manufacturer.
- .3 Firestopping compounds shall not contain volatile solvents or require special application to protect plastic pipe from firestopping compound.

1.6 PRE-INSTALLATION MEETING

- .1 Prior to commencement of firestopping, arrange and conduct a pre-installation meeting as specified in Section 01 31 00.
- .2 Pre-installation Meeting: discuss proposed methods and materials to be used in all instances.
- .3 Representatives of the Owner, Consultant, Contractor, installer, manufacturer and the authority having jurisdiction are to be in attendance.
- .4 Do not conduct meeting unless all identified parties are present.

1.7 MOCK-UPS

- .1 Construct job site mock-up as specified in Section 01 40 00.
- .2 Apply one sample seal on representative substrates on each site for each fire rating required at each type of wall, floor or roof construction.

- .3 Comply with project requirements as to thickness and density of application to achieve fire rating.
- .4 Proceed with installation only after Consultant has reviewed and accepted mock-up.
- .5 Acceptable mock-up may remain as part of the completed Work as standard.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver Products to the Place of the Work in their original unopened packages.
- .3 Store Products in an enclosed shelter, preventing damage to containers.

1.9 PROJECT CONDITIONS

- .1 Do not apply sealants when temperature of substrate material and surrounding air is below 5 degrees C (42 degrees F).
- .2 Maintain sealant at a minimum 18 degrees C (68 degrees F) for best workability.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Manufacturers of firestopping and smoke seals having Product considered acceptable for use:
 - .1 A/D Fire Protection Systems Inc.
 - .2 Dow-Corning Canada Inc.
 - .3 Hilti Canada.
 - .4 STI Firestop
 - .5 3M Canada
 - .6 Tremco
- .2 Substitution Procedures: refer to Section 01 25 00.

2.2 MATERIALS

- .1 Firestop Sealant, Type A: non-sag; asbestos-free; single component sealant composed of high temperature ceramic fibers and organic and silica binders; ULC labelled; to ULC-S115 and CAN/ULC-S102-M.
- .2 Firestop Sealant, Type B: three component; epoxidized polyurethane terpolymer; accommodating joint movement of +40/-25%; ULC labelled; to CAN/CGSB-19.24-M and ULC-S115.
- .3 Firestop Sealant, Type C: three component; self-levelling; chemically curing polyurethane sealant; ULC labelled; to ULC-S115.
- .4 Firestop Sealant, Type D: single component; low modulus; silicone rubber; moisture curing; ULC labelled; to CAN/CGSB-19.13-M and ULC-S115.

- .5 Firestop Sealant, Type E: single component; modified polyurethane; moisture curing; ULC labelled; to CAN/CGSB-19.13-M and ULC-S115.
- .6 Primer: as recommended by sealant manufacturer for specific material, substrate and end use.
- .7 Firestop Insulation: to CAN/ULC-S702, Type 2; mineral fibre manufactured from rock or slag, suitable for manual application:
 - .1 Density: 72 kg/m³ when tested to ASTM C303.
 - .2 Combustibility: Noncombustible to CAN/ULC-S114.
 - .3 Melt Temperature: greater than 1,175 degrees C (2,385 degrees F).
 - .4 Surface Burning Characteristics: to CAN/ULC-S102, maximum flame spread of 0, smoke developed of 0.
 - .5 Moisture Sorption: 0.04 percent when tested to ASTM C1104.
 - .6 Smoulder Resistance: 0.01 percent when tested to CAN/ULC-S129.

2.3 COMPONENTS

- .1 Provide firestopping and smoke sealing systems to ULC-S115 and as described below:
 - .1 Asbestos free materials and systems fully capable of maintaining an effective barrier against gases, flame and smoke in compliance with ULC-S115, not exceeding opening sizes stated.
 - .2 Service Penetration Assemblies: certified by ULC-S115 and used by ULC Guide 40 U19. Service components listed as certified in this guide are noted under Label Service of ULC.
 - .3 Fire resistance rating of fire stopping material assembly must meet or exceed the fire resistance rating of the floor or wall section being penetrated.
 - .4 Firestopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal; do not use a cementitious or rigid seal at such locations.
 - .5 Damming and back up materials, supports and anchoring devices shall be to manufacturer's recommendations, and in strict accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
 - .6 Sealants: non-sagging type for vertical joints.

3 EXECUTION

3.1 EXAMINATION

- .1 Confirm compatibility of surfaces to receive sealant materials.
- .2 Verify that surfaces of openings are sound, clean, dry and ready to receive application of sealant.
- .3 Verify that penetration elements are securely fixed and properly located.
- .4 Commencement of installation means acceptance of existing conditions.

3.2 PREPARATION

- .1 Protect adjacent surfaces and equipment from damage.
- .2 Clean contact surfaces of dirt, dust, grease, oil, loose material, or other matter that may affect bond of sealant.
- .3 Remove incompatible materials that affect bond by scraping, brushing, water or solvent cleaning, or sandblasting.

3.3 PENETRATION SIZING

- .1 The following shall regulate sizing of service penetrations to be fire stopped, in an effort to standardize and minimize penetration sizes:
 - .1 Sleeve single, circular penetrations except in fire rated gypsum wallboard, under work of mechanical and electrical Subcontractors.
 - .2 Multiple penetrations of circular elements are defined as more than one circular penetration having a maximum space of 100 mm (4") between closest faces of such penetrating elements. Forming of such multiple penetrations is responsibility of respective sections whose service penetrates the rated assembly, and such formed opening shall be a square or rectangular frame around a group of penetrations in which maximum clearance between outer penetration element and face of opening shall be 25 mm (1"). This also applies to single circular penetrations in fire rated gypsum wallboard. Fire rated pipe insulation, where applied is to be considered penetrant requiring above mentioned amounts.
 - .3 Square penetrations shall be created in same manner as the above mentioned multiple circular penetrations, but the edge clearance may be increased to maximum 50 mm (2").
 - .4 Exception: At fire dampers, clearances are governed by testing authorities' requirements.

3.4 APPLICATION

- .1 Install mineral fibre insulation in compacted thicknesses required by ULC design. Compress insulation approximately 33 percent.
- .2 Apply sealant in strict accordance with manufacturer's instructions and ULC certification.
- .3 Coordinate and cooperate with adjacent, contiguous and related materials trades, such as concrete, drywall, plumbing, conduit, electrical wiring, communication systems, etc., to ensure a proper and timely installation.
- .4 Seal holes or voids made by penetrating items to ensure an effective fire and smoke barrier.
- .5 Seal all intersections and all penetrations of floors, ceilings, walls and columns.
- .6 Seal around all cutouts for lights, cabinets, pipes and plumbing, ducts, electrical boxes, etc.
- .7 Wrap non-insulated heated pipes that may be subject to movement with a non-combustible smooth material to permit the pipe to move without damaging the firestopping and smoke seal.
- .8 Maintain the integrity of any insulation and vapour retarders on insulated pipes and ducts at the fire separation.

- .9 Where floor openings exceed 100 mm (4") in width and may be subjected to traffic or loading, install cover plate systems capable of supporting same loading as floor.
- .10 Apply tags on each mechanical and electrical seal, either on penetrant(s), on seal or next to seal, at Subcontractor's option. Wall seals require tags on each side. Tag floor seals on the top only. Tags need not exceed 3 sq.in. in size but shall state seal number, installation date, installer's initial and the following text, "Firestop system not to be severed unless prepared to repair immediately".

3.5 FIELD QUALITY CONTROL

- .1 Perform field testing and inspection as specified in Section 01 45 00.
- .2 Conduct inspections to ASTM E2174.
- .3 Examine finished penetrations to ensure proper installation before concealing or enclosing any areas of work.
- .4 Keep areas of work accessible until inspection has been completed.
- .5 Manufacturer's Field Service: inspect to verify and confirm that systems installation is in strict accordance with manufacturer's and ULC requirements.
- .6 Correct unacceptable work and provide further inspection to verify compliance with requirements.

3.6 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.
- .2 Remove all excess materials from site as Work proceeds and at completion. Remove all excess cuttings, ends, tapes, etc.
- .3 Immediately remove all spots, smears, stains, residues, adhesives, etc., from the work of this Section and from upon adjacent areas or surfaces which resulted from the work of this Section.
- .4 Cleaning to be free of volatile solvents. Leave the Work in a clean and satisfactory condition.
- .5 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy satisfactory to the Owner.
- .6 Leave surfaces clean and ready for subsequent Work.

3.7 PROTECTION

- .1 After installation, and until Owner occupancy, protect the rated firestop systems from damage.
- .2 Remove damaged materials and replace with new, undamaged Product, at no additional cost to Owner.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 1.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 SUMMARY

- .1 Section includes: Provide joint sealants, including but not limited to the following:
 - .1 Remove sealant from existing joints indicated and clean joints.
 - .2 Seal all areas indicated on Drawings, in list following and where required to make building watertight and weathertight:
 - (1) Both sides of hollow metal frames.
 - (2) Interior and exterior of aluminum window and door frames.
 - (3) Joint where two different materials abut.
 - (4) Exterior carpentry (fascias, trim).
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 04 20 00 - Unit Masonry: sealants used in conjunction with masonry.
 - .2 Section 06 20 00 – Finish Carpentry
 - .3 Section 06 40 00 - Architectural Woodwork: sealants used in conjunction with counters and casework.
 - .4 Section 07 84 00 - Firestopping: firestop sealants.
 - .5 Section 08 11 00 – Metal Doors and Frames: sealants used in conjunction with hollow metal frames.
 - .6 Section 08 51 13 – Aluminum Windows: sealants used in conjunction with window frames.
 - .7 Section 08 44 12.13 – Glazed Fibreglass Curtain Wall: sealants used in conjunction with curtain wall frames.
 - .8 Section 08 80 00 – Glazing: sealants used in conjunction with glazing methods.
 - .9 Section 09 21 16 - Gypsum Board Assemblies
 - .10 Section 09 51 00 - Acoustical Ceilings: sealants used in conjunction with suspended metal ceiling systems.

1.3 REFERENCES

- .1 ASTM C920-05: Standard Specification for Elastomeric Joint Sealants.

- .2 CAN/CGSB-19.13-M87: Sealing Compound, One Component, Elastomeric, Chemical Curing.
- .3 CAN/CGSB-19.17-M90: One Component Acrylic Emulsion Base Sealing Compound.
- .4 CAN/CGSB-19.22-M89: Mildew Resistant Sealing Compound for Tubs and Tiles.
- .5 CAN/CGSB-19.24-M90: Multicomponent, Chemical Curing Sealing Compound.

1.4 SUBMITTALS

- .1 Submit Product data and samples as specified in Section 01 33 00.
- .2 Submit manufacturers' test data as specified in Section 01 45 00.

1.5 QUALITY ASSURANCE

- .1 Applicator: a recognized specialized applicator having skilled mechanics, thoroughly trained and competent in all phases of caulking work, and a member in good standing of the Caulking Contractor's Association of Ontario.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver and store Products in undamaged and original containers, with labels intact and showing the manufacturer's name, brand, colour, etc.
- .3 Ensure at time of use that Products are still within recommended shelf life.
- .4 Maintain storage area at a temperature in accordance with manufacturer's recommendations.

1.7 ENVIRONMENTAL CONDITIONS

- .1 Do not install solvent curing sealants in enclosed building spaces.
- .2 Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.8 WARRANTY

- .1 Submit extended warranties in accordance with the General Conditions of the Contract.
- .2 Extended System Warranty: for a period of 2 years, including coverage against delamination, cracking, running, loss of adhesion and cohesion, blistering, peeling, colour change and staining.
- .3 Extended Manufacturer Warranty: for a period of 10 years, including coverage against failure of the sealant material to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, maintain stability, or not cure.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Manufacturers of joint sealants having Products considered acceptable for use:
 - .1 CSL Silicones Inc.

- .2 Dow Corning.
- .3 PRC Chemicals.
- .4 Sika Canada Inc.
- .5 Tremco Canada.
- .2 Substitution Procedures: refer to Section 01 25 00.

2.2 MATERIALS

- .1 Sealant A: 2-part, polysulphide; CAN/CGSB-19.24-M, Type 2, Class B
- .2 Sealant B: (non-sag, for non-glazing) 2-part, polysulphide; CAN/CGSB-19.24-M, Type 2, Class A
- .3 Sealant C: (non-sag, for glazing) 1-part, acrylic emulsion latex CAN/CGSB-19.17-M.
- .4 Sealant D: 1-part, chemical curing, silicone CAN/CGSB-19.22-M
- .5 Sealant E: 1-part, moisture curing, polyurethane CAN/CGSB-19.13-M
- .6 Joints In Bathrooms, Laundries, Etc.
 - .1 Sealant: Mildew Resistant
 - (1) Silicone Sanitary Sealant (1702 Series) by Canadian General Electric.
 - (2) 786 by Dow Corning.
 - (3) Tremoil 600 by Tremco
- .7 Thinners and Primers: type compatible with appropriate sealant and substrate as recommended by manufacturer.
- .8 Cleaning material: As recommended by manufacturer.
- .9 Joint backing material: preformed, compressible, resilient, non-staining foam compatible with primers, sealants, outsize 30%, polyethylene, extruded closed cell foam, Shore "A" hardness 20, tensile strength 20-30 psi, such as PRC Backer Rod or equal. Outsize 50%, polyethylene, extruded open cell foam, Shore "A" hardness 10, tensile strength 140-150 psi, such as PRC open cell.
- .10 Bond breaker: where joint configuration does not allow for proper depth/width ratio with the use of backer rod (see Section 3.2.5.) - a pressure sensitive plastic tape such as 3M #226 or #481 which will not bond to the sealant shall be placed at the back of the joint.
- .11 Sealant Colours: as selected by Consultant from manufacturers' standard colour range.

3 EXECUTION

3.1 EXAMINATION

- .1 Report to the Consultant, in writing, defects of surfaces or work prepared by other trades and unsatisfactory site conditions.
- .2 Commencement of work implies total acceptance of surface and site conditions.

- .3 Thoroughly examine surfaces scheduled to receive sealants to ensure that they are dry, clean, level; free from cracks, ridges, dusting, scaling, carbonation, mortar droppings, parging, curing compounds, rust, grease, oil, paint or other foreign material likely to impair adhesion, performance or appearance.
- .4 Test substrate for adhesion and staining if any doubt exists.
- .5 Verify at the site that joints and surfaces have been provided as specified under the work of other sections; and that joint conditions will not adversely affect execution, performance or quality of completed work; and that they can put into acceptable condition by means of preparation specified in this section.
- .6 Ascertain that sealers and coatings applied to sealant substrates are compatible with sealant used and that full bond between the sealant and substrate is attained.
- .7 Request samples of the sealed or coated substrate from their fabricators for testing of compatibility and bond if necessary.
- .8 Verify that specified environmental conditions are ensured before commencing work.
- .9 Ensure that releasing agents, coating or other treatments have either not been applied to joint surfaces or that they are entirely removed.
- .10 Defective work resulting from application to unsatisfactory joint conditions will be considered the responsibility of those performing the work of this section.
- .11 Protect adjacent Products from damage, and make good any resulting damage in accordance with the Contract Documents.

3.2 PREPARATION

- .1 Remove dust, paint, loose mortar and other foreign matter and dry joint surfaces.
- .2 Remove dust, silt, scale and coating from ferrous metals by wire brush, grinding or sandblasting.
- .3 Remove oil, grease and other coating from non-ferrous metals.
- .4 Prepare concrete, masonry, glazed and vitreous surfaces as recommended by sealant manufacturer.
- .5 Examine joint sizes and modify to achieve proper width-to-depth ratio.
- .6 For joints wider than 50 mm (2"), contact sealant manufacturer's representative for recommendations.
- .7 Install backer rod or apply bond breaker tape to achieve correct joint configuration.
- .8 Where necessary to prevent staining, mask adjacent surfaces with tape prior to priming and application of sealant.
- .9 Prime sides of joint in accordance with manufacturer's directions, immediately prior to sealing.
- .10 Prior to application, test each sealant with proposed substrate for indications of staining or poor adhesion.
- .11 At locations where another surface will cover the sealed joint (e.g. cove base) ensure the sealant is finished flush with adjacent surfaces.

3.3 QUALITY OF WORK

- .1 Quality of work shall be in accordance with good practice and in strict compliance with the recommendations of the manufacturer of materials being used.
- .2 Check work area for adequate light and heat.
- .3 Carefully mask adjacent surfaces, materials and items not scheduled to receive sealant, taking care to see that masking remains intact until application is complete. Remove masking immediately upon completion of caulking.
- .4 Do not apply sealant to substrate until thoroughly cured and dried.

3.4 APPLICATION

- .1 Prime sides of joints before placing joint backing. Use bond breaker where joint backing not required.
- .2 Mix and apply sealant in strict accordance with manufacturer's directions and under supervision of manufacturer's field representative.
- .3 Sealants shall be of gun grade or knife grade consistency to suit joint condition.
- .4 Apply sealants in accordance with manufacturer's directions, using a gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid, as indicated on Drawings.
- .5 Form surface of the sealant with full bead, smooth, free from ridges, wrinkles, sags, and embedded impurities. Neatly tool surface to a slight concave joint.
- .6 Clean adjacent surfaces immediately and leave work neat and clean. Remove excess and droppings using recommended cleaners as work progresses. Remove masking tape immediately after tooling of joints.
- .7 In masonry cavity construction with an air seal, vent sealed joints from cavity to beyond external face of wall.
- .8 Superficial pointing with the skin bead is not acceptable.
- .9 Provide test results of pull test performed by the manufacturer representative before completion of sealant work.
- .10 Promptly, as the work proceeds and upon completion, clean-up and remove from the Place of the Work masking tapes, rubbish and surplus material.

3.5 SCHEDULE

- .1 Sealant A or E:
 - .1 Masonry to metal
 - .2 Masonry to masonry
 - .3 Masonry to stucco
 - .4 Masonry to wood
 - .5 Metal to metal

- .6 Wood to stucco
- .2 Sealant B:
 - .1 Glass to all materials
- .3 Sealant C or E:
 - .1 Gypsum board to gypsum board
 - .2 Gypsum board to wood
- .4 Sealant D:
 - .1 Plumbing fixtures to wall and floor surfaces

3.6 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.
- .2 Remove all excess materials from site as Work proceeds and at completion. Remove all excess cuttings, ends, tapes, etc.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy satisfactory to the Owner.
- .4 Leave surfaces clean and ready for subsequent Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 1.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 SECTION INCLUDES

- .1 Supply only of:
 - .1 Steel Frame Products including frames, transom frames (glazed or panelled), side light and window assemblies, fire labelled and non-labelled as indicated on drawings and door schedule.
 - .2 Steel doors, swing type, flush, glazed or louvred, fire labelled, with or without temperature rise ratings, and non-labelled as indicated on drawings and door schedule.

1.3 RELATED WORK NOT INCLUDED IN THIS SECTION

- .1 Section 04 20 00 – Unit Masonry: Building in and grouting frames into concrete unit masonry.
- .2 Section 06 20 00 – Finish Carpentry: Installation of frames, doors, surface mounted hardware and finishing hardware.
- .3 Section 07 92 00 – Joint Sealants: sealing joints between frames and other building components.
- .4 Section 08 70 00 – Hardware: Supply of finishing hardware.
- .5 Section 08 80 00 – Glazing.
- .6 Section 09 21 16 - Gypsum Board Assemblies: Gypsum board partitions.
- .7 Section 09 90 00 – Painting and Coating.

1.4 REFERENCES

- .1 ASTM A568/A568M-06a: Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
- .2 ASTM A653/A653M-03: Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 CAN/CGSB-1.181-99: Ready-Mixed Organic Zinc-Rich Coating.
- .4 CGSB 41-GP-19Ma: Rigid Vinyl Extrusions for Windows and Doors.
- .5 CAN/CSA-G40.21-04: Structural Quality Steel.
- .6 NFPA 80-1999: Fire Doors and Windows.
- .7 CAN4-S104-M80: Fire Tests of Door Assemblies.

1.5 REGULATORY REQUIREMENTS

- .1 Install fire labelled steel doors and frames products to NFPA 80.

1.6 SHOP DRAWINGS

- .1 Submit shop drawings as specified in Section 01 33 00.
- .2 Shop Drawings: indicating type of door, material, steel core thickness, mortises, reinforcements and glazed openings and details. Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.

1.7 QUALITY ASSURANCE

- .1 Supply material manufactured to standards of Canadian Steel Door and Frame Manufacturers Association (CSDFMA) "Canadian Metric Guide for Steel Doors and Frames" (Modular Construction).
- .2 Fire rated doors frames glazing stops and fire door hardware shall bear U.L.C. labels. Refer to architectural drawings for location of fire rated assemblies. All hollow metal work in fire separations and fire walls shall be in accordance with NFPA 80 and CAN4-S104.

1.8 REJECTIONS

- .1 Defective materials whenever found at any time prior to final acceptance of the work shall be rejected regardless of previous site review. Site review will not relieve Contractor from responsibility but is a precaution against oversight and error.
- .2 Remove and replace defective materials and work of other trades affected by this replacement at no additional cost to the Owner.

1.9 WARRANTY

- .1 Materials and quality of work shall be warranted by Manufacturer in accordance with the CSDFMA members standard warranty for steel doors and frames.

2 PRODUCTS

2.1 MATERIALS

- .1 Doors
 - .1 Acceptable Materials: All and only steel doors and frames product manufactured by CSDFMA members are eligible for use on this project.
 - .2 Minimum requirements for fire doors are that individual manufacturer's proprietary designs must be successfully tested to CAN4-S104-M.
 - .3 Fire Rated Doors assembly and fire rated glazing stops, material and construction approved by ULC.
 - .4 Interior Door Faces: 1.2 mm (18 gauge) base thickness as Commercial grade steel to ASTM A568, Class 1, hot-dip galvanized to ASTM A653, ZF75 (A25) coating designation, known commercially as "Colourbond", "Satincoat" or "Galvanneal". Minimum base steel thickness shall be as per Table 1 / CSDFMA.
 - .5 Use Z275 (G90) fully galvanized door faces on door numbers indicated on door schedule.

- .6 Cores for non-insulated interior doors: honeycomb structural core consisting of kraft paper having 20 mm (3/4") cell size to thickness indicated to ULC Guide 40U8.8.

.2 Frames

- .1 Frames: 1.6 mm (16 gauge) base thickness steel, zinc wipe coated steel for interior door frames and fully galvanized to Z275 (G90) for exterior door frames.
- .2 Frames shall be blanked, reinforced, drilled and tapped for mortised, templated hardware minimum steel thickness.
- .3 Mortised cutouts shall be protected with steel guard boxes minimum steel thickness 1.2 mm (18 Gauge).
- .4 Frames shall be reinforced, where required, for surface mounted hardware. Drilling and Hardware reinforcing minimum steel thickness 3.5 mm (10 Gauge), tapping is by others on site, at time of installation.
- .5 Provide for appropriate anchorage to floor and wall construction. Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb. For rebate opening heights up to and including 1520 mm (60") provide two anchors, and an additional anchor for each additional 760 mm (30") of height or fraction thereof, except as indicated below. Frames in previously placed concrete masonry or structural steel shall be provided with anchors located not more than 150 mm (6") from the top and bottom of each jamb, and intermediate anchors at 660 mm (26") on centre maximum. Minimum anchors steel thickness 1.6 mm (6 Gauge).
- .6 Each door opening shall be prepared for single grey or black stud neoprene door silencers, three for single door openings, and two for double door openings.
- .7 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .8 Fire labelled frame products shall be provided for those openings requiring fire protection ratings, as scheduled on the drawings. Such products shall be tested to CAN4-S104-M, ASTM E152, or NFPA 252 and listed by a nationally recognized agency having a factory inspection service and shall be constructed as detailed in Follow-Up Service Procedures / Factory Inspection Manuals issued by the listing agency to individual manufacturers.
- .9 Corrugated Steel Frame Tee Anchors: Thickness and design approved by ULC.
- .10 Glazing Stops in Fire Rated Frames: Commercial grade 1.5 mm (16 Gauge) sheet steel thickness and ULC approved design. All approved design.
- .11 Glazing Stops-Non-Fire Rated Doors and frames: Minimum 0.8 mm (20 gauge) base thickness sheet metal with zinc finish as per door, tamperproof on exterior doors, screw fixed on interior doors.
- .12 Reinforcing Channel: To CAN/CSA-G40.21, Type 300W.
- .13 Primer: For touch up, rust inhibiting primer to CAN/CGSB-1.181.
- .14 Specialty trims: "J" shaped electro-galvanized steel trims, to cover cut ends of concrete blocks where new doors cut into existing walls. Custom shape and size trims to suit door and wall conditions.

2.2 FABRICATION

- .1 Fabricate doors, panels, screens and frames as detailed in accordance with Canadian Steel Door and Frame Manufacturers Association, "Specifications for Commercial Steel Doors and Frames", for insulated, hollow steel and honeycomb core construction, except where specified otherwise.
- .2 Fabricate fire rated doors and frames in accordance with details, approved shop drawings and ULC requirements at the time of printing.
- .3 Provide temperature rise doors where indicated in the door schedule, Doors shall have fire rated mineral cores as manufactured by RODIX or Georgian Pacific.
- .4 Stiffen interior doors with honeycomb core, laminated to face sheets under pressure. Insulate exterior doors, using manufacturer's recommended adhesive and pressure.
- .5 Fabricate interior doors and frames of wipe coat galvanized steel.
- .6 Fabricate interior steel frames in minimum thickness of 1.6 mm (16 gauge) thick sheet steel.
- .7 Grind welded corners and joints to flat plane, fill with metallic paste filler and sand to uniform smooth finish.
- .8 Close tops of exterior doors with steel caps in minimum thickness 1.6 mm (16 gauge) so they are flush with face edges. Close top of interior doors with PVC caps.
- .9 Mortise, reinforce, drill and tap doors and reinforcements to receive hardware using templates provided by finish hardware supplier.
- .10 Doors to have tack welded and filled seams, ground smooth. Tack weld 6 in. on centre.
- .11 Make provision for glass where indicated and provide glazing stops.
- .12 Provide astragals for pairs of doors in accordance with ULC requirements.
- .13 Protect strike and hinge reinforcements using guard boxes welded to frames.
- .14 Weld in two channel spreaders per frame, to ensure proper frame alignment.
- .15 Provide for anchorage of frames to floors. Provide 1.6 mm (16 gauge) angle clips, with two holes for floor anchorage welded to frame.
- .16 Reinforce head of frames wider than 1200 mm (4' - 0").
- .17 Provide frames with manufacturer's proprietary anchorage system suitable to secure frame rigidly to wall assembly. Secure frames set into previously constructed concrete or masonry openings by countersunk expansion bolts at same centres as for adjustable Tee-anchors. Reinforce frame at fastening location to prevent indentation of frame by fastening device.
- .18 Construct rail and stile doors in same manner as flush doors.
- .19 Construct matching panels in same manner as doors.
- .20 Chemically treat surfaces of plain steel doors and frames and apply one coat of primer.
- .21 Attach ULC labels to doors and frames requiring fire rating.

- .22 Install three (3) bumpers on strike jamb for each single door and two bumpers at head for pairs of doors.

3 EXECUTION

3.1 INSTALLATION

- .1 Install fire rated frames, doors and fire door hardware to NFPA 80.

3.2 FRAME INSTALLATION

- .1 Isolate from each other dissimilar metals and metal from concrete or masonry to prevent electrolysis.
- .2 Set frames plumb, square, level and at correct elevation, maintaining door widths and heights. Install fire rated frames to NFPA 80.
- .3 Secure anchorages and connections to adjacent construction.
- .4 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreaders at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- .5 Make allowances for deflection to ensure structural loads are not transmitted to frames.

3.3 DOOR AND HARDWARE INSTALLATION

- .1 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers Association, as modified for special mounting height requirements for elementary schools.
- .2 Where door stop contacts door pulls, mount stop to strike bottom of pull.

3.4 GLAZING INSTALLATION

- .1 Refer to Section 08 80 00 for glazing.

3.5 ADJUSTING AND CLEANING

- .1 Adjust operable parts for correct function.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 1.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 INTENT

- .1 Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.

1.3 SECTION INCLUDES

- .1 Supply of wood doors indicated on Drawings.

1.4 RELATED SECTIONS

- .1 Section 00 01 13 – List of Standard Details
- .2 Section 06 20 00 – Finish Carpentry: Installation of doors, surface mounted hardware and finishing hardware.
- .3 Section 08 11 00 Metal Doors and Frames.
- .4 Section 08 70 00 – Hardware: Supply of finishing hardware.
- .5 Section 08 80 00 – Glazing.
- .6 Section 09 90 00 – Painting and Coating

1.5 REFERENCES

- .1 Architectural Woodwork Manufacturer's Association of Canada (AWMAC) - wood doors.
- .2 NFPA 80-2013: Fire Doors and Windows.
- .3 Underwriter's Laboratories of Canada - "List of equipment & materials" Volume II Building Construction.

1.6 REJECTIONS

- .1 Defective materials or quality of work whenever found at any time prior to final acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error.
- .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Pile doors flat on level supports to prevent warping. Protect face of first door by placing plywood or cardboard between supports and door. Cover the top door & edges in a similar manner.

- .2 Store doors in a dry, well ventilated area. Doors stored for an extensive period of time shall have top and bottom edges sealed.
- .3 Lift doors on & off piles, never dragged across each other to prevent surface damage & scratching. Do not stand doors on end for storage.

1.8 WARRANTY

- .1 Institutional doors, three (3) years.
- .2 Fire doors, life of the installation. Interior use only.

1.9 SAMPLES

- .1 Submit samples as specified in Section 01 33 00.
- .2 Submit plastic laminate samples demonstrating colour and texture for door faces for Owner and Consultant review.

2 PRODUCTS

2.1 MATERIALS

- .1 Provide new materials in perfect condition, free from defects impairing strength, durability or appearance.
- .2 All materials shall be new and in perfect condition, free from defects impairing strength, durability or appearance.

2.2 INTERIOR FLUSH DOORS

- .1 AWMAC Quality Grade: Custom.
- .2 Faces for Plastic Laminate: Faces shall be 1.5 mm high pressure decorative laminate. All inside cuts for lites in plastic laminate shall have corners radiused a min. 3 mm to prevent radical cracking. File smooth.
 - .1 Colour to be "Hardrock Maple" by Arborite, Formica, Wilson Art or equal.
- .3 Construction: Type PC-HPDL-3, 45mm one piece particle board core to ANSI A208.1, LD-1 (density to meet or exceed 28 lbs/cu.ft) in accordance with AWMAC Standards, QSI 1300.
- .4 Stiles and rails shall be hardwood not less than 28 mm bonded to core.
- .5 Edge: factory finish, satin (clear catalyzed lacquer), solid hardwood, Grade 1, maple or birch.

2.3 FLUSH WOOD FIRE RATED DOORS

- .1 Construction: Type FD-HPDL-3, 45mm one piece particle board core to ANSI A208.1, and in accordance with AWMAC Standards, QSI 1300.
- .2 Flush wood fire rated doors shall be ULC or WHI rated per door schedule.
- .3 Flush wood fire rated doors shall be ULC or WHI rated per door schedule.
- .4 Flush wood fire rated doors shall have reinforced door edge and blocking system to manufacturer's standard.
- .5 Edges shall be to door manufacturer's standard for fire rated wood doors.

3 EXECUTION

3.1 Install doors as specified in Section 06 20 00 and as follows.

3.2 EXAMINATIONS

- .1 Report to the Consultant, in writing, all defects of work prepared by other trades and on unsatisfactory site conditions.
- .2 Do not commence until openings to receive wood doors and frames are plumb and free from defects or foreign material liable to impair the performance or appearance of the completed installation.
- .3 Commencement of work implies total acceptance of all surface conditions by this Contractor.
- .4 Waive any after claims by failure to comply with the above procedure of examination.

3.3 QUALITY OF WORK AND INSTALLATION

- .1 Carry out installation of wood doors and frames by workers skilled in this trade and one in strict accordance with the manufacturer's direction to produce a first class installation.
- .2 Condition doors to the average humidity of the location before hanging.
- .3 Trim all doors square and accurately as to size, individually inspected, benched, belt sanded and labelled.
- .4 Cut down doors to fit openings smaller than those for which they are manufactured.
- .5 When planing to fit, trim equally from door sides. If height is to be reduced more than 19 mm, trim equally from top and bottom, never more than 19 mm from bottom.
- .6 Bevel the lock edge, of the floor, approximately 3 mm for a 51 mm thick door, for proper clearance.
- .7 Hang doors so that they will operate freely without tension or free swing. Allow 5 mm clearance in overall opening width and 3 mm clearance at top to allow for swelling in extreme humidity.
- .8 Seal all door edges and routings for hardware.
- .9 Double seal, with exterior sealer, all exterior doors having edges and areas exposed for hardware and glazing openings.
- .10 In preparing a door for light and/or louvre openings (when not factory produced) the edge of an opening should be not less than 127 mm from any edge of the floor. The total area of all openings in slab doors shall not exceed 40% of the total door area. Seal opening edges.
- .11 Install finishing hardware relating to wood doors supplied under Section 08 70 00.

3.4 CLEANING

- .1 Upon completion of the work of this Section, all surplus materials and debris caused by the work of this Trade shall be removed from the site to the satisfaction of the Consultant.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section Includes: Provide all labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.

- .1 Provide all of the aluminum frames and doors indicated on the working drawings or specified herein, including, but not limited to, the following:

- (1) Aluminum Doors and Frames
- (2) Aluminum Sills
- (3) Weather Stripping
- (4) Sealant and Bedding for Aluminum Sills and Other Concealed Areas

- .2 Related Sections

- .1 Section 06 20 00 – Finish Carpentry: wood blocking.
- .2 Section 07 92 00 – Joint Sealants: Caulking except concealed areas.
- .3 Section 08 80 00 – Glazing.

1.3 REFERENCES

- .1 CAN/CSA-A440-00: Windows.
- .2 CAN/CSA-A440.1-00: User Selection Guide to CSA Standard CAN/CSA-A440-00, Windows.
- .3 CAN3-S157-M83: Strength Design in Aluminum.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings as specified in Section 01 33 00.

1.5 WARRANTY

- .1 Provide a warranty for aluminum entrance system framing for a period of ten (10) years from the date of Substantial Completion of the project. Warranty to cover installation and materials for workmanship and system design against structural failure, leakage or failure to meet specified performance requirements.
- .2 Provide a manufacturer's warranty for a period of twenty (20) years for all Anodic finishes on aluminum items.
- .3 Provide a manufacturer's warranty for a period of 10 years on closers, 5 years on exit devices

1.6 REJECTIONS

- .1 Defective materials or quality of work whenever found, at any time prior to final acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve this Contractor of responsibility, but is a precaution against oversight and error. Defective materials shall be removed and replaced by this Contractor at his own expense, and he shall be responsible for the cost of the work of other trades affected by this replacement.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Alumicor Limited
- .2 Kawneer
- .3 OldCastle Building Envelope
- .4 Windspec

2.2 DOORS

- .1 Framing members, doors, transition members, mullions, adapters and mountings shall be extruded of aluminum with alloy and temper consistent with the method of manufacturer. These members shall be 6063-T5. All screws, miscellaneous fastening devices and internal components shall be of stainless steel or plated or corrosion resistant materials of sufficient strength to perform the functions for which they are used.
- .2 Frame components shall be one piece extrusions.
- .3 Basis of Design: Alumicor ThermaPorte 7700, thermally broken, Wide Stile series, or equal by approved manufacturers.
 - .1 Proposed substitutions shall be in accordance with Section 01 25 00 – Substitutions Procedures.
- .4 Finish shall be:
 - .1 Clear anodized: exposed aluminum sections to receive an anodic oxide treatment, in accordance with Aluminum Association Specification AA-M12C 22A41. Class I Coating.

2.3 ENTRANCE HARDWARE

- .1 Prepare door and install hardware supplied by Section 08 70 00 including but not limited to door locks, panic devices, overhead concealed door closers, continuous hinges, door pull handles, surface door closers, drop plates, concealed overhead door stops, rim exit devices and trim, removable mullions and threshold and sweeps.
- .2 Hardware supplied by others:
- .3 Install thresholds supplied by finishing hardware Section 08 70 00.

2.4 ENTRANCE FRAMES

- .1 Framing members, doors, transition members, mullions, adapters and mounting shall be extruded of aluminum with alloy and temper consistent with the method of manufacturer. These members shall be 6063-T5 extruded aluminum alloy (ASTM B221054T alloy C.S. 10A-T5). All screws, miscellaneous fastening devices and internal components shall be of stainless steel, or plated or corrosion-resistant materials of sufficient strength to perform the functions for which they are used.
- .2 Entrance frames shall be as specified in Part 2 of Section 08 44 00 – Curtain Wall and Glazed Assemblies.
- .3 The entrance door assembly including aluminum framing and sealed glazing units shall achieve a minimum U-value of 0.70 in accordance with Climate Zone 5 performance criteria mandated by OBC, SB-10.

3 EXECUTION

3.1 INSTALLATION

- .1 Glass framing members shall provide for flush glazing on all sides with through sight lines, and no projecting stops.
- .2 Door frames shall be glazed by Glazing Sub-contractor in accordance with Section 08 80 00.
- .3 Provide fully resilient settings for glass and panels by use of EPDM elastomeric glazing gaskets on both sides of glass installed in window frames and doors, and make provision for thermal shrinkage.
- .4 See that all door mouldings are fitted accurately to flush hairline joints and mechanically fastened with screw and spline joinery at door corners and sub-frame intersections. Doors shall be dual-moment welded at all corners.
- .5 Set all items under this heading in their correct locations as shown on the details and shall be level, square, plumb and at proper elevations and in alignment with other work.
- .6 Provide a maximum sealed joint size of 10 mm wide between aluminum frame and masonry. Adequate backing shall be inserted to support sealant application by Sealant Sub-contractor, Section 07 92 00.
- .7 Screw all materials in place using backing, masonry plugs, or anchor straps as required.
- .8 Accurately cut and fit joined mouldings to result in a tightly closed joint.
- .9 Interior trims shall be secured with mounting clips fastened at no less than 600 mm on centre.
- .10 Exterior panning butt joints shall be mechanically connected with panning clips and shall be back sealed with Tremco Dymonic caulking.
- .11 Exterior panning perimeter caulking shall be Tremco Dymonic, anodized aluminum colour, applied in accordance with the manufacturer's specifications.
- .12 Frame interior, install a barrier consisting of a single component polymeric insulating sealant to form a complete continuous bridge, full depth of the cavity between the window frame and existing building. Approved material: Hilti CB124 or insta-Foam NBS 700.

3.2 CLEANING AND PROTECTION

- .1 Protect all aluminum work during period of construction.
- .2 Remove protective materials and clean aluminum work with plain water or water with soap or household detergent. Be responsible for damages to all aluminum work resulting from the use of improper materials or carelessness on the part of other trades.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified or required, to complete the work of this Section including but not limited to the following:
 - .1 Aluminum curtain wall.
 - .2 Aluminum entrance doors.
 - .3 Glass and glazing in accordance with Section 08 80 00.
 - .4 Seal joints within the work of this section, except where specified otherwise and at abutting joints between this section and the work of other sections.
 - .5 Air barrier transitions and connections between air barriers of adjacent wall and roofing systems.
 - .6 Prefinished aluminum panel fabrications, including closures, sills, copings, flashings at interface with roofing flashing.
 - .7 Firestopping and smoke seal in joint between edge of concrete slab and back of curtainwall, in accordance with Section 07 84 03.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 04 20 00 – Unit Masonry
 - .2 Section 07 21 00 – Thermal Insulation
 - .3 Section 07 84 00 – Firestopping
 - .4 Section 07 92 00 – Joint Sealants
 - .5 Section 08 41 00 – Entrances and Storefronts.

1.3 REFERENCES

- .1 ASTM C920-05: Standard Specification for Elastomeric Joint Sealants.
- .2 CAN/CGSB-1.40-97: Anticorrosive Structural Steel Alkyd Primer.
- .3 CAN/CGSB-1.181-99: Ready-Mixed Organic Zinc-Rich Coating.
- .4 CAN/CGSB-12.8-97: Insulating Glass Units.
- .5 CAN/CGSB-12.20-M89: Structural Design of Glass for Buildings.
- .6 CAN/CGSB-19.24-M90: Multicomponent, Chemical Curing Sealing Compound.
- .7 AAMA/WDMA/CSA 101/I.S.2/A440, NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights.

- .8 CAN/CSA-A440-00: Windows.
- .9 CAN/CSA-A440S1: Canadian Supplement to AAMA/WDMA/CSA Standard.
- .10 CAN/CSA-A440.1-00: User Selection Guide to CSA Standard CAN/CSA-A440-00, Windows.
- .11 CAN/CSA-G40.21-04: Structural Quality Steel.
- .12 CAN3-S157-M83: Strength Design in Aluminum.
- .13 CAN/CGSB-12.1-M90: Tempered or Laminated Safety Glass.
- .14 CAN/CGSB-12.9-M91: Spandrel Glass.
- .15 CAN/CGSB-12.20-M89: Structural Design of Glass for building.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Conduct a pre-installation meeting in accordance with Section 01 11 01 and the following requirements:
 - .1 Review methods and procedures related to glazing systems including the following:
 - (1) Review flashings, special interface details and scheduling with adjacent material assemblies, penetrations, and conditions of other construction that will affect glazing systems.

1.5 SUBMITTALS

- .1 Submit required submittals in accordance with Section 01 33 01.
- .2 Submit warranty specimen prior to commencement of shop drawings.
- .3 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .4 Shop drawings:
 - .1 Submit engineered shop drawings.
 - .2 Further to requirements of Section 01 33 01, indicate with plans, sections, elevations and sufficient full size details, components and methods of assembly, materials and their characteristics relative to their purpose, and other fabrication information including relationships to adjacent systems.
 - .3 Identify and describe material types being supplied, wall thicknesses of extrusions, and shapes including connections and grades, dimensions and tolerances (minimum and maximum), attachments, reinforcing, anchorage and locations of fastenings, air barrier transitions to various adjacent building envelope air barrier materials, and provisions for thermal and structural movement between components of this section and adjacent materials.
 - .4 Include description of materials, metal finishing specifications, and other pertinent information.
 - .5 Design loads, typical reactions and support movement allowances, both vertical and horizontal, shall be placed on the shop drawings.
 - .6 Shop drawings shall clearly indicate the specification of materials and, where applicable, indicate installation methods and coordination with other sections.

.5 Design calculations:

- .1** Submit under seal, calculations prepared by the professional engineer responsible for the preparation of the shop drawings that clearly indicate the following:
 - (1) Design assumptions regarding loadings and seismic design, related to the building code.
 - (2) Codes and standards to which calculations are based upon.
 - (3) Materials proposed and their allowable shear and bending stresses.
 - (4) Maximum and minimum tolerances for proposed materials including anchors, holes and spacings.
 - (5) Testing data to confirm compliance with performance requirements for the work of this section.
 - (6) Analysis for dead, wind, snow and guard loads as required and movements caused by temperature changes, support deflections and building sway.
 - (7) Analysis to include anchors, glazing members, structural joints, sealants, glass, custom aluminum caps. Show section property computations for framing members and submit full sized drawings.
 - (8) Analysis to include thermal performance.

.6 Samples:

- .1** Submit 450 mm (18") x 450 mm (18") size samples of types of glass and aluminum framing assemblies including custom aluminum caps with specified finishes. Submit 450 mm (18") x 450 mm (18") size samples of types of spandrel assemblies. Submit 200 mm (8") long samples of typical component sections (head, jamb, sill, meeting rail, and the like), fully assembled, indicating glazing and weatherproof methods.
- .2** Control samples:
 - (1) Submit two 305 mm (12") square samples of aluminum having specified finish of the required colours. Submit samples as many times as required to obtain approval of the range.
 - (2) Mark direction of metal grain and rolling and aluminum finish application on back of control samples.

.7 Test and evaluation reports:

- .1** Submit valid independent laboratory test reports of full-scale mock-up for the specific glazing systems required under the work of this section, including framing members, glazing units, anchorage, slab edge covers, opening units, doors and transitions to adjoining assemblies and materials to demonstrate compliance respecting specified air and water infiltration and environmental separation performance and specified performance requirements specified in this section.
 - (1) Test reports shall be recent and produced within the past 5 years.
- .2** Work shall not be fabricated until laboratory test reports demonstrate compliance with requirements of the Contract Documents. Where independent laboratory test reports do not demonstrate compliance with the Contract Documents include the cost of necessary testing in the Contract Price.
- .3** Structural silicone test reports and submittals:
 - (1) Submit to the Consultant, for record purposes only, the documents from the sealant manufacturer listed hereunder. Materials submitted to the sealant manufacturer for these tests to be from the same Supplier and representative of the materials to be used in the Work.
 - (a) Test reports on adhesion of the silicone to the specified substrates in accordance with ASTM C794-15A.

- (b) Test reports on compatibility of materials to be used adjacent to the structural silicone in accordance with ASTM C1087-00(2011).
 - (c) Written recommendation for surface preparation, the cure environments and handling and storage methods for the silicone.
 - (d) A written statement that shop drawings, design calculations, and Contract Documents have been reviewed.
 - (2) Suitability of glass: Submit to the Consultant, for record purposes only, glass manufacturer's written statement that proposed types of glass that are to be supported by structural silicone are suitable for such application.
 - (3) Manufacturing procedures: Before commencing manufacture of frames and applying structural silicone submit for review manufacturing procedures including the gunning, tooling, handling and clamping (if necessary) of glass and frames.
 - (4) Record forms: Submit for review record forms and labels as specified herein for recording manufactured panels and test samples.
 - (5) Log book: maintain a log book at the Place of the Work, for review by Consultant when requested, recording adhesion and quality control test results performed during the application of structural silicone sealant, as well as concurrent weather conditions.
 - (6) Perform the following quality control tests in accordance with sealant manufacturer's directions and record results in log book:
 - (a) Skin-over time/elastomeric test (performed once per day and on each new lot of sealant to be used for one-component sealants).
 - (b) Quality control test procedures as recommended by manufacturer for two- component sealants.
 - (c) Adhesion and cure quality control tests procedures as recommended by manufacturer for two-component sealants.
 - (7) Record sealant batches/lots to control Product expiration.
- .4 Certifications; structural silicone applications:
- (1) Submit certification that adhesion of sealant to samples of metal and glass is adequate when tested in accordance with ASTM C794-15A.
 - (2) Submit certification that materials in contact with sealant are compatible with sealant after 4,500 hours, tested in accordance with ASTM C1135-15 using QUV Weatherometer.
 - (3) Submit statement that stress on each detailed sealant joint will not exceed design stress of sealant when exposed to specified wind loads.
 - (4) Submit certification that insulating glass units will withstand design loads specified in the Contract Documents.
 - (5) Letter from insulating glass unit manufacturer verifying that a review of Project has been done and size of secondary silicone seal designed based on design wind loads and glass sizes.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit closeout submittals in accordance with Section 01 77 01.
- .2 Operation and maintenance data:
 - .1 Provide training to the Owner in the operation, maintenance, and cleaning of the aluminum framed glazing systems. Submit printed copies of maintenance instructions given to the Owner.
 - .2 Submit maintenance data for cleaning and maintenance for windows, curtain walls for incorporation into the operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- .1 Installers:

- .1 The work of this section shall be performed by a Subcontractor who is regularly engaged in the engineering, manufacture, fabrication, assembly, glazing and installation of curtain wall glazing systems. Subcontractor shall demonstrate to the acceptance of the Consultant that they have successfully performed on comparable projects over the previous 10 years.
- .2 Aspects of the work of this section are required to be prepared by a professional engineer.
- .3 Field Sample Installations:
 - .1 Construct on the Project, a typical sample installation of the glazing assemblies provided under work of this section, complete with finishes, sealants, and glazing, as directed by Consultant, for review before proceeding with the remainder of the installation. Location and size of sample installation(s) to be as directed by Consultant.
 - (1) Coordinate mock-up requirements of this section with requirements of Section 05 50 00 and include stainless steel panel panels into installation of the mock-up specified herein.
 - .2 Coordinate work of sample installation(s) with related work of other sections.
 - .3 Adjust sample installation(s) as required to gain acceptance of the Consultant. Accepted work may form a part of the final installation.
 - .4 Work shall match accepted sample installation(s).

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Store parts in a dry place and permit natural ventilation over their finished surfaces.
- .2 Store materials in locations protected from damage by other trades.
- .3 Under conditions of high humidity or cold temperatures, supply heating or forced air ventilation to prevent accumulation of surface moisture.
- .4 Mark components to show location on building and on drawings.
- .5 Protect finishes with strippable coating that will not mar, nor deface finish on removal, or a similar method designed to afford an equivalent amount of protection. Leave protected coating intact until damage risk is past or immediately prior to final cleaning.
- .6 Stacking should be done to prevent bending pressure or abrasion of finished surfaces.

1.9 FIELD CONDITIONS

- .1 Comply with requirements of Product manufacturers.

1.10 EXTENDED WARRANTY

- .1 Warrant work of this section in accordance with Division 01.
 - .1 Special systems warranty: Standard form in which warrantor agrees to repair or replace components and assemblies that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - (1) Failures include, but are not limited to, the following:
 - (a) Structural failures including, but not limited to, excessive deflection.
 - (b) Noise or vibration created by wind and thermal and structural movements.
 - (c) Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - (d) Water penetration through fixed glazing and framing areas.

- (e) Failure of operating components.
 - (f) Failed glass units.
- (2) Warranty period:
 - (a) 10 years.
- .2 Special product warranty; glass units: in accordance with Section 08 80 00.
- .3 Special product warranty; exterior exposed aluminum finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - (1) Failures to paint finish include, but are not limited to, the following:
 - (a) Colour fading more than 5 Hunter units when tested according to ASTM D2244-15A.
 - (b) Chalking in excess of a No. 8 rating when tested according to ASTM D4214-07(2015).
 - (c) Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - (2) Warranty period: 5 years.

2 PRODUCTS

2.1 MANUFACTURER

- .1 Manufacturers shall develop materials and Products of this and related sections to achieve design intent as indicated and specified.
 - .1 Subject to compliance with requirements, provide products by one of the following manufacturers:
 - (1) Alumicor Limited.
 - (2) Kawneer Company Canada Limited.
 - (3) Oldcastle Building Envelope.
 - .2 Requests for substitutions shall be made in conformance with Section 01 60 00.
 - .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
 - .4 Single source responsibility: Obtain all Work of this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.2 MATERIALS

- .1 Glass Design:
 - .1 Glass shall be designed according to CAN/CGSB 12.20-M89 and Section 08 80 00.
 - .2 Insulating glass units in accordance with Section 08 80 00.
- .2 Curtainwall:
 - .1 Acceptable Products:
 - (1) 2600 by Alumicor
 - (2) Equivalent systems by listed manufacturers.
 - .2 Description:
 - (1) Thermally broken sections.
 - (2) Fasteners: concealed.

- (3) Cap extensions shall be extruded to profiles indicated and scheduled. Break- formed cap extensions will not be accepted.
- .3 Aluminum entrances, screens, and framing:
 - .1 Acceptable entrance framing products:
 - (1) Exterior entrance framing; acceptable Products:
 - (a) Curtainwall framing as specified above.
 - .2 Acceptable door products shall be thermally broken, compatible with curtainwall framing:
 - (1) Exterior doors (wide stile) aluminum.
 - (2) Where drawings show half glazed doors, the upper insert is glass per section 08 80 00 and bottom panel shall have aluminum insert minimum 19mm plywood core with 3mm aluminum sheets laminated to interior and exterior of panel.
 - .3 Description:
 - (1) Fasteners: concealed.
 - (2) Door framing connections: Reinforce mechanically-joined corners of doors by welding, spigotting, welding and spigotting or by one piece cast aluminum angle to produce sturdy door unit.
 - (3) Weather-stripping: Dense, bulb polymeric material, resilient and retains weathering ability under temperature extremes, complete with EPDM blade gasket sweep strip applied to the bottom door rail with concealed fasteners.
 - (4) Door hardware; hinges, closers, thresholds, push/pulls, locks, exit hardware, and as indicated: supplied by Section 08 70 00 for installation by this section.
- .4 Aluminum extrusions: Accurately formed, extruded aluminum alloy ASTM B221-14: AA- 6063-T5/T6, free from defects impairing appearance, strength and durability.
 - .1 Minimum thickness of 3 mm (0.125") for framing members, and 1.27 mm (0.050") for glazing stops, snap caps and similar components unless indicated otherwise.
- .5 Aluminum flashing:
 - .1 Minimum wall thickness: 0.812 mm (0.0320")(20 B&S gauge), unless otherwise indicated.
 - .2 Aluminum alloy:
 - (1) For painted finish:
 - (a) ASTM B209-14: AA5052-H32 Painting Quality.
- .6 Aluminum sheet panels and copings:
 - .1 Minimum wall thickness: 3 mm (0.125").
 - .2 Surface flatness: 0.38 mm (0.015") maximum deviation when measured with 150 mm (6") rule.
 - .3 Squareness: 0.05 mm (0.002") maximum for each 25.4 mm (1") of length at panel edge.
 - .4 Aluminum alloy:
 - (1) For painted finish:
 - (a) ASTM B209-14: 3003H14.
- .7 Shims: Utility grade aluminum sheet when not in contact with concrete; stainless steel when in contact with concrete or cementitious substances of thickness required, or galvanized steel.

- .8 Air seal gaskets; between unitized glazing assemblies: Silicone or silicone compatible EPDM sheet with Durometer hardness between 50 to 60 or alternate approved by Consultant.
- .9 Air barrier materials; transition from glazing system air barrier and tying into building envelope air barrier systems:
 - .1 Refer to Section 07 27 00.
- .10 Fasteners:
 - .1 Non-magnetic (austenitic) 300 series alloy stainless steel unless otherwise indicated.
 - .2 Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - .3 Provide nuts or washers of design having means to prevent disengagement; deforming of fastener threads is not acceptable.
 - .4 Provide concealed fasteners unless indicated otherwise.
 - .5 For exposed locations, provide countersunk flathead fasteners with finish matching item fastened.
- .11 Anchors: Three-way adjustable anchors with minimum adjustment of that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - .1 Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M-09 or ASTM A153/A153M-09 requirements.
- .12 Sheet metal backpans and air barriers: 0.91 mm (0.036") (20 gauge) thickness, galvanized sheet steel to ASTM A653/A653M-11, Designation G90/Z275.
 - .1 Fasteners: Corrosion resistant, zinc plated, covered and sealed to sheet metal with silicone sealant.
- .13 Dielectric separator: Non-staining alkali resistant, rubber isolation pads or 10 mil vinyl membrane type, electrolytic isolation factor of 1.0.
- .14 Internal sealant and air barrier sealant: One-part, neutral cure, high performance silicone sealant complying with ASTM C920-11, Type S, Grade NS, Class 25, capable of sustaining dynamic movements, SWRI sealant validated.
- .15 Insulation at spandrels, closures and flashings: ASTM C612-10, Type IVB, non-combustible to CAN/ULC-S114-05, 5 kPa compressive strength at 10% compression.
 - .1 Acceptable Products:
 - (1) Owens Corning 'Fiberglas Type 703'.
 - (2) Johns Manville 'MinWool Curtainwall'.
 - (3) Roxul 'CurtainRock'.
- .16 Insulation attachment; one of the following:
 - .1 Galvanized stick-pins, welded to sheet metal backpans, located at maximum spacing of 300 mm (12") o/c and within 150 mm (6") from edge of insulation boards. Seal welds with 1 coat zinc-rich coating.
- .17 Zinc-rich coating: Touch-up paint for welded galvanized areas; 2 coats of zinc-rich paint to CAN/CGSB 1.171-98, VOC <340 g/L.

.18 Thermal break component:

- .1 Rigid polyvinyl chloride or neoprene or polyurethane providing full separation of interior and exterior components. Thickness shall be as required to meet design, 6 mm (1/4") minimum thickness.
- .2 Glass fibre reinforced polyamide porthole extrusion providing full separation of interior and exterior components. Thickness shall be as required to meet design, 6 mm (1/4") minimum thickness.

.19 Miscellaneous steel: CSA G40.21-04, Grade 300W.

.1 Finishes:

- (1) Behind air/vapour barrier: CISC/CPMA 2-75 primer.
- (2) Exterior to air/vapour barrier, and where condensation could occur: hot dip galvanized after fabrication or Type 300 series stainless steel.

.20 Spacers for glazing sections receiving metal flashed, panels; behind pressure plate: High density polyethylene (HDPE) or PVC.

2.3 FINISHES

.1 Exposed aluminum surfaces:

- .1 Colour Anodized Finish: Ensure aluminum finish is colour anodized in accordance with Aluminum Association; www.aluminum.org, Finish Designation AA-M12C22A44, Class I, minimum 0.018 mm (0.7 mils) thick finish for exterior and interior exposure. Colour to match reviewed sample.
- .2 Colour: as per Drawings.

.2 Finish exposed metal fasteners: finish to match related aluminum surfaces.

.3 Finish steel clips and reinforcing steel with 380 g/m² (13.4 oz/ft²) zinc coating to CAN/CSA G164-M92.

2.4 FABRICATION - GENERAL

- .1 Insofar as practical, execute fitting and assembly in the shop with the various parts or assemblies ready for erection at the Place of the Work.
- .2 Take field measurements and levels required to verify or supplement those shown for the proper layout and installation of the Work. Coordinate dimensional tolerances in adjacent building elements and confirm prior to the commencement of the work of this section. Commencement of installation floor by floor shall be construed as acceptance of building conditions. Glazing systems shall not deviate from tolerances specified.
- .3 Verify measurements at the Place of the Work and fabricate systems to suit dimensions at the Place of the Work.
- .4 Conceal nuts, bolts, screws, clips and other means of fastening in finished Work, except where shown or specified otherwise.
- .5 Maintain dimensional tolerances from vertical and horizontal planes with the closest possible accuracy for the various parts as previously designated.
- .6 Means of anchoring systems shall have sufficient adjustment to permit correct and accurate alignment. After adjustment, positively lock anchorage devices in manner to preclude movement, once alignment is achieved.

- .7 Isolate aluminum bearing contact with dissimilar materials other than air/vapour seal. Method of isolation shall be to Consultant's acceptance.
- .8 Make allowances for deflection of structure above when making connection thereto, and ensure that no structural load is transmitted to glazing systems.
- .9 Fixing screws shall be countersunk and concealed. Screws shall be oval head, Phillips head, set flush with adjacent surfaces.
- .10 Assume full responsibility for the design of assemblies. Reinforcing, furring and anchoring shall suit each specific condition complying with the parameters previously specified, required and as shown.
- .11 Form accurate extrusions with clean, straight, sharply defined profiles free from any defects.
- .12 Form flashing bends with clean, straight, sharply defined profiles without damage and discolouration to finish.
- .13 Extrusion thickness shall be adequate to satisfy loading and deflection, as required and indicated.
- .14 Weld aluminum where required with inert metal arc equipment by methods recommended by the Aluminum Co. of Canada. Welders shall qualify according to CSA W47.2- 11(R2015). Make exposed welds continuous and flush with adjacent surface. Do not mar surface finishes with welds in back of exposed aluminum. Do not deform the exposed metal and finish in any way by welding.
- .15 Weld steel, where required, in accordance with CSA W59-13. Welded joints shall be of adequate strength and durability with jointing tight and flush. Welder shall be fully approved by the Canadian Welding Bureau and shall comply with CSA W47.1-09(R2014), Division 3. Where it is necessary to weld components already galvanized, remove galvanizing for 50 mm (2") around weld and paint over welds where galvanizing is removed as specified hereinafter.
- .16 Insert concealed prime painted steel reinforcement into cavities of frame members to the interior side of integral air seal web, sized to adequately withstand wind pressure requirements specified.
- .17 Include aluminum cover plates, trim components, bent plates, closure trim, extruded glazing corner posts, drips, flashings and other components required to complete the installation and as indicated whether specifically labelled/dimensioned or only notionally indicated.
- .18 Trim glazing spline at continuous embedded sill flashing locations (to ensure full upturn of flashing) behind pressure plate.
- .19 Include thermal barriers, and miscellaneous neoprene pads, shims and washers.
- .20 Metal-to-metal joints which require sealing to maintain weathertightness shall be designed and assembled with a ribbon of sealant that shall be compressed by approximately 50% of its original thickness when the joints are secured.
- .21 Fabricate frame systems complete with mullions, head and sill frames, spigots, and plugs for horizontals, spline gaskets, thermal break pressure plates, filler pieces, snap-on caps, and other necessary components.
- .22 Sill flashing: extruded aluminum with vertical concealed legs for support, finished to match aluminum frames, clipped to full length continuous bent aluminum clip with vertical leg at back, 25 mm (1") projection beyond wall cladding surface unless otherwise indicated. Provide preformed drip deflectors for sill ends at jambs. Provide preformed butt joint and corner sill splice connectors and sealant to prevent water penetration. Locate splice connectors (joint covers) at center line of mullions when required.

2.5 FABRICATION - ALUMINUM SHEET PANEL CONSTRUCTION

- .1 Fabricate aluminum sheet panel systems complete with continuous recesses to profiles and sizes shown, and to specified tolerances.
- .2 Systems shall be designed and fabricated using non-cumulative, concealed attachment methods.
- .3 Anchorage: Allow for expansion and contraction.
- .4 Include cold rolled framing, furring, brackets, clips, hangers and incidental components as required for secure fastening and provide weathertight installation including non-corrosive fasteners.
- .5 Allow for condensation and inner wall drainage at sill members and other shapes which would otherwise tend to trap water.
- .6 Lay out panels to obtain uniform metal and paint grain finish. Mark direction of metal grain and paint application on back of panels.

2.6 FABRICATION - HOT ROLLED STEEL FRAMING

- .1 Fabricate necessary hot-rolled, framing and support members and non-corrosive anchorage members required to support the glazing systems, concealed from view.
- .2 Framing members shall be welded construction, designed for welding to weld plates supplied for casting into concrete for welding to steel structure.
- .3 Framing finishes:
 - .1 Exterior to air barrier exposure: Hot-dipped galvanized.
 - .2 Interior to air barrier exposure: Prime painted CISC/CPMA 2-75.

2.7 FABRICATION - METAL AIR BARRIER

- .1 Brake form barrier from sheet metal to permit assembly using self-tapping screws, and attachment using powder-activated or pneumatic fixings or other means of secure fastening.
- .2 Make provision in barrier design to accommodate movement resulting from thermal change and from structural deflection.
- .3 Form edges to 45° angle to permit peripheral and joint sealing.
- .4 Cut, fit and form metal air barriers as required to accommodate conflicting framing connections, mechanical and electrical appurtenances and other obstructions.

2.8 FABRICATION TOLERANCES

- .1 Comply with the following maximum tolerances:
 - .1 Plumb: 3.2 mm in 3 m (1/8" in 10'-0"); 6.35 mm in 12.2 m (1/4" in 40'-0").
 - .2 Level: 3.2 mm in 3 m (1/8" in 10'-0"); 6.35 mm in 12.2 m (1/4" in 40'-0").
 - .3 Alignment:
 - (1) Where surfaces abut in line or are separated by reveal or protruding element up to 12.7 mm (1/2") wide, limit offset from true alignment to 1.6 mm (1/16").
 - (2) Where surfaces are separated by reveal or protruding element from 12.7 to 25.4 mm (1/2" to 1") wide, limit offset from true alignment to 3.2 mm (1/8").

- (3) Where surfaces are separated by reveal or protruding element of 25.4 mm (1") wide or more, limit offset from true alignment to 6.4 mm (1/4").
- .4 Variation from plane: 3.2 mm in 3.6 m (1/8" in 12'-0"); 12.7 mm (1/2") over total length.
- .5 Panels:
 - (1) Bow: 0.2% of panel dimensions up to 3.2 mm (1/8") maximum.
 - (2) Indicated size:
 - (a) Up to 1220 mm (48"): plus/minus 0.76 mm (0.030").
 - (b) 1220 mm to 3050 mm (4'-0" to 10'-0"): plus/minus 1.52 mm (0.060").
- .6 Square or rectangular: Maximum 3.2 mm (1/8") difference between diagonal measurements.
- .7 Variation from indicated position: plus/minus 3 mm (1/8").
- .2 Tolerances shall not be cumulative.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of this Section depends.
 - .2 Verify actual site dimensions and location of adjacent materials prior to commencing work.
 - .3 Ensure openings and recesses to receive work of this Section are within permitted tolerances.
 - .4 Report in writing to the Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of this Section.
 - .5 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .6 Commencement of work implies acceptance of existing conditions and work by others.

3.2 INSTALLATION - GENERAL

- .1 Verify dimensions of supporting structure by measurement at the Place of the Work so that aluminum framed glazing systems will be accurately designed, fabricated and fitted to the structure.
- .2 Coordinate with the work of other sections and hand-over items to be placed during the installation of other work at the proper time to avoid delays in the Work.
- .3 Erect frames complete with necessary reinforcing and incidental components.
- .4 Include anchors, dowels and fastenings shown, specified, or necessary to anchor work together or to work of separate sections. Supply items and inserts required to be built into other work. Submit instructions for proper location, and verify proper positioning. Survey location of imbeds after initial pour to verify tolerances.
- .5 Use anchors that will permit sufficient adjustment for accurate alignment.
- .6 Accurately fit and rigidly frame together units where required. Match components carefully to produce continuity of line and design. Provide flush hairline joints and weathertight connections.

- .7 Ensure adequate clearance and shim space at perimeter of openings.
- .8 After welding galvanized steelwork, touch-up weld areas with 2 coats of primer, zinc-rich at galvanized locations.

3.3 INSTALLATION TOLERANCES

- .1 Comply with the following maximum tolerances:
 - .1 Plumb: 3.2 mm in 3 m (1/8" in 10'-0"); 6.35 mm in 12.2 m (1/4" in 40'-0").
 - .2 Level: 3.2 mm in 3 m (1/8" in 10'-0"); 6.35 mm in 12.2 m (1/4" in 40'-0").
 - .3 Alignment:
 - (1) Where surfaces abut in line or are separated by reveal or protruding element up to 12.7 mm (1/2") wide, limit offset from true alignment to 1.6 mm (1/16").
 - (2) Where surfaces are separated by reveal or protruding element from 12.7 to 25.4 mm (1/2" to 1") wide, limit offset from true alignment to 3.2 mm (1/8").
 - (3) Where surfaces are separated by reveal or protruding element of 25.4 mm (1") wide or more, limit offset from true alignment to 6.4 mm (1/4").
 - .4 Variation from plane: 3.2 mm in 3.6 m (1/8" in 12'-0"); 12.7 mm (1/2") over total length.
 - .5 Panels:
 - (1) Bow: 0.2% of panel dimensions up to 3.2 mm (1/8") maximum.
 - (2) Indicated size:
 - (a) Up to 1220 mm (48"): plus/minus 0.76 mm (0.030").
 - (b) 1220 mm to 3050 mm (4'-0" to 10'-0"): plus/minus 1.52 mm (0.060").
 - .6 Square or rectangular: Maximum 3.2 mm (1/8") difference between diagonal measurements.
 - .7 Variation from indicated position: plus/minus 3 mm (1/8").
- .2 Tolerances shall not be cumulative.

3.4 FOAMED-IN-PLACE INSULATION

- .1 Install between aluminum framing and rough openings at exterior walls and where indicated, in accordance with Section 07 21 00.

3.5 ISOLATION

- .1 Provide Bituminous SA membranes on aluminum in contact with cement, concrete, masonry, plaster or dissimilar metals.

3.6 AIR BARRIER CONTINUITY WITH BUILDING ENVELOPE

- .1 Provide continuous air barrier transition between work of this section where work interfaces with building envelope air barrier materials. Provide EPDM or PVC glazing pocket filler or joint plug to seal glazing rebate where applicable; sealed airtight with silicone sealant.

- .2 Install in accordance with manufacturer's installation instructions. Seal lap joints and seal perimeter to adjacent building envelope air barrier material with silicone sealant.
- .3 Coordinate with adjacent materials for continuity and compatibility.

3.7 GLASS AND GLAZING

- .1 Furnish glass for work of this section to requirements herein and in accordance with Section 08 80 00, and assume total responsibility for sizing, design and other aspects of glass work and accessories.
- .2 Wherever practicable, factory install glass associated with doors of this section in accordance with requirements stipulated under Section 08 80 00, except as otherwise indicated herein.

3.8 SEALANT - INSTALLATION

- .1 Provide sealants associated with this section, following the requirements of Section 07 92 00. Make entire installation watertight.

3.9 FINISHING HARDWARE - INSTALLATION

- .1 Install finishing hardware in accordance with Section 08 70 00.

3.10 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Conduct field inspection and testing as specified in Section 01 45 00
 - .2 Field review programme to include:
 - (1) Verification of proper insulation, vapour retarder, and air barrier installation
 - (2) Checks of all interface and termination seals against other elements.
 - (3) Review of panel to panel air seals, review of roof/wall interface
 - (4) Review of panel fastening, exterior sealants etc.
 - (5) Checks of air and vapour seals/barriers for continuity, penetrations and correct orientation.
 - (6) Checks for continuity of insulation plane.
 - (7) Verification of flashing placement and continuity.
 - (8) Special review of interfaces between different elements such as wall/roof, curtain wall/masonry, to verify continuity of envelope performance.
 - (9) Review of exterior applied sealants and flashings.
 - (10) Confirmation of fastener size, type, and material
 - (11) Review of drainage paths to confirm clear.
 - (12) Verification of glass type and position
 - .3 Field Tests: Units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.
 - .4 Testing: Testing shall be performed per AAMA 503 by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements.
 - .5 Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², which ever is greater.

- .6 Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 psf (383 Pa).
- .2 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.

3.11 ADJUSTING AND CLEANING

- .1 Adjust operating hardware and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
- .2 Remove as the work of this section progresses, corrosive and foreign materials which may set or become difficult to remove at time of final cleaning or which may damage members. Inspect as often as required to ensure cleanliness.
- .3 Remove non-permanent labels.
- .4 Remove dirt and residue from surfaces.
- .5 Remove Products or materials that have been broken, chipped, cracked, discoloured, abraded, or damaged during construction period and Provide undamaged Products or materials meeting the requirements of the Contract Documents.
- .6 Wash exposed surfaces with a cleaning solution approved by Product manufacturers.

3.12 PROTECTION

At completion of the Work, remove protective coatings, clean glass and aluminum and remove surplus compounds and sealant materials. Replace or make good defective, scratched or damaged work

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 1.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 SECTION INCLUDES

- .1 Furnish, deliver and install all finish hardware.
- .2 It is intended that the following list of hardware will cover all finish hardware to complete the project.

1.3 RELATED SECTIONS

- .1 06 20 00 - Finish Carpentry
- .2 06 40 00 - Architectural Woodwork
- .3 08 11 00 - Metal Door & Frames
- .4 08 14 00 - Wood Doors
- .5 08 41 00 – Entrances and Storefronts
- .6 Division 26

1.4 PRODUCTS SUPPLIED BUT NOT INSTALLED IN THIS SECTION

- .1 Power supplies, compressor/control boxes, junction boxes installed by Division 26.

1.5 ALLOWANCES

- .1 The Contract Price includes a stipulated sum cash allowance as specified in Section 01 21 00.

1.6 SUBMITTALS

- .1 Submit a hardware schedule showing a detailed list of finish hardware complete with a description, purpose and location of each hardware item.
- .2 Templates: Upon award of Contract, furnish promptly to the applicable trades, any patterns, templates, template information and manufacturer's literature required to the proper preparation for the application of hardware, in ample time to facilitate the progress of the work.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials undamaged, in original wrappings or containers with manufacturer's labels and seals intact.
- .2 Pack finishing hardware for each floor, etc., where possible, in the same carton complete with all screws, expansion shields and necessary fittings for fixing same.
- .3 Clearly label cartons and packages designating contents and locations for which each item is intended. Indicate on packing memos carton in which each item is packed.

1.8 REJECTIONS

- .1 Defective materials or quality of work whenever found at any time prior to final acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error.
- .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

1.9 EXTRA MATERIALS

- .1 At the completion of the Work, supply Owner with the following:
 - .1 Two (2) sets of manufacturer's instructions for door closers, locksets, door holders and panic hardware.

1.10 WARRANTY

- .1 Provide warranties by the accepted manufacturers:

HARDWARE ITEM	LENGTH OF WARRANTY
.1 Mortise Hinges	Lifetime
.2 Locks (Mortise)	3 years
.3 Exit Devices	3 years
.4 Door closers -mechanical	30 years
.5 Door Operators - Electro mechanical	2 years
.6 Electric Hold Open Devices - Electro mechanical	2 years
.7 Overhead stops/holders	1 year
.8 Floor/Wall stops	1 year
.9 Electric Strikes/Key Switches/Power Supplies	1 year

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Products listed in the hardware groups are from the manufacturers listed below:

ITEM	MANUFACTURER NAME
.1 Full Mortise Hinges	Ives
.2 Continuous Hinges	Ives
.3 Locksets/Latchsets/Deadbolts	Schlage
.4 Exit Devices	Von Duprin
.5 Surface/Flush Bolts	Ives
.6 Door Closers	LCN
.7 Overhead Door Holders/Stops	Glynn Johnson

.8	Door Pulls/Flatware	Canadian Builders Hardware
.9	Wall/Floor Stops	Ives
.10	Weather/Smoke/Sound Seals	KN Crowder
.11	Door Sweeps/Thresholds	KN Crowder
.12	Automatic Door Operators/Actuators	LCN
.13	Electric Strikes	Von Duprin
.14	Power Supplies/Junction Boxes	Von Duprin

2.2 MATERIALS

.1 Screws and Fasteners:

- .1 All screws to be matching finish to their product and to be manufacturer's standard. Door closers, door holders and exit devices installed on fire rated wood doors and hollow metal doors to be attached with the appropriate fasteners to meet code requirements.

Materials-Acceptable Manufacturers (Note: Supply all products in a given category from the same manufacturer):

(1) Mortise Hinges

- (a) Furnish five knuckle ball bearing hinges with NRP option on all reverse bevel doors with locking hardware. Doors less than 950mm wide supply 114 high hinges, door greater than 950mm wide supply 127mm high hinges. Hinge width to accommodate door closer projection, door trim and allow for 180-degree swing. High traffic doors listed in hardware groups to be supplied with 4 heavy weight hinges. Balance of doors up to 2286mm in height, supply 3 hinges, doors greater than 2286mm in height add one hinge for every additional 760mm of door height. Supply ferrous (steel) material for all interior and/or fire-rated doors and stainless steel for exterior doors.

- (i) As Specified: Ives Hinges, 5BB1, 5BB1HW

(2) Continuous Hinges:

- (a) Continuous hinges to be Ives heavy duty edge mount/edge guard continuous gear type aluminum hinges. Ives aluminum hinges tested and approved to UL 10C (90 minutes). Material 6063-T6 aluminum, clear satin finish (628). Aluminum geared hinges certified to ANSI 156.26 Grade 2. Hinge length 25mm (1") less door height.

- (i) As Specified: Ives 112HD

(3) Surface/Flush Bolts/Co-Ordinators

- (a) Surface Bolts: Surface bolts to have 1" throw for maximum security with concealed mounting that prevents vandalism. Units to be constructed of heavy duty steel and cUL listed up to three (3) hours when used on the inactive door of a pair up to 8' in height.

- (i) Supply as Specified: Ives SB453 series.

- (b) Flush Bolts-Metal Doors: Manual flush bolt for metal doors to be cUL listed for 3-hour fire doors with ½" diameter bolt tip with ¾" throw. Standard rod length to be 12", supply longer length rods to suit higher door heights. Supply dustproof strikes with all flushbolts.

- (i) Supply as Specified: Ives FB458 series.
- (c) Constant Latching Flush Bolts-Metal Doors: Constant latching flush bolts for metal doors to be cUL listed for 3-hour fire doors. Inactive door remains latched until the active door is opened, releasing the automatic bottom bolt and then the top bolt can be manually released. Inactive door will relatch automatically. Standard rod length 12", supply longer rod length to suit higher door heights. Non-Handed with fire-rated models with auxiliary fire latch to eliminate the use of a bottom bolt. Supply dustproof strikes with all flushbolts.
 - (i) Supply as Specified Ives FB50 series
- (4) Locksets/Deadlocks/Privacy Sets:
 - (a) Cylindrical-Lever: Standard duty commercial exterior and interior cUL listed for all functions up to 3-hour doors. Levers to be solid pressure cast zinc with no plastic inserts. Precision solid brass 6-pin cylinder with nickel silver keys available in all Schlage keyways. Grade 2 lever sets to have through bolts to prevent chassis rotation with internal components and chassis constructed of cold rolled steel with zinc dichromate plating to resist corrosion. Lever sets to have independent heavy duty compression springs as well as precision laser cut stainless steel spindles with interlocking on keyed side.
 - (i) Supply as Specified: Schlage "AL" series
 - (b) Mortise: Grade 1 Operational, Grade 1 Security, mortise lock for commercial and institutional buildings. Manufacture lock cases from fully wrapped, heavy 12 gage steel with a protected leading edge and screw configuration that limits access to operating parts. Lock components to be manufactured of zinc dichromate plated steel. Latch bolts to have a standard 2 3/4" backset with a full 3/4" throw. Latchbolts to be non-handed, field reversible with out opening the lock case. Latchbolts to be 2 piece anti-friction, manufactured from stainless steel. Solid latchbolts and/or plastic anti-friction devices are not acceptable. Deadbolts to be 1 3/4" total length have standard 1" throw with a minimum 3/4" internal engagement when fully retracted. Deadbolts to be constructed of stainless steel, incorporating a security roller pin with a minimum Rc60 rating for surface hardness. Lever assembly (external) to be one piece design attached by threaded bushing. Lever assembly (internal) to be attached by screw less shank. Lever attachments by common tools (allen nuts and/or set screws) are not acceptable. Thru bolt lever assemblies through the door for positive interlock. Levers to have independent rotation in both directions. Lever operation to be free wheeling (clutch) when in the locked mode. Spring cages are to be incorporated into the lever assemblies. Hub blocking plate to be solid, cast stainless steel. Manufacturers utilizing open hub designs are not acceptable. Spindles to be independent, designed to "break away" at a maximum of 75psi torque. Mounting tabs are to be automatic self adjusting, vertically and horizontally for door bevel and strike alignment. Cylinders to be secured by a cast stainless steel, dual retainer. Manufacturers utilizing screws and/or stamped retainers are not acceptable.
 - (i) Supply as Specified: Schlage "L" series, 03B lever design
 - (c) Strike Plates: Provide lockset and latchset strike plates with lip centre dimensions sized to minimally clear trim. Where strike lip extends beyond the projection of the casing or other trim, provide curved lip strikes. Strike plates applied to inactive leaf of paired openings to have flat lip sized to fit flush with the face of the door skin.
- (5) Exit Devices/Device Trims/Mullions:

- (a) Narrow Style: Exit device to be cUL listed for panic hardware and fire exit hardware. Supply exit devices and fire exit devices featuring coil compression springs on all device mechanism subassemblies and dead latching mechanisms for all active latchbolts. Supply exit devices with smooth mechanism case and "the quiet one" fluid dampener to eliminate noise associated with exit device operations. Non-handed device with touchpad assemblies with no exposed fasteners and cast end caps, reinforced aluminum with stainless steel touchpad and raised edge to minimize pinching. Doors greater than 915mm wide supply long bar exit devices, doors greater than 2134mm high supply extension rods were required. Fits door stiles as narrow as 1 3/4".
 - (i) Supply as Specified: Von Duprin 35A series
- (b) Heavy Duty: Exit device to be cUL listed for panic hardware and fire exit hardware. Supply exit devices and fire exit devices featuring coil compression springs on all device mechanism subassemblies and dead latching mechanisms for all active latchbolts. Supply exit devices with smooth mechanism case and "the quiet one" fluid dampener to eliminate noise associated with exit device operations. Non-handed device with touchpad assemblies with no exposed fasteners and cast end caps, reinforced aluminum with stainless steel touchpad and raised edge to minimize pinching. Roller strikes to be standard on all rim and surface vertical rod devices. Doors greater than 915mm wide supply long bar exit devices, doors greater than 2134mm high supply extension rods for surface vertical rod series. 1,000,000cycle testing independently certified by ETL.
 - (i) Supply as Specified: Von Duprin 98, series
- (c) Device Trim: Supply device trim featuring recessed cylinder mounting and coil compression spring design with shear pin protection for all lever designs. Similar lever designs for exits as specified for locksets.
 - (i) Supply as Specified Von Duprin 996 series
- (d) Mullions Rated: Fire rated cUL approved mullion for up to three hour openings up to 8' x 8' using Von Duprin rim devices prepared for 499F strikes. Supply with key removable kit to provide quick removal to provide single door performance and security on double door applications.
 - (i) Supply as Specified: Von Duprin KR9954
- (e) Mullions Non-Rated: Aluminum mullions complete with mullion stabilizers prepared with 1408 strikes for use with all Von Duprin rim devices to provide single door performance and security on double door applications.
 - (i) Supply as Specified: Von Duprin 5754
- (6) Door Closers:
 - (a) Door closers to have the following features (see separate closer sections below for further information):
 - (i) Fully hydraulic, rack and pinion action with high strength cast iron cylinders and one piece forged steel pistons.
 - (ii) Include high efficiency, low friction pinion bearings.
 - (iii) Hydraulic fluid of a type requires no seasonal adjustments, ULTRA X TM fluid has constant temperature control from -35o C to +49o C.
 - (iv) Hydraulic regulation controlled by tamper-proof, non-critical screw valves, adjustable with a hex wrench.
 - (v) Separate adjustments for backcheck, general speed and latch speed.

- (vi) Door closers with special template (ST-) numbers include all required associated product, information sheets and instructions
 - (vii) Size 1 manual door closers to provide less than 5 pounds opening force on a 900mm door leaf.
 - (viii) Door closer with Pressure Relief Valves are not accepted.
 - (ix) Door closer bodies, arms, covers to be powder coated
 - (x) Closers with painted finishes shall exceed a minimum 100-hour salt spray test, as described in ANSI A156.18 and ASTM B117.
 - (xi) Closers detailed with plated finishes shall include plated covers (or finish plates), arms and visible fasteners.
- (b) Medium Duty Mechanical (Interior/Exterior): Non-sized (1-6) and non-handed cylinder body to have 1 ¼" piston diameter with 5/8" single heat-treated shaft. Track closer cylinder body non-sized (2-4) or (1-2). Closers to have forged steel main arm and forearm. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.
- (i) Supply as Specified: LCN 1460 HD FC series
- (c) Heavy Duty Mechanical (Multiple Applications): Non-sized (1-6) and non-handed cylinder body to have 1 1/2" piston diameter with 11/16" journal double heat-treated pinion shaft with full compliment bearings and certified to exceed ten million (10,000,000) full load operating cycles by a recognized independent testing laboratory. Closer to have "FAST" Power Adjust speed dial to show spring size power. Track closers non-sized 1-4. Closers to have stamped main arm and forearm (forged steel main arm and forearm EDA and SCUSH type arms). Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever forged arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.
- (i) Supply as Specified: LCN 4040, 4040XP series
- (d) Heavy Duty Mechanical (Top Jamb Mount): Non-sized (1-5) and handed cylinder body to have 1 1/2" piston diameter with 11/16" double heat-treated shaft and certified to exceed ten million (10,000,000) full load operating cycles by a recognized independent testing laboratory. Track closers sized 1,3 or 4. Closers to have forged steel main arm. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.
- (i) Supply as Specified: LCN4020 series
- (e) Heavy Duty Electric Operator (Push Side Mount): Non-sized (2-5) and non-handed cylinder body to have 1 1/2" piston diameter with 11/16" double heat-treated shaft and certified to exceed ten million (10,000,000) manual full load operating cycles by a recognized independent testing laboratory. Power operator to include:
- (i) Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical code.
 - (ii) "Second Chance" function: program within the on-board computer monitoring resistance during opening cycle. If resistance is present operator pauses for a few seconds, then attempts to open door again. If resistance does not exist door will open normally. However if resistance still exists, door will pause and the unit will time out and door will close.

- (iii) "Breakaway" drive system: System within the motor/clutch assembly. If the door is forced closed while in the opening cycle, the clutch slips preventing damage to the operator, door and frame.
- (iv) "Soft Start" motor control: required for controlled start once actuator is depressed to extend the service life of all drives components.
- (v) "Built in Power Supply" to deliver 12V and 24V outputs up to a maximum of 1.0 amp.
- (vi) Certified by cUL for use on labeled doors.
- (vii) Independent adjustments for all electrically controlled functions within controller module.

a Supply as Specified: LCN 4640 series

(7) Actuators:

- (a) Wall Type: Wall plate switch to be hard-wired actuator with round, stainless steel touch plate in either 4 ½" diameter. Engraved blue filled handicap symbol conforms to most accessibility codes. Units to include heavy grade components for vandal resistant mounting and weather resistant switch standard.

(i) Supply as specified: LCN 8310-856T c/w 8310-874

(8) Overhead Door Stops/Holders

- (a) Heavy Duty Surface Mounted: Surface overhead stops/holders to be stainless steel base, non-handed for single-acting doors with a heavy-duty channel/slide-arm design and offset jamb bracket to allow for simple field modifications of functions. Channel to be surface mounted to the door with thru bolts and the jamb bracket is surface mounted to the jamb.

(i) Supply as Specified: Glynn-Johnson 90 series

- (b) Heavy Duty Concealed Mounting: Concealed overhead stops/holders to be stainless steel base, non-handed for single or double-acting doors with a low profile channel, mortised in the door and jamb bracket is mortised in the doorframe. Unit to be fully concealed when door is in the closed position. Units to be field adjustable for function changes if required.

(i) Supply as Specified: Glynn-Johnson 100 series

(9) Door Pulls/Flatware/Coat Hooks:

- (a) All flatware to be of stainless steel material unless otherwise noted.
 - (i) Supply as Specified:
 - a CBH 903 T304 B4E (Kickplates 40mm less door width single door and 25mm less door width double doors)
 - b CBH 923 T304 B4E Push Plate
 - c CBH 380 127 x 508, cut for cylinder where specified with a cylinder/deadlock
 - d CBH 350 cylinder pull
 - e CBH 400 door pull
 - f CBH7238 door pull
 - g CBH 7523B door pull

(10) Floor/Wall Stops:

- (a) Wall Stops: Wall stops to be constructed of brass/bronze base with special retainer cup that makes the rubber stop tamper resistant. Convex design of rubber bumper.

(i) Supply as Specified: Ives WS401CVX

- (11) Weather/Smoke/Sound Seals/Finger Guards:
 - (a) Supply as Specified:
 - (i) KN Crowder W-20S (head seal)
Note: Mount head seal prior to soffit mounted hardware.
 - (ii) KN Crowder W-50S (jamb seal, head/jamb seal))
 - (iii) KN Crowder W-21 (head/jamb seal)
 - (iv) KN Crowder W-13 (sound seal)
 - (v) National Guard 2248A – 76"
- (12) Thresholds/Weather-strip/Door Sweeps:
 - (a) Supply as Specified:
 - (i) KN Crowder W-24S (Door Sweep)
 - (ii) KN Crowder CT-46 (Threshold)
 - (iii) KN Crowder CT-41-1, CT-43-1(Threshold)
- (13) Keyswitch/Electric Strikes/Power Supplies, Power Transfers, Mortar Guards:
 - (a) Keyswitch: Keyswitch housing to be cast zinc to protect against vandalism, housing to provide a concealed rear mounting attachment which cannot be compromised when the cylinder is attached with a set screw. Standard stainless steel cover plate.
 - (i) Supply as Specified: Schlage 650 series
 - (b) Electric Strikes: Grade 1, electric strikes to be cUL listed burglary-resistant and electric strike for fire doors and frames. A label for single doors and B label for double doors. Electric strikes to be stainless steel construction, non-handed available in 12V or 24V AC or DC with continuous duty solenoid and accept ¾" throw latchbolts. Strike box to be adjustable to compensate for any misalignment of the door or frame with two piece plug connector for ease of installation.
 - (i) Supply as Specified: Von Duprin 6000 series
 - (c) Power Supplies: Power supplies to be tested and certified to meet UL294. Universal 120-240 VAC input, low voltage DC output, regulated and filtered. Power supplies to have 2A, 4A, 6A output, 12/24VDC field selectable with jumper. Provide emergency release terminals, where required, that allow the release of all devices upon activation of the fire alarm system complete with fire alarm input for initiating "no delay" exiting mode. Power supply to be flat mounting design and polarized locking connections for additional option boards specified.
 - (i) Supply as Specified: Von Duprin/Schlage Electronics PS-902, PS-914
 - (d) Electro-Magnetic Door Holders: Provide floor and wall mounted units to hold door in open position and to release and automatically close under fire alarm conditions. Electromagnet shall be protected against transients and voltage surges up to 600 volts. Power requirements, tri-voltage field selectable, 12, 24VDC, 120VAC.
 - (i) Supply as Specified: LCN-SEM 7800 series
 - (e) Power Transfer: Provide a means to transfer power from frame to door stile. Devices shall be reversible and allow a full 180° door swing with 4 1/2" x 4 1/2" butt hinges or 3/4" offset pivots. When door is in closed position, transfer unit shall be concealed. Transfer units shall contain ten 24 awg UL approved conductors. Rating: 10 Amps at 24 VDC (Class 1 low voltage)
 - (i) Supply as Specified: Von Duprin EPT

- (f) Mortar Guards: Provide and weld in place TA-LD1 or TA-LD2 at frame locations where electrified hardware components are to be mounted. Provide proper handing of mortar guard boxes to the hollow metal frame supplier. Hollow Metal frame supplier is responsible for ensuring the proper location of all required mortar boxes.
- (g) Junction Box: Provide high quality NEMA 1, junction box to provide convenient installation for electrified hardware. Units are surface mounted 254mm high, 254mm wide, 152mm deep and includes hinged door with twist turn lock, 20 position terminal strip to accept 24 to 12 guage wire.
- (i) Supply as Specified: Von Duprin JB7

2.3 FINISHES

- .1 Unless otherwise specified, all finishes to be brushed chrome (626).
- .2 Finishes are specified as follows:

ITEM	HMA#	DESCRIPTION	BASE MATERIALS
HINGES	630	SATIN STAINLESS STEEL	STAINLESS STEEL
HINGES	652	SATIN CHROME PLATED	STEEL
CONTINUOUS HINGES	628	ANODIZED ALUMINUM	ALUMINUM
LOCK TRIM	626	SATIN CHROME PLATED	BRASS/BRONZE
EXIT DEVICES	626	SATIN CHROME PLATED	BRASS/BRONZE
DOOR CLOSER	689	POWDER COAT ALUMINUM	STEEL
DOOR PULLS	630	SATIN STAINLESS STEEL	STAINLESS STEEL
CYLINDER PULL	626	SATIN CHROME PLATED	BRASS/BRONZE
PROTECTIVE PLATE	630	SATIN STAINLESS STEEL	STAINLESS STEEL
DOOR STOPS/HOLDERS			
OVERHEAD	630	SATIN STAINLESS STEEL	STAINLESS STEEL
WALL/FLOOR	626	SATIN CHROME PLATED	BRASS/BRONZE
THRESHOLDS	628	ANODIZED ALUMINUM	ALUMINUM
WEATHERSTRIP	628	ANODIZED ALUMINUM	ALUMINUM
MISCELLANEOUS			
MULLIONS	628	POWDER COAT ALUMINUM	STEEL
KEY SWITCHES	630	SATIN STAINLESS STEEL	STAINLESS STEEL
ELECTRIC STRIKES	630	SATIN STAINLESS STEEL	STAINLESS STEEL
JUNCTION BOXES	689	POWER COATED	STEEL

2.4 KEYING - CYLINDERS, KEYING SYSTEMS AND KEY CONTROL

- .1 Meet with the Owner to finalize keying requirements and obtain keying instructions in writing as outlined in Division 1. Interior locks and cylinders shall be furnished in a new Schlage Grand Master key system D123 keyway, facility code E11297. Exterior locks and cylinders to be Schlage Primus High Security Removable Core Cylinders 20-740 series "CEP" keyway supplied "0" bitted with unique Level Three side-bit milling.
- .2 Provide temporary construction keying system during construction period. Permanent keys will be furnished to the Owner's Representative prior to occupancy. The Owner or Owner's Security Agent will void the operation of the construction keys.
- .3 Furnish keys in following quantities:
 - .1 Furnish a sum total of six (6) cut change keys per change combination. This sum total of keys to be cut and furnished as directed by Owner.

- .2 Furnish a sum total of(6) each Cut Master Key per group, twenty (20) cut grand master keys, 100 cut lock down keys.. Furnish any unused balance of Master Keys of any type as key blanks directly to Owner with the Cut Keys.
- .3 Pack keys independently from cylinders and ship as directed by Owner.
- .4 Permanent cylinders to be keyed by factory, combined in sets or subsets, master keyed or great grand master keyed, as directed by Owner. Stamp key biting on one of the six change keys issued. DO NOT stamp keys and cylinders with key code combinations.
- .5 Deliver all permanent key blanks and Primus High Security cylinders and other security keys direct to Owner's representative (address noted on authorized Primus Level Three facesheet) from factory by secure courier, return receipt requested. Failure to properly comply with these requirements may be cause to require replacement of all or any part of the cylinders and keys involved as deemed necessary at no additional cost to the Owner.
- .6 After the Owner or the Owners Security Agent has removed the last construction cylinder inserts, check all locked doors against the approved keying schedule.
- .7 Hardware distributor will provide key cabinets with complete cross-index system, place keys on markers and hooks in the cabinet as determined by the finial key schedule and directed by the owner. See misc hardware group for model numbers.
- .4 All keying requirements to be confirmed by owner.

3 EXECUTION

3.1 ADJUSTING

- .1 The services of a competent mechanic shall be provided without additional cost to the Owner.
- .2 Mechanic: inspect the installation of all hardware furnished under this Section and supervise all adjustments (by the trades responsible for fixing) which are necessary to leave hardware in perfect working order.

3.2 DEMONSTRATION

- .1 Demonstrate proper care of hardware to Owner as specified in Section 01 77 00, including:
 - .1 lubrication of locksets,
 - .2 adjustments of door closers,
 - .3 cleaning, and
 - .4 general maintenance.

3.3 HARDWARE GROUPS

Hardware Group No. 01

PR 2032 X 2150 X 45 X ALD X ALF X NONRTD

For use on door #(s):

C1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	CONT. HINGE	112HD EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	5754	628	VON
1	EA	PANIC HARDWARE	CD-35A-DT-386	626	VON
1	EA	ELEC PANIC HARDWARE	RX-EL-HD-35A-NL-386	626	VON
1	EA	MORTISE CYLINDER	20-001 114 XQ11-949 D123 KWY	626	SCH
1	EA	RIM CYLINDER	20-057ICX	626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX key switch	626	SCH
2	EA	PRIMUS CORE	20-740 CEP "0" BITTED	626	SCH
2	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4021	689	LCN
1	EA	SURF. AUTO OPERATOR	4642	689	LCN
1	EA	MOUNTING PLATE	4020-18G	689	LCN
1	EA	WEATHER RING	8310-800	BLK	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-856T	630	LCN
2	EA	ESCUTCHEON	8310-874	689	LCN
2	EA		WEATHERSEAL BY DOOR SUPPLIER		
2	EA	DOOR SWEEP	W-24S	628	KNC
1	EA	THRESHOLD	CT-41-1	628	KNC
1	EA	THRESHOLD	CT-42-1	628	KNC
1	EA	THRESHOLD	FROST INSERT	628	KNC
1	EA	KEYSWITCH	653-14 L2	630	SCE
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS914 900-4RL	LGR	VON
1		CARD ACCESS ROUGH IN			

Hardware Group No. 02

PR 1830 X 2150 X 45 X HMD X HMF X 45MIN

For use on door #(s):

C1a

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
8	EA	HW HINGE	5BB1HW 127 X 114 NRP	652	IVE
2	EA	FIRE EXIT HARDWARE	9849-L-BE-F-996-03-LBL	626	VON
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA ST-3068 Template to 180 degrees	689	LCN
1	EA	SURF. AUTO OPERATOR	4642	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-856T	630	LCN
2	EA	ESCUTCHEON	8310-874	689	LCN
2	EA	KICK PLATE	CBH 903 150 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS401CVX	626	IVE
1	SET	SMOKE SEAL	W-21	BLK	KNC
2	EA	ASTRAGAL	W-25	628	KNC

Hardware Group No. 03

SGL 1015 X 2150 X 45 X HMD X HMF X 45MIN

For use on door #(s):

C2

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
4	EA	HW HINGE	5BB1HW 114 X 114 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	9849-L-F-996-03-LBL	626	VON
1	EA	RIM CYLINDER	20-021 D123 KWY	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA ST-3068	689	LCN
1	EA	KICK PLATE	CBH 903 150 X SIZE TO SUIT	630	CBH
1	EA	FIRE/LIFE WALL MAG	SEM7850	689	LCN
1	SET	SMOKE SEAL	W-21	BLK	KNC
1	EA	ASTRAGAL	W-25	628	KNC

Note: Connect SEM magnets to fire alarm panel.

Hardware Group No. 04

SGL 965 X 2150 X 45 X WD X HMF X NONRTD

For use on door #(s):

218

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 114 X 102	652	IVE
1	EA	STOREROOM LOCK	L9080P 03B D123 KEY	626	SCH
1	EA	SURFACE CLOSER	1461 DEL HD REG	689	LCN
1	EA	KICK PLATE	CBH 903 150 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS401CVX	626	IVE

Hardware Group No. 05

SGL 965 X 2150 X 45 X WD X HMF X NONRTD

For use on door #(s):

220 222 224

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 114 X 102	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050P 03B D123 KWY	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA ST-3068	689	LCN
1	EA	KICK PLATE	CBH 903 150 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS401CVX	626	IVE

Hardware Group No. 06

SGL 965 X 2150 X 45 X HMD X HMF X NONRTD

For use on door #(s):

226

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 114 X 102	652	IVE
1	EA	STOREROOM LOCK	L9080P 03B XL11-422 D123 KEY	626	SCH
1	EA	INTERFACE BOX	JB7	GRAY	VON
1	EA	MORTAR GUARD	TAC-LD1-ES	BLK	TAC
1	EA	ELECTRIC STRIKE	6211 FS	630	VON
1	EA	SURF. AUTO OPERATOR	4631	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-856T	630	LCN
2	EA	ESCUTCHEON	8310-874	689	LCN
1	EA	KICK PLATE	CBH 903 150 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS401CVX	626	IVE
1	EA	PUSH TO LOCK BUTTON	CM-400/8	630	CAM
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	MORTAR GUARD	TAC-LD1-DC	BLK	TAC
1	EA	WASHROOM RELAY	EMF-2		CAM
1	EA	POWER SUPPLY	PS902	LGR	SCE

Hardware Group No. 07

SGL 965 X 2150 X 45 X HMD X HMF X NONRTD

For use on door #(s):

232

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 114 X 102	652	IVE
1	EA	STOREROOM LOCK	L9080P 03B D123 KEY	626	SCH
1	EA	KICK PLATE	CBH 903 100 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS401CVX	626	IVE

Hardware Group No. 08

SGL 965 X 2150 X 45 X WD X HMF X NONRTD

For use on door #(s):

208

210

227

229

231

233

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 114 X 102 NRP	652	IVE
1	EA	CLASSROOM SECURITY	L9071P 03B XL11-986 D123 KWY	626	SCH
1	EA	KICK PLATE	CBH 903 150 X SIZE TO SUIT	630	CBH
1	EA	WALL STOP	WS401CVX	626	IVE

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 1.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 SUMMARY

- .1 Supply and install automatic swing door operators as detailed on drawings. Co-ordinate installation and operation of new work with existing doors, frames, and controls such as card access system, to suit owners requirements and maintain continued public access to premises during work.
- .2 Related Sections
 - .1 Section 08 70 00 – Hardware
 - .2 Section 26 05 00 – Common Work Results for Electrical: Electrical connections to automatic swing door.
 - .3 Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables: Operators and low voltage wiring between activation.
 - .4 Section 26 29 00 – Low-Voltage Controllers: Button locations and power door operation.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Administrative requirements shall be in accordance with General Conditions and Division 01.
- .2 Coordination:
 - .1 Cooperate and coordinate fully with Work of other Sections in order to proceed with Work of this Section in a timely manner.
 - .2 Supply items to be built-in in ample time to be incorporated into work of other Sections together with measurements and other information required for location thereof.
 - .3 Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing automatic door operators.
 - .4 Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.
 - .5 Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to power supplies and access-control system.
 - .6 Ensure work which may create dust does not proceed during work related to painting and final finishing.

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
- .3 Shop Drawings:
- .4 Submit shop drawings showing assembly and installation details, methods and location of fastenings. Include manufacturer's catalogue cut sheets for all products for the Work of this Section.
- .5 Include plans, elevations, sections, hardware mounting heights, and attachment details.
- .6 Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- .7 Indicate locations of activation and safety devices.
- .8 Include diagrams for power, signal, and control wiring.
- .9 Include plans, elevations, sections, and attachment details for guide rails.

1.5 QUALITY ASSURANCE

- .1 Manufacturer's:
 - (1) Manufacturer shall have a minimum of 5 years' experience having successfully supplied products required for the Work of this Section for other projects of similar size and complexity.
- .2 Installer's:
 - (1) Installer shall have a minimum of 5 years' continuous Canadian experience successfully completing projects similar in size and complexity as the Work of this Section. Submit proof of experience upon Consultant's request.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials of this Section in accordance with Section 01 61 00.
- .2 Deliver materials undamaged, in original wrappings or containers with manufacturer's labels and seals intact.
- .3 Clearly label cartons and packages designating contents and locations for which each item is intended. Indicate on packing memos carton in which each item is packed.

1.7 WARRANTY

- .1 Manufacturer Warranty:

- .1 General Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.
- .2 Failures include, but are not limited to, the following:
 - (1) Faulty or sporadic operation of automatic door operator, including controls.
 - (2) Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.
- .3 Automatic Door Operators shall be free of defects in material and workmanship for a period of two (2) year from the date of Substantial Performance.
- .4 During the warranty period a factory-trained technician shall perform service and affect repairs. An inspection shall be performed after each adjustment or repair.

1.8 REJECTIONS

- .1 Defective materials or quality of work whenever found at any time prior to final acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error.
- .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

1.9 EXTRA MATERIALS

- .1 At the completion of the Work, supply Owner with the following:
 - .1 Two (2) sets or wrenches.
 - .2 Two (2) sets of manufacturer's instructions.

2 PRODUCTS

2.1 AUTOMATIC SWING DOOR OPERATORS

- .1 Full energy, automatic swing door operators shall be "Power Swing", self contained, surface mounted system, as manufactured by Besam (Division of ASSA ABLOY Entrance Systems)
- .2 Operator Housing: The operator shall be completely contained in a 130 x 110 mm, extruded, clear anodized, Class I aluminum housing. The housing shall extend across entire door opening. Where located on a leaf of a double door, it shall extend over both doors. All aluminum sections shall be of 6006-T6 alloy and shall have a minimum wall thickness of 4 mm. The operator housing shall provide a seal against dust, dirt and moisture.
- .3 Electrical Motor: Electric motor shall be minimum 1/4 HP, 120 V and shall be equipped standard with a built-in thermal overload protection and shall not exceed 5 amps.
- .4 Operator Assembly: Operator shall be non-handed and the power transmission shall be servo unit type with one moving part. Helical/mesh or chain driven system will not be accepted.

- .5 Electric Control: A self-contained, 100% solid state integrated circuit shall control the operation and switching of the swing door power operator. The electronic control shall provide low voltage power supply for all means of operation. No external or auxiliary low voltage source shall be allowed. The control shall include time delay (adjustable between 1 to 60 seconds) for normal cycle. Plug-in relays, resistors, contacts, etc. will not be accepted.
- .6 Push Buttons:
 - .1 Nominal 100 mm diameter flush mount, engraved with "Push to Open", with a blue handicap logo.
 - .2 Finish: Stainless Steel, with a satin finish.

2.2 OPERATION

- .1 Power Open: The automatic door operator shall be powered by a force transmitted by the electric motor to the servo unit and shall be connected by way of an adjustable arm linkage to the door. A constant opening pressure shall be maintained at all times. Both opening speed and backcheck must be individually adjustable. External/manual stops will not be accepted. The automatic door system shall function as a manual door closer in the event of a power failure, and allow for manual operation at all times, requiring no more than 5 - 7 pounds force on opening manually.
- .2 Spring Close: The automatic door operator shall be spring closed action. The spring shall be non-handed and designed to counter-act wind and stack conditions, and return the door to its fully closed position. Both closing speed and latching shall be individually adjustable, without the need to change resistors or any other components.
- .3 The automatic door system shall be self-contained, requiring no remote pumps or compressors. Pneumatic tubing will not be accepted.
- .4 Operator must be adjusted with sufficient backcheck to prevent wind from damaging the door.
- .5 Push and go feature will not be accepted.
- .6 Manual reset buttons will not be accepted.
- .7 Operator must be electro-hydraulic technology to ensure longer life with lower maintenance.

2.3 FASTENINGS

- .1 Provide hardware complete with screws, bolts, expansion shields and other fastening devices as required for the satisfactory installation and operating of the hardware.
- .2 Provide fastening devices of the same finish as the hardware that is to be fastened.

2.4 SHOP FINISHES

- .1 Provide hardware of type and finish in accordance with, and equal in all respects to the samples of hardware and finishes approved by the Consultant.
- .2 Metal finishes shall be free from defects, clean and unstained, and of a uniform colour and finish for each type of finish required.

3 EXECUTION

3.1 EXAMINATION

- .1 Verify that the openings are plumb and are dimensioned properly. Insure adequate support has been provided for the operator header. Proceed with the installation only after conditions have been deemed satisfactory.

3.2 INSTALLATION

- .1 Install equipment in accordance with manufacturer's installation guidelines.
- .2 Adjust equipment to ANSI 156.10.
- .3 Refer to Division 26 for wiring, connections and installation standards. Provide wiring diagrams and schematics.

3.3 ADJUSTING

- .1 The services of a competent mechanic shall be provided without additional cost to the Owner.
- .2 Mechanic: inspect the installation of hardware furnished under this Section and supervise adjustments (by the trades responsible for fixing) which are necessary to leave hardware in perfect working order.

3.4 DEMONSTRATION

- .1 Demonstrate proper care of hardware to Owner as specified in Section 01 79 00, including:
 - .1 lubrication,
 - .2 adjustments,
 - .3 cleaning, and
 - .4 general maintenance.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section Includes: Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required, to complete the work of this Section
 - .1 Provide all of the glazing materials and products indicated on the drawings and room finish schedule including but not limited to the following:
 - (1) Safety glass
 - (2) Fire rated glass
 - (3) Insulated glass units
 - (4) Spandrel glass
 - (5) Mirrors
 - (6) Glazing gasketry, sealants, tapes, vision strips
 - (7) Glazing compounds and glazing putty.
 - .2 Work Installed in This Section But Furnished By Others:
 - .1 All items required for glazing installation supplied by windows, door and frame contractor.

1.3 REFERENCES

- .1 CAN/CGSB-12.1-M90: Tempered or Laminated Safety Glass
- .2 CAN/CGSB-12.3-M91: Flat, Clear Float Glass
- .3 CAN/CGSB-12.5-M86: Mirrors, Silvered
- .4 CAN/CGSB-12.8-97: Insulating Glass Units
- .5 CAN/CGSB-12.11-M90: Wired Safety Glass
- .6 CAN/CGSB-12.9-M91: Glass Spandrel
- .7 ANSI Z97.1: American National Standard for Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test
- .8 ASCE 7 – Minimum Design Loads for Buildings and Other Structures
- .9 ASTM C-162: Standard Terminology of Glass and Glass Products
- .10 ASTM C-1048: Standard Specification for Heat-Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass
- .11 ASTM C-1376: Standard Specification for Pyrolitic and Vacuum Deposition Coatings on Flat Glass
- .12 ASTM E-2188: Standard Test Method for Insulating Glass Unit Performance
- .13 ASTM E-2189: Standard Test Method for Testing Resistance to Fogging in Insulating Glass Units
- .14 ASTM E-2190: Standard Specification for Insulating Glass Unit Performance and Evaluation

1.4 REJECTIONS

- .1 Defective materials or quality of work whenever found at any time prior to final acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error.
- .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

1.5 WARRANTY

- .1 Manufacturer's Warranty for Coated-Glass Products: Manufacturer's standard form, made out to the glass fabricator, in which the coated glass manufacturer agrees to replace coated glass units that deteriorate during normal use within the specified warranty period. Deterioration of the coated glass is defined as peeling and/or cracking, or discolouration that is not attributed to glass breakage, seal failure, improper installation, or cleaning and maintenance that is contrary to the manufacturer's written instructions. Warranty Period: 10 years from date of Substantial Completion.
- .2 Manufacturer's Warranty on Insulating Glass: Manufacturer's standard form in which the insulating glass unit manufacturer agrees to replace insulating-glass units that deteriorate during normal use within the specified warranty period. Deterioration of insulating-glass units is defined as an obstruction of vision by dust, moisture, or a film on the interior surfaces of the glass caused by a failure of the hermetic seal that is not attributed to glass breakage, improper installation, or cleaning and maintenance that is contrary to the manufacturer's written instructions. Warranty Period: 5 years from date of Substantial Completion.
- .3 Manufacturer's Warranty on Laminated Glass: Manufacturer's standard form in which the laminated glass manufacturer agrees to replace laminated glass units that deteriorate during normal use within the specified warranty period. Deterioration of laminated glass is defined as defects, such as discolouration, edge separation, or blemishes exceeding those allowed by ASTM C 1172 that are not attributed to glass breakage, improper installation, or cleaning and maintenance that is contrary to the manufacturer's written instructions. Warranty Period: 10 years from date of Substantial Completion.
- .4 Warrant mirrors for a minimum of 5 years against silver deterioration.

1.6 SUBMITTALS

- .1 Shop Drawings and Product Data:
 - .1 Product data on glass types specified – structural, physical and environmental properties, size limitations, special handling or installation requirements.
- .2 System Description:
 - .1 Glass and glazing materials shall provide continuity of building enclosure vapour and air barrier.
 - .2 Size of glass to withstand dead loads and positive and negative live loads acting normal on plane of glass.
 - .3 Limit glass deflection to 1/200 (confirm) or flexure limit of glass with full recovery of glazing materials; whichever is less.
- .3 Samples: Submit 2 – 300x300mm size, demonstrating insulated glazing unit colouration.
- .4 Quality Assurance:
 - .1 Standards

- (1) FGMA Standard
- (2) IGMAC Standard

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Glazing material shall be supplied by the following manufacturers or approved equal.

- .1 Viracon Glass (Insulated Glazing Units, and coatings)
- .2 AFG (Glass, Mirrors)
- .3 PPG Limited (Glass, Mirrors)
- .4 Opaci-Coat 300 (Silicone coatings for Spandrel Glass)
- .5 Bradley Washfountain Company (Mirrors)
- .6 Bobrick Washroom Equipment of Canada Limited (Mirrors)
- .7 Tremco (Canada) Limited (Sealants)
- .8 PRC Chemical Corp. of Canada Limited (Sealants)
- .9 Sinmast of Canada Limited (Sealants)

2.2 MATERIALS

- .1 Provide new materials in perfect condition, free from defects impairing strength, durability or appearance.
- .2 Verify and confirm, to the Consultant, that the glass being installed in the designated lights is of the type, weight and quality specified.

2.3 FLOAT GLASS

- .1 Float glass: to CAN/CGSB-12.3-M, B Quality
 - .1 4mm for sizes up to 2794 mm United inches.
 - .2 5mm for sizes up to 3302 mm United inches.
 - .3 6mm for sizes up to 4 sq.m.
 - .4 Draw lines shall run horizontally.

2.4 SAFETY GLASS

- .1 Tempered safety glass: 6 mm thick; to CAN/CGSB-12.1-M, Type 2, heat treated.
- .2 Laminated safety glass: 6 mm thick; to CAN/CGSB-12.1-M.

2.5 FIRE RATED GLASS

- .1 Wired Glass: 6 mm Georgian polished, to CAN/CGSB-12.11.

2.6 SEALED DOUBLE GLAZED UNITS

- .1 Sealed Insulated Glass Units: to CAN/CGSB-12.8, dehydrated air space.

.1 Insulated Glazing Unit (IGU), Type 1:

- (1) Exterior light: 6 mm tempered, Blue 2000T by PPG glass.
- (1) Air Space: Argon filled
- (2) Warm edge spacer
- (3) Interior light: 6 mm tempered clear glass with Solarban 70xL (or other Low E as required to meet total system performance requirements)
- (4) U-Value: Max 0.26 or as required to meet overall framing plus glazing system U-Value of 0.35 max.
- (5) SHGC: Max 0.37 or as required to meet overall framing plus glazing system SHGC of 0.35 max.

2.7 SPANDREL GLASS

.1 Spandrel Glass: Low iron, Tempered safety glass, with back coating on No. 2 surface

.1 Back Coating: One component, water-based silicone coating supplied as flowable, thixotropic emulsion.

- (1) Acceptable Product: Opaci-Coat 300 Silicone Paint, Colour: "Arctic Blue, Eclipse Advantage".

2.8 LIGHT DIFFUSING INSULATED GLAZING UNITS

.1 Where indicated in architectural drawings, provide OKALUX light diffusing glass fiber insert by SCHOTT.

.1 Distributed by ClearStream: johnc@clearstreamarchitectural.com

.2 Thickness shall accommodate argon gas within sealed unit.

.2 Or approved equal by Solera (aerogel)

.1 Distributed by Advanced Glazings Ltd.: info@advancedglazings.com

2.9 MIRRORS

.1 Mirrors: 6 mm type 18 Float glass Blue label, to CAN/CGSB-12.5-M; c/w galvanized steel back; as follows:

.1 Over Lavatories: 457 mm x 610 mm over each lavatory, stainless steel frame with concealed wall hangers.

- (1) Mounting height of mirrors shall be maximum 1000mm above finished floor.

.2 Over Vanities: 914 mm high by full width of vanities, polished edges with tamperproof fasteners.

2.10 ACCESSORIES

.1 Glazing sealant shall be Tremco "Proglaze". P.R.C. "Rubber Calk 2000" or approved equal.

.2 Glazing Tape:

.1 Lites under 1900 mm united inches Tremco "440" tape or approved equal.

.2 Lites over 1900 mm united inches Tremco "Polyshim" tape or approved equal.

.3 Setting blocks: Neoprene or EPDM with a Shore "A" hardness of 80-90 durometer.

- .4 Shims and spacers: as recommended by the glass manufacturer.

3 EXECUTION

3.1 EXAMINATIONS

- .1 Report to the Consultant, in writing, all defects of work prepared by other trades and unsatisfactory site conditions.
- .2 Commence the work of this division when surfaces specified to receive glazing are dry, clean, level; free from cracks, ridges, dusting, scaling, carbonation, mortar droppings, parging, curing, compounds, grease, oil, or other foreign material liable to impair adhesion, performance or appearance.
- .3 Commencement of work implies total acceptance of all surface conditions.
- .4 Waive any after claims by failure to comply with the above procedure of examination.

3.2 BREAKAGE

- .1 Make good any and all breakage resulting from faulty quality of work.

3.3 QUALITY OF WORK

- .1 Remove protective coatings and clean contact surfaces with solvent and wipe dry.
- .2 Apply primer-sealer to contact surfaces.
- .3 Place setting blocks as per manufacturer's instructions.
- .4 Install glass, rest on setting blocks, ensure full contact and adhesion at perimeter.
- .5 Install removable stops, without displacing tape or sealant.
- .6 Provide edge clearance of 3 mm minimum.
- .7 Insert spacer shims to center glass in space. Place shims at 600 mm OC and keep 6 mm below sight line.
- .8 Apply cap bead of sealant at exterior void.
- .9 Apply sealant to uniform and level line, flush with sightline and tooled or wiped with solvent to smooth appearance.
- .10 Do not cut or abrade tempered, heat treated, or coated glass.

3.4 GLAZING (EXTERIOR)

- .1 Combination method - tape/sealant:
 - .1 Cut glazing tape to proper length and set against permanent stops, 6 mm below sightline. Install horizontal strips first; extend over entire width of opening before applying vertical strips. Weld corners together by butting tape and dabbing with sealant.
 - .2 Fill gap between glass and applied stop with sealant to depth equal to bite of frame on glass but not more than 12 mm below sightline.

3.5 GLAZING (INTERIOR)

- .1 Dry method - tape/tape:
 - .1 Cut glazing tape to length and install against permanent stop, project 1.5 mm above sightline.
 - .2 Place glazing tape on free perimeter of glass in same manner described above.

3.6 CLEANING

- .1 Remove all debris and tools from site upon completion and acceptance of the work.
- .2 Final cleaning of glass will be done by the Contractor at the completion of the Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 Section includes: Provide the following prefabricated items to be supplied:

- .1 Louvres

- .2 Related Sections

- .1 Section 04 20 00 – Unit Masonry.
 - .2 Section 06 40 00 – Architectural Woodwork.
 - .3 Section 07 92 00 – Joint Sealants.
 - .4 Section 08 11 00 – Metal Doors and Frames.
 - .5 Division 23 – Mechanical

1.3 REFERENCES

- .1 AAMA 2605-05: Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- .2 AMCA 501-03: Application Manual for Louvres.
- .3 ANSI/NFPA 80-1999: Fire Doors and Fire Windows.
- .4 CAN/CSA-G164-M92 (R2003): Hot Dip Galvanizing of Irregularly Shaped Articles.

1.4 DESIGN REQUIREMENTS

- .1 Design Products to withstand wind and snow loads in accordance with local code requirements.
- .2 Allowable Deflection for Structural Members: maximum L/180 or 19 mm, whichever is less.
- .3 Allowable Deflection for Blades: maximum L/120 or 13 mm across the weak axis, whichever is less.
- .4 Design louvres to have an average free area of 51 percent when tested to AMCA 500-L.
- .5 Design louvres to have an intake pressure drop of 1.44 mm H₂O measured at 213 metres per minute free area velocity.
- .6 Design louvres to have an exhaust pressure drop of 2.94 mm H₂O measured at 305 metres per minute free area velocity.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings as specified in Section 01 33 00, specifically provide the following:
 - .1 Profile, options, finishes, louvre sizes, quantity, and location.
 - .2 Identify free area of each louvre.
 - .3 Identify interface to adjacent wall construction. Provide details of insulated blank-off section.
 - .4 Refer to Mechanical Drawings for sizes, locations and quantities.

1.6 REJECTIONS

- .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight or errors.
- .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver and store materials undamaged in original cartons or wrappings.
- .3 Store material in a secure, dry area.

2 PRODUCTS

2.1 LOUVRES

- .1 Exterior metal louvres, as shown or indicated on plans, elevations, sections or door finish schedule shall be:
 - .1 Model SP345 by M.W. McGill & Associates or equivalent by Construction Specialties. Finish shall be Duranar from the standard colour range to Architect's selection. Birdscreen: 12 x 12 mm aluminum mesh in extruded aluminum frame.
- .2 Approved Manufacturers:
 - .1 Construction Specialties Ltd.
 - .2 K.N. Crowder Mfg. Co. Ltd.
 - .3 Daymond Limited
 - .4 Ferrowall Sales Ltd.

2.2 FABRICATION

- .1 Fabricate Products free from distortion and effects detrimental to appearance and performance.
- .2 Fasten louvre frames and blades with stainless steel screws or heliarc welding.

- .3 Neatly mitre louvre frames at corners and reinforce with corner brackets.

2.3 SHOP FINISHING

- .1 Aluminum Surfaces: Painted to AAMA 2605, two-coat thermosetting fluoropolymer coating, 0.03 mm thick; eg. PPG Duranar, colour as selected by Consultant.
- .2 Galvanizing: to CAN/CSA-G164-M, hot dipped method, minimum 275 g/m² zinc coating.

3 EXECUTION

3.1 EXAMINATIONS

- .1 Report to the Consultant, in writing, all defects of work prepared by other trades and on unsatisfactory site conditions.
- .2 Do not commence the work of this Division until surfaces, area, conditions specified or indicated on drawings, to receive manufactured specialties, are compatible with the manufacturer's installation requirements.
- .3 Commencement of work implies total acceptance of all preliminary installation requirements by the Contractor installing manufactured specialty items.
- .4 Waive any after claims by failure to comply with the above procedure of examination.

3.2 INSTALLATION

- .1 Securely install Products plumb and level, with uniform joints, and in accordance with manufacturer's installation guidelines.
- .2 Install louvres and vents to AMCA 501.
- .3 Cut and trim components during erection only with the approval of the manufacturer. Make good damaged finishes.
- .4 Remove and replace members where site-cutting or trimming has impaired the strength or appearance of the assembly.
- .5 Flash exterior louvres, vents and grilles to prevent water infiltration into building enclosure.
- .6 Seal around louvre and grille frames to ensure weathertight joint. Conform to Section 07 92 00.
- .7 Install attic vents properly flashed to prevent water infiltration into building enclosure.

3.3 ERECTION TOLERANCES

- .1 Maximum Variation From Plane: plus or minus 3 mm per 3.66 metres of length, but not exceeding 13 mm in any total building length.
- .2 Maximum Offset From True Alignment Between Two Members: plus or minus 1.5 mm, under both loaded and non-loaded conditions.

3.4 ADJUSTING

- .1 Field touch-up scratches or damaged enamel finishes.

3.5 CLEANING

- .1 Upon the completion of work, remove from the site all surplus materials and debris caused by this work and leave the site in a clean condition to the satisfaction of the Consultant.
- .2 Remove dirt spots and foreign material from the installed items, leaving them in a clean, usable condition.

3.6 PROTECTION

- .1 Be responsible for protection of all manufactured specialty work during period of construction.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 1.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 SUMMARY

- .1 Section includes: Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified or required, to complete the work of this Section including but not limited to the following:
 - .1 Non-load-bearing steel stud partitions
 - .2 Ceiling and bulkhead framing
 - .3 Wall furring
 - .4 All gypsum wallboard
 - .5 Gypsum wallboard trims
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 05 40 00 – Cold-Formed Metal Framing.
 - .2 Section 06 10 00 - Rough Carpentry: Wood support systems.
 - .3 Section 09 51 00 - Acoustical Ceilings.

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian General Standards Board (CGSB):
 - (1) CAN/CGSB-71.25-M88: Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.
 - .2 Canadian Standards Association (CSA):
 - (1) CAN/CSA-A82.27-M91: Gypsum Board.
 - (2) CSA A82.31-M1980: Gypsum Board Application.
 - .3 Gypsum Drywall Construction Handbook by Canadian Gypsum Company.
 - .4 Manual of Gypsum Wallboard Construction by Gypsum Drywall Contractors International.

.5 U.S. Green Building Council (USGBC):

(1) Reference Guide for Building Design and Construction (BD+C), v4. – current version

1.4 SUBMITTALS

.1 Submittals under this Section shall be in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements.

.3 Shop Drawings:

.1 Submit shop drawings indicating design, construction, control joint layout, sound attenuating construction, adjacent construction, elevations, finishes and relevant details of furring, enclosures and partitions which require fire rating

.2 Submit written confirmation and design for shaft wall construction showing adequacy of system in meeting fire ratings and its ability to withstand pressures and deflections that may occur.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Manufacturer's:

(1) Manufacturer shall have a minimum of 5 years' experience having successfully supplied products required for the Work of this Section for other projects of similar size and complexity.

.2 Installer's:

(1) Installer shall have a minimum of 5 years' continuous Canadian experience successfully completing projects similar in size and complexity as the Work of this Section. Submit proof of experience upon Consultant's request.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials of this Section in accordance with Section 01 61 00.

.2 Deliver and store Products in a dry area under cover, in original wrappings, cartons or containers clearly marked as to type, colour and manufacturer.

.3 Store gypsum board flat. Take care to avoid undue sagging damage to ends, edges, or surfaces. Avoid stacking unequal lengths together.

.4 Store gypsum board so that it is not in contact with new concrete floors - use dunnage @ 400 mm (16") OC to raise board piles.

.5 Provide separate disposal container for all gypsum products left over from construction. Arrange for recycling of gypsum materials with product Supplier.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - (1) Bailey Metal Products Ltd.; www.bmp-group.com
 - (2) Chicago Metallic; www.chicagometallic.com
 - (3) CGC Inc; www.cgcinc.com
 - (4) Georgia-Pacific Canada, Inc.; www.gp.com
 - (5) Gordon Incorporated.; www.gordongrid.com
 - (6) Roll Formed Specialty; www.rollformed.com
 - (7) Westroc Inc.; www.westroc.com
 - (8) Trim-Tex Inc.; www.trim-tex.com
 - (9) Unifix Inc.; www.unfixinc.ca
 - (10) Unistrut Canada; www.unistrut.com
 - .2 Substitution Limitations:
 - .1 Comparable Products from manufacturers not listed herein may be accepted provided they meet requirements of this Specification.

2.2 MATERIALS

- .1 Steel Studs: Minimum 0.55 mm (25 ga.) hot dipped or electro-galvanized sheet steel at 400 mm (16") OC, to ASTM C645; knockout pass-through holes at 460 mm (18") OC; Flanges minimum 30 mm (1¼") wide, edges bent back 90 degrees and doubled over; single length floor to ceiling.
- .2 Floor and Ceiling Track (standard application): Minimum 0.55 mm (25 ga.) hot dipped or electro-galvanized sheet steel at 400 mm (16") OC, to ASTM C645; Leg design minimum 25 mm (1") high; width to suit studs. Provide deflection track as required to suit deflection anticipated by structural conditions.
- .3 Ceiling Track (deflection application): Inner and outer deflection type tracks; minimum 0.91 mm (20 ga) x size to fit 92 mm (3 5/8") stud, and full galvanized G60 steel; by Bailey or approved equal. Refer to Standard Details.
- .4 Ceiling track (curved walls): Two 0.55 mm (25 ga.) continuous angles, crimped/cut to suit shape.
- .5 Ceiling Deflection Track and Firestop System: Fire Trak System by Fire Trak Corp., Kimball, MN (1-800-394-9875). System shall include 16 gauge galvanized steel ceiling runner profile (Shadowline, Cavity Shadowline, Reveal or Cavity Reveal) and Fire Trak Stud Clips.

- .6 Furring Channels: 19 mm, 22 mm (3/4", 7/8") - minimum .55 mm (25 gauge) G90 galvanized steel at 400 mm (16") OC.
- .7 Fasteners: Manufacturer's standard, suitable for application intended.
- .8 Tie Wire: 1.6 mm (16 gauge) galvanized soft annealed steel wire.
- .9 Hangers: 4.1 mm (No. 8) galvanized wire.
- .10 Carrying Channels: 39 mm x 19 mm - 1.6 mm (1½" x 3/4" - 16 gauge) G90 galvanized steel channel, for bulkhead construction.
- .11 Ceiling Suspension Systems
 - .1 Rigid "X" drywall suspension system by CGC Inc. or approved equal.
 - .2 System shall be comprised of 30 mm x 24 mm (1½" x 15/16") tee sections of 0.60 mm (24 gauge) steel and 73 mm x 22 mm (2" x 7/8") cross channels of 0.38 mm (26 gauge) hot dipped galvanized steel.
- .12 Furring Clips: Snap-on clips - 2.6 mm (12 gauge) wire.
- .13 Partition Attachment to T-bar: Use partition attachment clips PACS15 (standard edge) or PACR15 (Reveal Edge) by CGC Interiors.
 - .1 Securement Channel: 0.55 mm (25 gauge) galvanized steel - 50 mm x 25 mm (2" x 1") by Bailey or approved equal.
 - .2 Fasteners: Non-powder activated as recommended by manufacturer, suitable for wall composition by Rawl Tapcon or approved equal.
- .14 Gypsum Board: to CAN/CSA A82.27-M, as follows:
 - .1 Moisture and mold resistant wall panels conforming to ASTM C1658, glass mat water-resistant gypsum panel.
 - (1) 16mm (5/8") tapered edge, straight cut ends.
 - (2) 13mm (1/2") tapered edge, straight cut ends.
 - (3) Acceptable Products:
 - (a) DensArmour Plus by Georgia-Pacific Gypsum
 - (b) Glass-Mat Panels Mold Tough by CGC
 - .2 Fire Resistant Board (Type "X"): Minimum 16 mm (5/8") thick, tapered edges, straight cut ends, type X., identified for use in a ULC tested assembly.
 - .3 Abuse-Resistant Board: 16 mm (5/8") Sheetrock Abuse-resistant gypsum panels; tapered edges; panel weight minimum 2500 lbs./MSF
 - .4 Impact Resistant Board: 16 mm (5/8") high density core 40 bls. Hardness "Fiberbond" by Louisiana - Pacific (Phone: 1-800-411-2500 / 902-625-3070)

2.3 ACCESSORIES

- .1 Corner Bead, Casing Bead "L" Type: 0.55 mm (25 ga) G90 galvanized sheet metal with perforated flanges.

- .2 Wall reveal trims: (where shown on drawings)
 - .1 within drywall face: SWR-038-063 by Pittcon, or approved alternate.
 - .2 at drywall panel edge: STR-100-063 by Pittcon or approved alternate; size to suit particular application
- .3 Wall cap for exposed wall ends (where required): SWC-358-8 (for 3 5/8" stud) by Pittcon, or approved alternate. Size to suit wall stud width.
- .4 Screws: Self-drilling, self-threading case hardened steel; length as recommended by board manufacturer for each application.
- .5 Adhesive: High strength, waterproof, compatible with materials; to CAN/CGSB-71.25-M.
- .6 Joint Filler: Casein, vinyl or latex base, slow setting, as recommended by board manufacturer.
- .7 Joint Tape: 50 mm (2") wide perforated paper as recommended by board manufacturer.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of this Section depends.
 - .2 Report in writing to the [Consultant] [Project Manager] any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of this Section.
 - .3 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .4 Commencement of work implies acceptance of existing conditions and work by others.

3.2 PREPARATION

- .1 Protect work of other trades from damage resulting from work of this trade.
- .2 Make good any resulting damage, to the satisfaction of the Consultant at no additional cost.
- .3 Maintain uniform temperature in work area, adequate for work being performed, as recommended by materials manufacturer.
- .4 Keep temperature as uniform as possible with deflectors or screens.
- .5 Provide air circulation if humidity is excessive. Avoid high temperature with low humidity. Avoid force drying.
- .6 Allow concrete and masonry to dry thoroughly before installing gypsum board.
- .7 Protect installed materials from weather and dampness.
- .8 Replace any damaged work before further work proceeds.

- .9 Promptly, as the work proceeds and upon completion, clean-up and remove from the site all rubbish and surplus material resulting from work of this trade.

3.3 QUALITY OF WORK

- .1 Erect framing level, plumb and true; to a tolerance of 5 mm in 3 metres (1/4" in 10'), and square with adjoining work.

3.4 INSTALLATION

.1 Framing System

.1 Metal Stud Partitions

- (1) Place studs vertically at 400 mm (16") centres and not more than 50 mm (2") from abutting walls, openings, and each side of corners. Install studs in tracks at floors and ceiling.
- (2) Provide freedom for deflection under beams and structural slabs.
- (3) Permanently attach studs for cornice height partition to top and bottom track.
- (4) Full-height stud each side of opening.
- (5) Erect track at head and/or sill of opening to accommodate intermediate studs above and/or below opening in same manner and spacing as wall studs. Screw fasten members together adjacent to openings.

.2 Deflection Head Allowance

- (1) Allow for a maximum of 2" deflection under beams and structural slabs by utilizing outer and inner top tracks as per Standard Details in this Section.

.3 Fire Dampers in Fire Rated Partitions

- (1) Frame openings for fire dampers required by the Mechanical Contractor. Provide a 13 mm (1/2") drywall filler piece inside the perimeter of opening before installation of the damper so as to maintain the partition fire rating.

.4 Ceiling Suspension System

- (1) Hangers for suspended gypsum board ceilings shall support the grillage independent of walls, columns, pipes, ducts: erect plumb and securely anchor to the structural frame or imbed into concrete slabs.
- (2) Install angle moulding at wall perimeter at a level above the finished ceiling line equal to the total thickness of wallboard to be used. Install only on walls perpendicular to cross channels.
- (3) Hang main tees in parallel rows spaced 1220 mm (4'-0") apart and supported by hanger wires spaced 1220 mm (4'-0") apart at same level as angle moulding. Main tees in adjacent rows must have cross tee slots in perpendicular alignment.
- (4) Install cross-channels by snap locking into position in perpendicular rows spaced 400 mm (16") apart and not less than 200 mm (8") from parallel walls. Fasten ends of cross-channels to angle moulding with screws or pop rivets.
- (5) Fire rated assemblies shall have additional cross-channels within 200 mm (8") of all butt joints and openings for ducts or light fixtures. Allowable percentage of openings and additional wallboard enclosures shall conform to U.L.C. design criteria.

.2 Wall Furring

- .1 Attach furring channels to masonry or concrete surfaces at 400 mm (16") OC and not more than 100 mm (4") from corners and openings.
- .2 Wallboard Application: Always leave a 3 mm (1/8") to 6 mm (1/4") gap between wall board and floor.
- .3 Single Layer Board
 - .1 Screw-on Application
 - (1) Erect gypsum board horizontally or vertically on walls; across framing on ceilings; and secured to the framing with drywall screws at:
 - (2) Ceilings: 300 mm (12") OC
 - (3) Walls:
 - (a) 300 mm (12") OC along ends of board
 - (b) 200 mm (8") OC at perimeters of board
 - (c) 300 mm (12") OC through centre of board.
 - (4) Where it must be applied parallel, support or furring must be provided at maximum 400 mm (16") OC.
 - (5) Allow for 1/4" gap between bottom of gypsum board and top of floor.
 - (6) Ceiling board: 12.7 mm (1/2") minimum thickness.
 - .2 Adhesive Application
 - (1) Apply panel adhesive in 6 mm (1/4") beads to face of framing members or masonry substrate, using caulking gun. Avoid adhesive squeeze-out at joints.
 - (2) Erect gypsum board immediately, press firmly into place and drive supplementary screw fasteners at 600 mm (24") centres.
 - (3) Apply adhesive in well ventilated area. Avoid open flame.
 - .3 Screw-on Application
 - (1) Apply base layer horizontally and screw fasten. Apply face layer vertically and screw fasten in the same manner as base layer.
 - (2) Screw fastening spacing shall be at 300 mm, 600 mm (12", 24") centres.
 - (3) Locate joints over framing and secure with screws.
 - .4 Adhesive Application
 - (1) Adhere base layer to framing with 6 mm (1/4") adhesive beads.
 - (2) Laminate face layer to base layer, using Panel Adhesive (Joint Filler).
- .4 Tilebacker Board
 - .1 Fasten to framing with screws at 200 mm (8") centres where ceramic tile finish is called for on stud partitions.
 - .2 Apply 50 mm (2") glass fibre tape over joints and corners, embed with mortar or adhesive used to set tile.
- .5 Control Joints
 - .1 Gypsum board surfaces should be isolated with control joints or other stress relief where:

- (1) partition or furring abuts a structural element or dissimilar wall or ceiling;
 - (2) ceiling abuts a structural element, dissimilar wall or partition or other vertical penetration;
 - (3) construction changes within the plane of the partition or ceiling;
 - (4) partition or furring run exceeds 9 m (30');
 - (5) ceiling dimensions exceed 15 m (50') for drywall in either direction;
 - (6) exterior soffit dimensions exceed 9 m (30') in either direction;
 - (7) wings of "L", "U" and "T" -shaped ceiling areas are joined;
 - (8) expansion or control joints occur in the structural elements of the building.
- .2 Ceiling-height door frames may be used as control joints, as may less-than-ceiling-height door frames if control joints extend to ceiling from both corners.
 - .3 Leave a 13 mm (1/2") continuous opening between gypsum boards for insertion of surface-mounted joint.
 - .4 Interrupt wood floor and ceiling plates with a 13 mm (1/2") gap, wherever there is a control joint in the structure.
 - .5 Do not attach steel studs on one side of control joint.
 - .6 Provide separate supports for each control joint flange.
 - .7 Provide an adequate seal behind control joint where sound and/or fire ratings are prime considerations.
 - .8 Agree on exact locations of joints with the Consultant.
 - .9 Use drywall screws to fasten board to framing.
 - .10 Minimum fastener length to provide:
 - (1) 10 mm (3/8") minimum penetration into steel framing.
 - (2) 16 mm (5/8") minimum penetration into wood framing.
 - .11 Drive screws perpendicular to face of board with sufficient penetration of screw head to sink below the surface of board without breaking the paper face.
 - .12 Start securing board from the centre and work towards perimeter.
 - .13 Hold board firmly to framing while fastening.
 - .14 Do not set unlike edges together; always mate square to square or tapered to tapered edges.
 - .15 Install casing bead at junction with dissimilar materials.

3.5 SITE QUALITY CONTROL

- .1 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.

3.6 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00.
- .2 Remove all excess materials from site as Work proceeds and at completion.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc., and leave Site neat, clean and tidy to the satisfaction of the Owner.
- .4 Clean and make good surfaces soiled or otherwise damaged as a result of Work of this Section at no additional cost to the Owner.
- .5 Leave surfaces clean and ready for subsequent Work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 INTENT

- .1 Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required, to complete the work of this Section.

1.3 SECTION INCLUDES

- .1 Provide all ceramic tile and required accessories as indicated on the Drawings, and Finishes Plan, including but not limited to, the following:
 - .1 Porcelain floor tiles
 - .2 Porcelain base
 - .3 Grouting
 - .4 Adhesives
 - .5 Setting materials: sand, cement, lime
 - .6 membranes
 - .7 Ceramic accessories
 - .8 Accessories: trims and transitions.
 - .9 Cleaning of ceramic tile installation.

1.4 RELATED SECTIONS

- .1 Section 03 30 00 – Cast-in-Place Concrete: floor slab.
- .2 Section 04 20 00 – Unit Masonry.
- .3 Section 22 10 00 – Plumbing Piping and Pumps: floor drains.

1.5 REFERENCES

- .1 ANSI A108.5-2005: Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
- .2 ANSI A118.4-2005: Latex-Portland Cement Mortar.
- .3 ANSI A118.6-2005: Ceramic Tile Grouts.
- .4 ASTM C370-88 (2006): Standard Test Method for Moisture Expansion of Fired Whiteware Products.
- .5 ASTM C372-94 (2001): Standard Test Method for Linear Thermal Expansion of Porcelain Enamel and Glaze Frits and Fired Ceramic Whiteware Products by the Dilatometer Method.
- .6 ASTM C373-88 (2006): Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Porous Whiteware Products.

- .7 ASTM C424-93 (2006): Standard Test Method for Craze Resistance of Fired Glazed Whitewares by Autoclave Treatment.
- .8 ASTM C484-99 (2003): Standard Test Method for Thermal Shock Resistance of Glazed Ceramic Tile.
- .9 ASTM C485-83 (2003)e1: Standard Test Method for Measuring Warpage of Ceramic Tile.
- .10 ASTM C499-78 (2003): Standard Test Method for Determining Facial Dimensions and Thickness of Flat, Rectangular Wall and Floor Tile.
- .11 ASTM C501-84 (2002): Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
- .12 ASTM C502-04: Standard Test Method for Wedging of Flat, Rectangular Ceramic Wall and Floor Tile.
- .13 ASTM C609-90 (2000): Standard Test Method for Measurement of Small Colour Differences between Ceramic Wall or Floor Tile.
- .14 ASTM C648-04: Standard Test Method for Breaking Strength of Ceramic Tile.
- .15 ASTM C1027-99 (2004): Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile.
- .16 ANSI 137.1 Dynamic Coefficient of Friction Standard.
- .17 CAN/CGSB-75.1-M88: Tile, Ceramic.
- .18 Terrazzo Tile & Marble Association of Canada (TTMAC): Tile Specification Guide, Latest Edition.

1.6 REJECTIONS

- .1 Defective materials or quality of work whenever found at any time prior to acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight and error.
- .2 Remove and replace defective materials and work of other Trades affected by this replacement, at no additional cost to the Owner.

1.7 PERFORMANCE REQUIREMENTS

- .1 All installation assemblies will be composed of materials from the same manufacturer and be completely compatible. The completed assembly will meet the service requirements "extra-heavy" or "heavy" passing ASTM C627 cycles 1 thru 14 as described in the TCA (Tile Council of America) Handbook and recognized by the TTMAC (Tile Terrazzo & Marble Association of Canada) and the CTCIA.
- .2 Install tiles to comply with ANSI A108.5 (80% uniform bonding mortar contact between the tile and the substrate. 95% uniform bonding mortar contact for exterior application).
- .3 Provide only those products that meet or exceed the performance standards as described in the specified ASTM Standards.

1.8 SUBMITTALS

- .1 Submit manufacturer test and performance data as specified in Section 01 33 00.
- .2 Manufacturer Test and Performance Data: indicating slip resistance, compressive strength, water absorption, coefficient of expansion, conductivity, and other pertinent values for each type of tile specified.

- .3 Do not commence work until the performance data sheets are reviewed.

1.9 SAMPLES

- .1 Submit samples as specified in Section 01 33 00.
- .2 Selection Samples: duplicate set of available tile sizes, shapes, and colours for selection by Consultant.

1.10 CLOSE-OUT SUBMITTALS

- .1 Submit three (3) copies of the manufacturer's maintenance instructions, for ceramic floor and wall tile, to the Consultant upon completion of the ceramic installation. Refer to Section 01 78 39.

1.11 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver and store Products in original cartons, clearly marked as to type, colour and manufacturer.
- .3 Store Products in a warm, dry area.
- .4 The Tile Contractor will be responsible to insure the timely arrival of installation materials on site and he will order the appropriate approved materials with sufficient lead time to insure that no delays are incurred due to late material procurement.

1.12 EXTRA MATERIALS

- .1 Furnish the Owner with 2 percent extra materials of each type of tile to be used for future repair work.

1.13 WARRANTY

- .1 Standard Warranty: for a period of two (5) years from substantial completion for parts and labour.
- .2 Manufacturer's Extended Warranty: Warranty products used in each assembly will be free from manufacturing defects and deterioration for a period of five (5) years from the date of Substantial Completion.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Olympia Tile
- .2 Crossville
- .3 Substitution Procedures: as specified in Section 01 25 00.

2.2 TILE MATERIALS

- .1 Porcelain Floor Tile, PTF in Finishes Plan : 300mm x 600mm size; to CAN/CGSB-75.1-M; Rockseries (unglazed) by Olympia tile or accepted alternate, colours as selected by Consultant from supplier's full range of colours:
 - .1 Rock Beige Code # OLRK BGE 1224.
- .2 Porcelain Base, Type PTB: 150mm x 600mm: Rock Series (unglazed) by Olympia Tile:
 - .1 Rock-Biege Code # OLRK BGE 0624.05.

- .3 Glazed Wall Tile, Type PTW: Colour and Dimension Collection by Olympia Tile:

- .1 Biscuit Bright, 100 mm x 400 mm QT.CD.BIS.0416.BR

2.3 GROUT AND ADHESIVES

- .1 Acceptable manufacturers:

- (1) LATICRETE International Inc.
 - (2) MAPEI Corp.
Flextile Ltd.

- .2 Substitution Procedures: as specified in Section 01 25 00.

- .2 Latex Portland cement thin bed mortar: thin set and slurry bond coats to be weather, frost, shock resistant, non-flammable and meet the following physical requirements:

- .1 Compressive strength (ANSI A118.4): 2400 psi (16.5 MPa) min.

- .2 Bond strength (ANSI A118.4): 500 psi (3.5 MPa) min.

- .3 Smoke and Flame Contribution (ASTM E84-06 Modified): 0

- .4 Acceptable products:

- (1) Laticrete 254 Platinum, one step, polymer fortified, thin-set mortar.
 - (2) 211 Crete Filler powder by Laticrete, with Laticrete 4237 Latex thin-set mortar additive.

- .3 Latex Portland cement grout: to be weather, frost and shock resistant, and meet the following physical characteristics.

- .1 Compressive Strength (ANSI A118.7): 3500 psi (24 MPa)

- .2 Water Absorption (ANSI A118.7): <5%

- .3 Linear Shrinkage (ANSI A118.7): <0.1%

- .4 Smoke and Flame Contribution (ASTM E84-06 Modified): 0

- (1) Floor: Laticrete Tri-Poly Fortified Sanded Grout (1500 Series) or Laticrete Tri-Poly Fortified Un-sanded Grout (1600 Series) gauged with Laticrete 1776 Admix Plus as manufactured by Laticrete International Inc., complete with grout sealer compatible with and recommended by manufacturer.

- .5 Grout colours to later selection by Consultant from manufacturer's full range.

2.4 ACCESSORIES

- .1 Floor leveling and repair compound: "Ultraplan 1 Plus" High Compressive Strength Self-Levelling Underlayment, as manufactured by MAPEI.

- .2 Trim and Control Joints: Schluter - Systems Trims and Control Joints or approved equal by Bengard Manufacturing Ltd.

- .3 Outside Corner Trim: Schluter - "Jolly" anodized aluminum trim for all outside corners on tile surfaces.

- .4 Transition Trim: Schluter - "Reno" extruded aluminum edge trim for barrier free access.

- .5 Control Joint: Schluter - "Dilex" BWS for control joints, colour to match adjacent grout.

- .6 Perimeter Control Joint: Schluter - "Dilex" - BWA for control joints at perimeter and around columns.
- .7 Anti-fracture Membrane: Schluter - "Ditra" membrane or Laticrete 9235 anti-fracture membrane.

3 EXECUTION

3.1 EXAMINATION

- .1 Before starting the work, examine existing surfaces to be covered and report to the Consultant, in writing, all defects of work prepared by others and unsatisfactory existing conditions.
- .2 Do not commence until surfaces specified to receive tile are dry, clean, level: free from cracks, ridges, dusting, scaling, carbonation, mortar droppings, parging, curing compounds, grease, oil, or other foreign material liable to impair adhesion, performance or appearance.
- .3 Commencement of work implies total acceptance of surface conditions.
- .4 Dry or dusty concrete or masonry surfaces shall be wet down or washed and excess water removed just prior to the application of finish.
- .5 Waive the right to any after claims by failure to comply with the above procedure of examination.

3.2 BREAKAGE

- .1 Make good any and all breakage resulting from faulty materials or installation.

3.3 QUALITY OF WORK

- .1 Ceramic tile application shall comply with the latest printed editions of the TTMAC Tile Specification Guide, the Tile Council of America Handbook for Ceramic Tile Installation, and relevant ANSI Standards.
- .2 Provide 80% uniform bonding mortar contact between the tile and the substrate for interior applications and 95% uniform bonding mortar for exterior application.
- .3 Install ceramic tiles over a "crack-free" substrate. All concrete joints or cracks should be in direct alignment with the tile expansion joints.
- .4 Control Joints
 - .1 For interior ceramic tile the control joint should be placed every 4.88 – 6.10 metres apart.
 - .2 All area control joints should also be placed around perimeter, around columns and where tile abuts other hard materials. Control joints must always be placed directly over all slab control and expansion joints.
- .5 The ambient air temperature and structural base temperature should be no less than 12 degrees C during application of ceramic tile and during curing period.
- .6 Neatly cut tile around fitments, fixtures and drains. Form intersections, corners and returns accurately.
- .7 Make joints in tile uniform in width, subject to normal variance in tolerance allowed in tile size. Joints shall be watertight without voids, cracks, excess mortar, or grout. Joints between sheets to be of same width as joints between individual tiles.
- .8 All internal angles of base to be square. External angles to be bullnose. Bullnose to be from full size tile.
- .9 Sound tile after setting; remove and replace hollow backed tile.

- .10 Allow minimum 24 hours after setting prior to grouting. Do not permit foot traffic for a minimum of 48 hours.
- .11 Completed work shall be free of broken, damaged or faulty tile.
- .12 Carry out layout of tile in accordance with the Consultant's approved tile colour percentages and patterns.
- .13 Pattern to be uninterrupted through doorways
- .14 All tiles should be fully embedded with at least 95% coverage of mortar on the back of tiles. Backbutter tiles larger than 200 x 200 mm in size.

3.4 CLEANING AND PROTECTION

- .1 Protect the ceramic tile work during the period of construction.
- .2 Remove all excess material and debris from the site and thoroughly wash and clean the tile work upon completion of the ceramic tile installation.
- .3 Do not use muriatic acid for cleanup.
- .4 Protect the finish floor installation with a suitable and durable material or by keeping traffic off the floor until the area is ready for occupancy.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions, and the General Requirements of Division 1.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 INTENT

- .1 Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified, or required, to complete the work of this Section.

1.3 SECTION INCLUDES

- .1 Provide all acoustic tile and required accessories as indicated on the working drawings, room finish schedule, including but not limited to the following:
 - .1 Acoustic Tile
 - .2 "T" Grid Suspension System

1.4 RELATED SECTIONS

- .1 Section 09 21 16 - Gypsum Board Assemblies.
- .2 Mechanical and Electrical Divisions: for installation of grilles, diffusers, lighting and additional requirements

1.5 REFERENCES

- .1 ASTM C635-00: Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- .2 ASTM C636-04: Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
- .3 ASTM E84-06: Standard Test Method for Surface Burning Characteristics of Building Materials.
- .4 ASTM E1264-98: Standard Classification for Acoustical Ceiling Products.

1.6 SAMPLES

- .1 Submit minimum 300 mm x 300 mm (1'-0" x 1'-0") samples of acoustic tile, as required for completion of the work for the Consultant's review before proceeding with the acoustic tile work.
- .2 Submit samples of acoustic products in type specified for approval by the Consultant.

1.7 CLOSE-OUT SUBMITTALS

- .1 Submit two copies of the manufacturer's maintenance directions for each type of acoustic panel or tile.

1.8 PERFORMANCE REQUIREMENTS

- .1 Design and install the ceiling system to support the weight of the light fixtures, maximum deflection of 1/360 of the span.
- .2 Submit a letter stating that the ceiling system is capable of supporting the light fixtures. This letter is required to obtain Ontario Hydro-Electric Commission approval.

1.9 REJECTIONS

- .1 Defective materials or quality of work whenever found at any time prior to acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight and error.
- .2 Remove and replace defective materials and work of other Trades affected by this replacement, at no additional cost to the Owner.

1.10 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver acoustic tile and materials in undamaged and original containers and make certain that the storage area is dry.

1.11 EXTRA MATERIALS

- .1 Furnish the Owner with 2 percent extra materials of each type of ceiling tile to be used for future repair work.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Armstrong World Industries Limited (Ceiling Tile and Suspension)
- .2 CGC Limited (Ceiling Tile and Suspension)
- .3 Bailey Metal Products (Suspension)
- .4 Chicago Metallic

2.2 ACOUSTIC CEILING TILE TYPE 1

- .1 Suspension system: to ASTM C635-07; DONN DX, Colour: white.
- .2 Acoustical Panels: to ASTM E1264-08e1, Cortega 823 Fireguard by Armstrong (610mm x 1220mm x 16mm)

3 EXECUTION

3.1 EXAMINATIONS

- .1 Report to the Consultant, in writing, all defects of work prepared by other trades and on unsatisfactory site conditions.

- .2 Do not commence the work of this Division until this Contractor has thoroughly examined all areas to receive an acoustic tile installation and has ascertained the compatibility of the installation of his material with the other trades involved directly or indirectly with this work, and has found the areas in a condition suitable for the commencement.
- .3 Consult and co-operate with trades whose work precedes or follows his work to permit an orderly and effective procedure in the execution of the work of this section.
- .4 Commencement of the work of this Section implies total acceptance of all applicable conditions by the Acoustic Tile Contractor.
- .5 Waive the right to any after claims by failure to comply with the above procedure of examinations.

3.2 QUALITY OF WORK AND APPLICATION

- .1 Install the tile and suspension system to ASTM C636, and in accordance with the manufacturer's specifications.
- .2 Plumb and square finish work with adjoining work.
- .3 Lay the work out, in accordance with the Consultant's approved reflected ceiling plan, symmetrical within each area to obtain uniform borders of at least half the acoustic panel size.
- .4 Distribute variations in shades of finish from several cartons of panels uniformly over the ceiling area.
- .5 Erect the suspension system level with tolerance of 3 mm (1/8") in 3600 mm (12').
- .6 Exposed main tees shall be as long in length as practical to minimize joints. Joints shall be tight, square flush, and reinforced with splines. Distribute jointing over the ceiling area.
- .7 Use edge moulding or shadow moulding where ceiling abuts vertical surfaces as indicated on the drawings. Use corner moulding along external edges at ceiling steps.

3.3 CLEANING AND PROTECTION

- .1 Be responsible for protection of all materials and work of this trade from damage during period of construction.
- .2 Be responsible for the protection of the work of other Contractors (trades) from damage resulting from work of this trade. He shall make good any resulting damage, to the satisfaction of the Consultant at his own expense.
- .3 Promptly, as the work proceeds and on completion, clean-up and remove from the premises all rubbish and surplus materials resulting from the foregoing work.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 INTENT

- .1 Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required, to complete the work of this Section.

1.3 SECTION INCLUDES

- .1 Provide resilient floors, adhesives and bases as indicated on the working drawings & room finish schedule, including but not limited to the following:
 - .1 Vinyl Composition Tile
 - .2 Sheet Vinyl
 - .3 Rubber Base
 - .4 Tactile Warning Tile
 - .5 Adhesives and Surface Preparation
 - .6 Transition Mouldings
 - .7 Stair Treads/Nosings
- .2 Flush and smooth transitions shall be provided. Transition strips are not an acceptable means to mediate differences in floor elevation. Feathering or self-leveling underlayment, extending minimum 2.4m is acceptable where recessing slab is not practical.

1.4 REFERENCES

- .1 ASTM F1066-04: Standard Specification for Vinyl Composition Floor Tile.
- .2 ASTM F1303-04: Standard Specification for Sheet Vinyl Floor Covering with Backing.
- .3 ASTM F1861-02: Standard Specification for Resilient Wall Base.
- .4 ASTM F1913-04: Standard Specification for Sheet Vinyl Floor Covering without Backing.

1.5 SAMPLES

- .1 Submit samples as specified in Section 01 33 00.
- .2 Selection Samples: duplicate 300 mm x 300 mm size samples, illustrating available colours and patterns for selection by Consultant.

1.6 REJECTIONS

- .1 Defective materials or quality of work whenever found at any time prior to acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight and error.

- .2 Remove and replace defective materials and work of others affected by this replacement, at no additional cost to the Owner.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver and store materials undamaged in original wrapping or cartons.
- .3 Store materials in warm, dry room; stack rolled sheet goods on end, stack tiles not more than four (4) cartons high.

1.8 EXTRA MATERIALS

- .1 Furnish the Owner with 2 percent extra stock of each type of floor tile to be used for future repair work.
- .2 Sheet Goods: Sort, bundle and tag all usable cuttings and leave with the Owner.

1.9 WARRANTY

- .1 Materials:
 - .1 The indoor resilient flooring shall be covered by the manufacturer against product defects for five (5) years. A 3rd party limited warranty shall also be provided as reinforcement.
- .2 Installation:
 - .1 The installation of the indoor resilient flooring shall be covered against poor workmanship and faulty installation by a five (5) year written, limited warranty provided by the contractor performing/overseeing the installation, commencing from the date of Substantial Completion.

2 PRODUCTS

2.1 MATERIALS

- .1 Floor Leveller: Mapei "Ultra-Plan" or "Plani-Patch" as recommended by the manufacturer for the specific application.
- .2 Patching compound: "Pro Patch" polymer modified patching compound, manufactured by Proma Adhesives Inc.
- .3 Vinyl Composition Tile: to ASTM F1066, Type II – through pattern, 3.2mm thick. Excelon Stonetex by Armstrong. Type VCT where indicated on drawings.
 - .1 52128 Desert dust (85%)
 - .2 52122 Pebble gray (5% Random)
 - .3 52126 Gravel blue (10% Random)
- .4 Sheet Vinyl: to ASTM F1913: Palettone PUR by Polyflor. Type SV where indicated on drawings.
 - .1 Thickness/wear layer: as specified in finish plans.
 - .2 Test data:
 - (1) Flexibility (ASTM F137): Passes
 - (2) Chemical Resistance (ASTM F925): Passes
 - (3) Static Load Limit (ASTM F 970): Passes 250 psi

- (4) Resistance to Heat (ASTM F1514): $\Delta E \leq 8$
- (5) Resistance to Light (ASTM F1515): $\Delta E \leq 8$
- (6) Residual Indentation (ASTM F1914): Passes
- (7) Static Coefficient of Friction (ASTM D 2047): ≥ 0.5 SCOF
- (8) Flammability (ASTM E648, Critical Radiant Flux): Class 1 (≥ 0.45 W/cm²)
- .3 Allow for colours and patterns as per finish plans.
- .4 Acceptable products and manufacturers:
 - (1) Palettone PUR by Polyflor
 - (2) Forbo
- .5 Comparable Products from manufacturers listed herein will be accepted provided they meet requirements of this Specification:
 - (1) Mipolam Affinity by GerFloor
 - (2) IQ Optima by Tarkett
- .5 Submit colour selection charts for final selection by Owner. Revised selections shall be within same product line price range.
- .6 Rubber Base: to ASTM F1861; Johnsonite "Duracove" 100 mm height, with toe; colour as selected by Consultant to coordinate with flooring colour in each room, from 'Colourmatch' system.
- .7 Transition Mouldings: suitable for wheel traffic and ADA compliant (Barrier free); as follows:
 - .1 CTA-XX-H: 6 mm carpet to 3 mm resilient.
 - .2 CTA-XX-J 8 mm carpet to substrate
 - .3 CTA-XX-K 10 mm ceramic to 3 mm resilient.
 - .4 CTA-XX-L 10 mm ceramic to 6 mm carpet.
- .8 Stair Treads: Heavy Duty Safe-T-Grip (VIG) by Johnsonite, square nose, depth to be full depth of stair tread with contrasting colour grit tape insert; colour to be selected from 'Colourmatch' system.
 - .1 Approved equal: Endura, Heavy Duty Stair tread to be "Uni-Step", one piece tread/riser combination.
- .9 Floor Adhesive: Adhesive shall be waterproof, (bath, washroom, & rooms with floor drains).
- .10 Base Adhesive
 - .1 Johnsonite #960 wall base adhesive for porous wall surfaces (unpainted) gypsum or masonry substrates).
 - .2 Johnsonite #945 contact bond adhesive for non-porous wall surfaces (metal, painted, ceramics, etc.).
- .11 Wax: Vinyl tile emulsion type, self-polishing, liquid, paste.

3 EXECUTION

3.1 EXAMINATIONS

- .1 Report to the Consultant, in writing, all defects or work prepared by other trades and on unsatisfactory site conditions.

- .2 Do not commence work until surfaces specified to receive resilient flooring are dry, clean level; free from cracks, ridges, dusting, scaling, carbonation, mortar droppings, parging, curing compounds, grease, oil, or other foreign material liable to impair adhesion, performance or appearance.
- .3 After the concrete slab has cured, test for excessive moisture by a method acceptable to the Consultant and Resilient Flooring Manufacturer. Concrete slab must be true and smooth and assessed as such before application commences.
- .4 Commencement of work implies total acceptance of all surface conditions by the Resilient Flooring Contractor.
- .5 Waive the right to any after claims by failure to comply with the above procedure of examination.

3.2 QUALITY OF WORK

- .1 Install resilient flooring employing mechanics with the necessary training and experience as certified by the manufacturer.
- .2 Do not commence laying Resilient Floor until just prior to completion of the building when all trades (except painter) has completed their work.
- .3 Temperature of room and material shall be maintained at a minimum 20 degrees C, 72 hours before, during and at least 72 hours after installation.
- .4 Concrete slabs shall be a minimum of 28 days old before commencing application and be below 2½ percent moisture content at centre of slab and free of surface moisture.

3.3 PREPARATION

- .1 Perform calcium chloride moisture test, if requested, and submit results to Consultant.
- .2 Fill cavities, cracks, saw cuts and joints with an approved filler such as "Pro Patch".
- .3 Install leveler as required to achieve slopes and levels indicated, and allow to cure for minimum 48 hours.
- .4 Flush and smooth transitions shall be provided. Transition strips are not an acceptable means to mediate differences in floor elevation. Feathering or self-leveling underlayment, is acceptable where recessing slab is not practical.
- .5 Clean floor and base surfaces to be covered: using a vacuum cleaner. Remove all substances deleterious to adhesive bond.
- .6 Pack around and under floor duct junction boxes and the like and fill recessed covers with latex to ensure flush level surface.
- .7 Cut and trim sheet vinyl flooring to fit neatly around fixed or excessively heavy objects. Seams shall be formed by overlapping and double-cutting or by scribing and cutting.

3.4 APPLICATION

- .1 Adhesive
 - .1 Apply adhesive uniformly with an approved notch-tooth spreader at the Manufacturer's recommended rate. Do not spread more adhesive than can be covered before initial set takes place.

.2 Tile Goods

- .1 Lay out each area to be tiled symmetrically square with axis of room to provide perimeter tile at least one half tile in width.
- .2 Distribute tiles having varying shade or pattern evenly over the entire floor area to obtain a uniform effect. Abrupt variations will not be permitted.
- .3 Tile joints shall be flush, uniform, in tight contact with no accentuated gaps and in straight lines.
- .4 Lay single colour directional grain tiles with grain running in same direction. Continuous joints to run in direction of grain. Horizontal joints to be staggered (staggered layout).
- .5 Edges at doors where there are no saddles shall be protected with reducer strip.

.3 Cove Base

- .1 Install cove base on top of flooring.
- .2 Install top set cove base in accordance with manufacturer's recommendations. Set base in adhesive tightly against wall and floor surfaces. Space joints uniformly.
- .3 Accurately scribe around door-frames, fitments and other obstructions.
- .4 Install base at all columns, walls and built-in fitments, in rooms where base is indicated.
- .5 Form external corners and end stops from preformed units. Internal corners to be coped (not mitered) to produce a tight fit.

3.5 MAINTENANCE

- .1 Furnish Owner with two copies of manufacturer's maintenance instructions.
- .2 Arrange with Owner to replace small furniture glides with suitable large glides or cups.

3.6 ADJUSTMENTS

- .1 Work shall be examined approximately ten days after completion and all adjustment of defects made good.

3.7 CLEANING AND PROTECTION

- .1 Protect all resilient flooring work during period of construction.
- .2 Upon completion of the resilient flooring installation, remove all excess tiles, clipping, etc. and remove any dirt spots and foreign materials to the satisfaction of the Consultant.
- .3 Protect the finished floor with suitable and durable material or by keeping traffic off the floor until the building or room is ready for occupancy.
- .4 Upon completion of work, remove equipment and debris resulting from the work of this Section.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SECTION INCLUDES

- .1 Complete painting of all surfaces noted on drawings as follows:
 - .1 Exterior:
 - (1) Hollow metal doors, frames, screens
 - (2) Metal surfaces - prime painted and galvanized
 - (3) Vents and stacks above the roof
 - .2 Interior:
 - (1) Wood surfaces
 - (2) Gypsum surfaces
 - (3) Metal surfaces - prime painted and galvanized, including but not confined to hollow metal doors and frames, convectors, grilles, louvres, diffusers, access panels, handrails, guardrails and stairs
 - (4) Masonry surfaces
 - (5) Concrete surfaces
 - .3 Backpainting of hollow metal door frames in exterior walls and designated "high humidity" areas.
 - .4 Mechanical and electrical conduit, piping and ductwork including hangers in exposed locations.
 - .5 Painting of walls and floors below access flooring.
 - .6 Top, bottom and edges of wood and plastic laminate doors.
 - .7 Painting electrical backboards.
 - .8 Painting of water immersed steel surfaces.
 - .9 Exposed electrical raceways.

1.3 RELATED SECTIONS

- .1 Section 05 10 00 – Structural Metal Framing: Shop painting of structural steel.
- .2 Section 05 50 00 – Metal Fabrications: Shop painting of metal fabrications.
- .3 Section 06 40 00 – Architectural Woodwork.
- .4 Section 07 92 00 – Joint Sealants.
- .5 Division 25: Mechanical equipment.

1.4 REFERENCES

- .1 CAN/CGSB-1.57-2003: Interior Alkyd Semigloss Enamel.
- .2 CAN/CGSB-1.100-99: Interior Flat Latex Paint.

- .3 CAN/CGSB-1.119-2000: Interior Latex Primer-Sealer.
- .4 CAN/CGSB-1.175-97: Polyurethane Interior Coating.
- .5 CAN/CGSB-1.188-2004: Emulsion Filler for Masonry Block.
- .6 CAN/CGSB-1.195-99: Interior Latex Semigloss Paint
- .7 CAN/CGSB-1.209-2003: Interior Latex Low Gloss Paint.
- .8 Environmental Choice Program ECP 07.89: Water-borne Surface Coatings.
- .9 Environmental Choice Program ECP 02.89: Solvent-borne Paints.
- .10 Master Painters Institute: Architectural Painting Specification Manual.
- .11 Steel Structures Painting Council.

1.5 SAMPLES

- .1 Submit brushouts 150 mm x 150 mm of each paint application, labelled as to product and location.
- .2 Proceed with painting and staining mock-up only when colour and finish has been approved.

1.6 QUALITY ASSURANCE

- .1 Employ fully trained workmen who are regularly employed in this field.
- .2 Arrange for testing of paint/coatings by product manufacturer. Obtain in writing from manufacturer representative, approval of surface preparation methods, and obtain reports that materials and application methods conform to specification.
- .3 Comply with VOC limits set out by Green Seal Organization for all non-alkyd and non-epoxy coatings/paints.

1.7 MOCK-UP

- .1 Consultant will locate testing area to establish standard of workmanship, texture, gloss and coverage.
- .2 Apply 300 x 300 mm samples of each finish on each type of surface to be coated with:
 - .1 correct material,
 - .2 number of coats,
 - .3 colour,
 - .4 texture and
 - .5 degree of gloss required.
- .3 Alternately, apply full size test samples in areas designated by Consultant of each finish on each type of surface to be coated with:
 - .1 correct material,
 - .2 number of coats,
 - .3 colour,

.4 texture and

.5 degree of gloss required.

.4 Provide additional panels, if required, to obtain approval. Do not continue painting until panels have been approved.

.5 Approved panels shall become standard of comparison for painting work on site. Approved full size mock-up panels may become integral part of finished work if permitted by Consultant.

1.8 REJECTIONS

.1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight or errors.

.2 Remove and replace defective materials and work of others affected by this replacement, at no additional cost to the Owner.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Refer to Section 01 61 00.

.2 Bring materials to the site in the original unopened containers labelled to indicate the name of the manufacturer, brand, colour and quality of the contents.

.3 Store thinners, loose soaked rags and similar combustible materials in closed containers. Remove from site or store in an assigned area.

.4 Store paint materials at temperatures recommended by manufacturer.

1.10 PROJECT CONDITIONS

.1 Co-operate in co-ordinating the work of other Sections with the work of this Section, so that the work may proceed in an orderly and effective manner.

.2 If requested, provide proof of purchase of all paint materials needed for the job.

1.11 ENVIRONMENTAL CONDITIONS

.1 Maintain minimum interior temperature of 18 degrees C during application and drying of paint, and maintain until handover to owner.

.2 Do not paint when ambient air and surface temperatures are less than 15 degrees C for 24 hours before or during painting application.

1.12 SCHEDULING

.1 Unoccupied Areas: Cooperate with other trades to minimize touch-ups, but to ensure completion prior to installation of floor coverings and furniture.

1.13 EXTRA MATERIALS

.1 Supply 1 litre of each finish material in each colour used at the Place of the Work, properly labelled.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Use only top line of products from any manufacturer.
- .2 Interior Latex Primer Sealer
 - .1 ICI Paints "CYW Designers Touch"
 - .2 ICI Paints "ICI dulux"
 - .3 Para - "PrimeTech Hi-Hide Latex Primer"
- .3 Interior Latex Eggshell
 - .1 Benjamin-Moore & Co. Limited "Regal Aquavelvet"
 - .2 ICI Paints "CIL Professional Interior Latex Pearl"
 - .3 ICI Paints "Glidden Ultra Interior Latex Pearl"
 - .4 PPG "Satin Latex Interior Acrylic"
 - .5 Sherwin Williams-MPI-52 Gloss Level 3 Interior Latex Eggshell
- .4 Interior Latex Flat (Ceilings)
 - .1 Benjamin-Moore & Co. Limited "Moorespec"
 - .2 ICI Paints "CYW Designer Touch"
 - .3 PPG "Speedhide"
- .5 Interior Latex Semi-gloss
 - .1 Sherwin Williams Promar 2000 Interior Semi-gloss Latex
 - .2 PPG "Pure Performance" Interior Semi-gloss Latex
- .6 Galvanized Primer (Interior)
 - .1 Benjamin-Moore & Co. Limited "Acrylic Metal Primer"
 - .2 ICI Devoe "Devflex"
 - .3 Para "Waterborne Galvanized Primer"
 - .4 PPG "Pitt Tech" DTM High Performance Primer
- .7 Dry Fall for Galvanized Steel
 - .1 Benjamin-Moore & Co. Limited "Sweep-up" Spray Latex Semi-gloss"
 - .2 Benjamin-Moore & Co. Limited "Moorespec" Latex DTM Dryfall Coating
 - .3 ICI Paints "Spraymaster" Unigrip Arcrylic Dryfall
 - .4 PPG "Speed hide" Supertech WB Dry-fog Latex

- .8 Wood Stain Blocker / Gypsum Primer
 - .1 Benjamin-Moore & Co. Limited "Freshstart" 100% Acrylic Primer
 - .2 ICI Paints CIL Professional Interior Acrylic Stain Bloc
 - .3 PPG "Seal Grip" Acrylic Latex Stain Blocking Primer
 - .4 Sherwin Williams "PrepRite" Pro Block Latex Interior/Exterior Primer/Sealer
- .9 Floor Paint
 - .1 ICI Paints "ICI Xpert" Latex Floor Paint
 - .2 Benjamin Moore Porch and Floor 122 Latex Satin enamel.
 - .3 Pratt and Lambert "Palgard" epoxy coating.
- .10 Interior Wood Lacquer
 - .1 ICI Paints "Woodpride" Interior Aquacrylic Gloss/Satin Varnish
- .11 Paint and Interior Stain for Other Products Not Specifically Listed
 - .1 Benjamin-Moore & Co. Limited
 - .2 Glidden Company
 - .3 Olympic Stain, Comerco Inc.
 - .4 Pittsburgh Paints
 - .5 Pratt & Lambert Inc.
 - .6 International Paints
- .12 Exterior Stains
 - .1 Olympic Stain, Comerco Inc.
 - .2 Pratt & Lambert Inc.
 - .3 Glidden Company Stains
- .13 Fire Retardant Coating
 - .1 Ocean Fire Retardants Inc.
 - .2 Pratt & Lambert Inc.
 - .3 Sico Ltd.
 - .4 Glidden Company
 - .5 Laco Ad Film

2.2 MATERIALS

- .1 No claim as to unsuitability or unavailability of any material specified, or unwillingness to use same, or inability to produce first class work with same will be entertained unless such claims are made in writing and submitted with tender.
- .2 Select materials for application on each type surface from a single manufacturer.
- .3 Use only low VOC products with a VOC limit of 150g/L for non-flat, and 50g/L for flat finishes. Submit for consultant's review data sheets of any product that exceeds this VOC limit.

2.3 HOLLOW METAL FRAMES BACKPAINTING

- .1 Tremco "Instant Patch".

2.4 FINISH AND COLOURS

- .1 The Consultant will issue a schedule of the colours of paint and other finishes as required by job progress.
- .2 Gloss/Sheen Ratings:
 - .1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following values:

Gloss Level	Description	Units @ 60 Degrees	Units @ 85 Degrees
G1	Matte or flat finish	0 to 5	10 max.
G2	Velvet finish	0 to 10	10 to 35
G3	Eggshell finish	10 to 25	10 to 35
G4	Satin finish	20 to 35	35 min.
G5	Semi-gloss finish	35 to 70	
G6	Gloss finish	70 to 85	
G7	High-gloss finish	>85	

- .2 Gloss level ratings of all painted surfaces shall be as specified herein and as noted on finish schedule.
- .3 The submitted brushouts and approved mock-up shall be the only determining factors in assessing approved colour tone and shade.
- .4 Interior colours will be based on three (3) "field" colours and three (3) "accent" colours with a maximum of one (1) deep or bright colour. No more than eight (8) colours will be selected for the entire project and no more than three (3) colours will be selected in each area. (Note that this does not include pre-finished items by others, e.g. aluminum or vinyl windows, aluminum doors and handrails, etc.)
- .5 Unless otherwise noted or scheduled, wall shall be painted the same colour within a given area.
- .6 Ceilings shall be painted white in a G1 finish.
- .7 Corridors shall be painted different colours on alternate floors with two (2) separate colour schemes prepared for door frames and trim.

- .8 Except as noted herein or indicated on the finish schedule, interior walls and ceiling surfaces shall be painted in accordance with the following criteria over appropriate prime / sealer coat:
 - .1 All areas (except as noted): Washable latex with G3 (eggshell) finish.
 - .2 Bathrooms: washable latex with G5 (semi-gloss) finish.
- .9 Doors (where not designated as plastic laminate finish), shall be painted a different colour than door frames and trim with walls a different colour than either. Unless otherwise noted or scheduled all doors, frames and trim shall be painted using a G5 (semi-gloss) finish.
- .10 Access doors, prime coated butts and other prime painted hardware (e.g. door closers), registers, radiators and covers, exposed piping and electrical panels shall be painted to match adjacent surfaces (i.e. same colour, texture and sheen), unless otherwise noted or where pre-finished.
- .11 Plywood service panels (e.g. electrical, telephone and cable vision panels) including edges shall be back-primed and painted flat grey.
- .12 The inside of light valances shall be painted gloss white.
- .13 The inside of all ductwork behind louvres, grilles and diffusers for a minimum of 460mm or beyond sight line, whichever is greater, shall be painted using flat black (non-reflecting) paint.

2.5 MIXING AND TINTING

- .1 Deliver paints and enamels ready mixed to jobsite. Job mix and tint only when approved by the Consultant.
- .2 Tint undercoats and each finish coat progressively to enable confirmation of number of coats.

2.6 PAINT AND STAIN APPLICATIONS FOR VARIOUS USES

- .1 Exterior (and interior steel where epoxy coating indicated on Drawings)
 - .1 Iron & Steel
 - (1) Items: - Structural steel framing
 - Ladders
 - Stairs
 - Doors and frames
 - Handrails and railings
 - Bollards
 - (2) 1-coat primer ICI 5465/5469, 3 to 4 mil Anti Corrosive Primer, except where material is shop or factory primed.
 - (3) 2-coats 5240/5269, 3 to 4 mil Polyamide Epoxy per coat.
 - .2 Galvanized Metal
 - (1) Items: - Downspouts
 - Gutters
 - Vents
 - Louvres
 - Flashing
 - (2) 1-coat galvanized metal primer
 - (3) 2-coats finish G6

.3 Masonry and Concrete

- (1) Items: - Concrete block
- Poured concrete
- Stucco Finish
- Brick

(2) 1-coat of latex primer filler

(3) 2-coats finish G1

.4 Asphalt

- (1) Items: - Line markings
- Outdoor play area game lines

(2) Finish: 1 coat Oleo-resinous paint.

.2 Interior

.1 Iron and Steel

- (1) Items: - Stairs
- Structural Steel
- Doors and frames
- Steel decking
- Grilles
- Convectors
- Piping and conduit
- Duct work

(2) 1-coat interior primer, except where material is shop or factory finished.

(3) 2-coats finish G6

.2 Painted Woodwork

- (1) Items: - Doors
- Trim
- Millwork

(2) 1-coat interior primer

(3) 2-coats finish G5

.3 Woodwork to be Stained and Varnished

- (1) Items: - Millwork (Section 06 40 00)

(2) Finish:

1-coat paste filler

1-coat wood stain

2-coats varnish (satin)

Submit samples for Owner and Consultant review with Millwork Submittal.

.4 Plaster & Drywall

- (1) Items: - Ceilings/Bulkheads
- Walls

- (2) 1-coat latex primer
- (3) 2-coats finish G3, Ceiling/Bulkhead Finish G1

.5 Masonry and Concrete

- (1) Item: - Walls
- (2) 1-coat primer filler
- (3) 2-coats finish G3

3 EXECUTION

3.1 EXAMINATION

- .1 Report to the Consultant, in writing, all defects of surfaces or work prepared by other trades and on unsatisfactory site conditions.
- .2 Thoroughly examine all surfaces scheduled to receive paint to see that they are dry, clean, free from cracks, scaling, grease, oil, or other foreign materials liable to impair adhesion, performance or appearance. Take moisture readings.
- .3 Commencement of work implies total acceptance of all surface conditions.

3.2 VERIFICATION OF SURFACE CONDITIONS

- .1 Do work only when surfaces and conditions are satisfactory for production of quality work. Report to Consultant in writing any surfaces which are found to be unsatisfactory. Commencement of work shall imply acceptance of substrate surfaces.
- .2 Ensure temperature of surfaces to be finished between 10 and 20 degrees C and surfaces are dry and free of dirt, grease or other contaminants that may affect applied finish.
- .3 Verify moisture content of surfaces with electronic moisture metre. Do not proceed without written directions if moisture reading is higher than 12-15 percent.
- .4 If substrate is steel, do not apply coatings over moisture or when surface temperature is within 3 degrees C of dew point.
- .5 If substrate is wood, do not stain or paint if moisture reading is higher than 12 percent. Inspect work to assure surfaces are smooth, free from machine marks and nail heads have been countersunk.
- .6 If substrate is plaster or masonry, allow to cure for 30 to 90 days. Ensure that moisture content is below 12 percent and test for alkalinity and neutralize (pH 6.5-7.5) before proceeding with priming.
- .7 If substrate is gypsum board, inspect to ensure joints are completely filled and sanded smooth. Inspect surfaces for "nail popping", screw heads not recessed and taped, breaks in surface or other imperfections and have repaired as required.
- .8 Conduct all moisture tests using a properly calibrated electronic moisture meter.
- .9 Test concrete floors for moisture using a cover patch test.
- .10 Test concrete, masonry and plaster surfaces for alkalinity as required.

3.3 SURFACE PREPARATION

- .1 Remove dust, grease, rust and extraneous matter from surfaces (except rust occurring on items specified to be primed under other Sections shall be removed and work re-primed under those Sections). Vacuum (fibre acoustic tile and) insulation covering surfaces. Vacuum clean floors before painting; wipe clean adjacent surfaces and surfaces to be painted before work is commenced to prevent dust and debris damage to wet paint.
- .2 Remove mildew by scrubbing affected area with solution of tri-sodium-phosphate (TSP)(150g) and bleach (125g) in 3.5L water. Rinse with clean water and allow to dry. If condition is serious, source out finishes with extra mildew resistance.
- .3 Be responsible for surface preparation to suit surface condition and conform to level of cleaning based on (SSPC), recommended metal cleaning procedures most commonly used to suit site conditions.
- .4 Ferrous Metal
 - .1 Clean to SSPC-SP1/2/3 described herein, to suit site conditions. Remove loose rust and prime bare metal with rust inhibitive steel primer. Touch-up damaged shop applied primer using compatible product. Provide full coat primer only if damage is extensive. Treat all weld areas with phosphoric acid (5% solution).
 - .2 SSPC-SP1 (Solvent Cleaning): Use of solvents (such as mineral spirits, xylene, toluene) or cleaning action to remove oil, grease, soil drawing and cutting compounds or similar solvent soluble contaminants. Use of gasoline or benzene shall be prohibited.
 - .3 SSPC-SP2 (Hand Tool Cleaning): Use of scrapers, sandpaper, wire brushing or hand impact tools to remove loose mill scale, non-adherent rust and scaling paint or other foreign matter. Do not use hand tool cleaning procedure for areas subject to corrosive environment or on surfaces for vinyl chloride top coating. Remove weld flux and spatter to avoid localized paint failure.
 - .4 SSPC-SP3 (Power Tool Cleaning): Use of power sanders and wire brushes, impact tools, grinders and power chipping hammers to remove loose mill scale, loose rust, paint or other foreign matter. Do not employ power tool cleaning excessively causing burnished mill scale preventing primers to adhere properly.
- .5 Hot Dipped Galvanized Steel (Unweathered):
 - .1 Allow to weather minimum of 26 weeks and xylene clean to SSPC-SP1 specified herein prior to coating to remove dust, dirt, grease, oxides and other foreign material. Remove silicates or similar surface treatments or any deposits of white rust by sanding or similar abrasive methods (bronze wool). Use of acetic acid to prepare galvanized surfaces is not acceptable.
- .6 Galvanized Steel (Weathered):
 - .1 Remove dust, dirt, grease, oxides and other foreign material and clean to SSPC-SP1 specified herein prior to coating.
- .7 Galvanized Steel (Pre-treated)(Non-crystal Appearance):
 - .1 Follow manufacturer's recommendations for preparation, priming and coating of pre-treated galvanized steel.

.8 Woodwork for Painting:

- .1 Seal all knots and sapwood in surfaces to receive paint with alcohol-based primer-sealer. Sand smooth rough surfaces of all woodwork to be finished and clean surfaces free of dust before applying first coat. Fill nail holes, splits and scratches with non-shrinking filler after first coat is dry. Remove salt deposits that may appear on wood surfaces treated with fire retarder.

.9 Concrete Block Masonry:

- .1 Fill voids and cracks in masonry block wall to provide uniform surface for subsequent coats.
- .2 Where necessary to neutralize surfaces, wash or paint with a solution of 1.36 kg. of zinc sulphate to 4.5 litres of water. Brush off any crystalline residue on drying.

.10 Gypsum Board:

- .1 Examine surfaces after for imperfections showing through and fill small nicks or holes with patching compound and sand smooth. Examine surfaces after priming for imperfections showing through. Clean surfaces dry, free of dust, dirt, powdery residue, grease, oil, wax or any other contaminants. Sand and dust as necessary prior to painting.

3.4 During work of this Section cover finished floors, walls, ceilings, and other work in vicinity and protect from paint and damage.

3.5 Clean adjacent surfaces which have been painted, soiled or otherwise marred.

3.6 APPLICATION

- .1 Spraying not allowed without written permission.
- .2 Paint entire plane of areas exhibiting incomplete or unsatisfactory coverage and of areas which have been cut and patched. Patching not acceptable.
- .3 Do not paint baked enamel, chrome plated, stainless steel, aluminum or other surfaces finished with final finish in factory. Finish paint all primed surfaces.
- .4 Advise Consultant when each applied paint coat can be inspected. Do not re-coat without inspection. Tint each coat slightly to differentiate between applied coats.
- .5 Sand smooth enamel and varnish undercoats prior to re-coating.
- .6 Apply primer coat soon after surface preparation is completed to prevent contamination of substrate.
- .7 Prime woodwork designated for painting as soon as possible after delivery to site and before installation. Prime all cut surfaces, whether exposed or not, i.e. all 6 edges of wood doors, before installation. Prime all cut surfaces of woodwork to receive transparent finish with 1 coat of transparent finish reduced 25%.
- .8 Fill open grain wood with filler tinted to match wood and work well into grain. Wipe excess from surface before filler sets.
- .9 Apply primer-sealer coats by brush or roller. Permit to dry in accordance with manufacturer's recommendations before applying succeeding coats. Touch-up suction spots and sand between coats with No. 120 sandpaper.
- .10 Apply primer coat to unprimed ferrous metal surfaces. Where sandblast preparation is specified, apply specified primer immediately after blast cleaning.
- .11 Apply final coats on smooth surfaces by roller or brush. Hand brush wood trim surfaces.

- .12 Apply additional paint coats, beyond the number of coats specified for any surface, to completely cover and hide the substrate and to produce a solid, uniform appearance.
- .13 Allow each coat of paint to cure and become dry and hard before application of succeeding coats (unless manufacturer's directions require otherwise).
- .14 Before finishing paint coats are applied, inspect and touch-up shop coats of primers previously applied by other trades or fabricators.
- .15 Apply paint in accordance with manufacturer's directions.
- .16 Provide paint coating thicknesses indicated, measured as minimum dry film thicknesses.

3.7 RE-TOUCHING

- .1 Make a close inspection of all surfaces decorated, after completing this work, and ensure that they are properly and perfectly re-touched where damaged before removing equipment.

3.8 CLEANING

- .1 Do not wash brushes, rollers, clothes etc. in running water; fill 2 suitably sized containers with clean water. Use first clean and second clean process for all paint. Final rinse only may be in running water.
- .2 Keep closed container of paint thinners on hand for ongoing cleaning. Do not dispose of paint thinners to sewer; take off site at end of each day and take to hazardous waste disposal depot.
- .3 Collect all emulsion from cleaning into containers and recycle or dispose at hazardous waste disposal depot, in accordance with local, provincial and federal environmental regulations.
- .4 Provide proof of proper disposal by receipt from hazardous waste disposal depot.

3.9 PROTECTION

- .1 Remove finish hardware, electrical switch and outlet covers, receptacle plates, fittings and fastenings, to protect from paint splatter. Mask items not removable. Use sufficient drop cloths and protective coverings for full protection of floors, furnishings, mechanical, electrical and special equipment, all other components of building which do not require painting or to be removed, from paint spotting and other soiling. Re-install items when paint is dry. Clean any components that are paint spotted or soiled.
- .2 Keep waste rags in covered metal drums containing water and remove from building at end of each day.
- .3 Prohibit traffic, where possible, from areas where painting is being carried out and until paint is cured. Post "wet paint" or other warning signage during and on completion of work.
- .4 When handling solvent coating materials, wear approved vapour/particulate respirator as protection from vapours. Dust respirators do not provide protection from vapours.

3.10 SCHEDULES

- .1 Colour Coding for Mechanical and Electrical Equipment
 - .1 The following is the recommended colour coding schedule. Final approval shall be obtained from the Consultant.
 - .2 Paint where equipment is exposed only:

	Pipe Colour	Stripe Colour
--	-------------	---------------

Equipment	Light Blue	---
Breeching	Cream	---
Ductwork	Cream	---
Equipment Drains	Black	---
Natural Gas	Yellow	---
Hot Water	Orange	---
Cold Water	Green	---
Recirculating Line	White	---

Electrical Conduit: Colour to match wall or ceiling finish.

- .2 A complete colour schedule of architectural finishes will be provided as the job progresses.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 1.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 INTENT

- .1 The following prefabricated items to be supplied and installed:
 - .1 Whiteboards
 - .2 Tackboards.
 - .3 Aluminum trim.
 - .4 Projection Screens with all mounting brackets and accessories.
 - .5 Projector Mounting arm, brackets and accessories.

1.3 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings as specified in Section 01 33 00, specifically provide the following:
 - (1) Location, type, size and panel arrangement.
 - (2) Backing, hardware and anchor details.
 - (3) Frame, trim and accessories.

1.4 REJECTIONS

- .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight or errors.
- .2 Approved Manufacturers: The manufacturers listed are only approved if they can provide the product as described.
- .3 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver and store materials undamaged in original cartons or wrappings.
- .3 Store material in a secure, dry area.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1 Architectural School Products (A.S.P.)
Mississauga, Ontario
(905) 822-4287
- .2 Global School Products
Mississauga, Ontario
(905) 565-9314
- .3 Forbo (Tackboards)
Mississauga, Ontario
800 842 7839

2.2 MATERIALS

- .1 Whiteboards
 - .1 Whiteboards core shall be impregnated sound absorbing fibreboard, 12 mm (7/16") thick. Laminate under heat and pressure.
 - .2 All whiteboards shall consist of face panel, core, balancing rear sheet, trim and chalk rails.
 - .3 Face panel shall be 28 gauge high quality enamelling steel base with a porcelain enamel writing surface fused to a ground coat of not less than 0.076 mm (.003") nor more than 0.127 mm (.005") after firing at temperatures between 730 Deg C. (1350 Deg F) and 760 Deg C (1400 Deg F), in accordance with the Porcelain Enamel Institute Standards PEI S104 as regards to durability, smoothness of texture, colour continuity and a gloss factor of 6-8 as measured by 45 Deg glossometer. Colour: white.
 - .4 Surface shall be washable. General household detergents shall not damage face panel in any manner. Surface shall be cleanable with acetone, alcohol and cleaning fluid.
 - .5 Balancing rear sheet shall be 28 gauge zinc coated stretcher leveled steel in one unjointed section. Overall thickness of whiteboard lamination shall not exceed 12.5 mm (1/2").
 - .6 Vertical jambs shall be provided for all chalkboards/whiteboards, same length of board, complete with contour fittings and castings.
 - .7 Trim shall be aluminum 6063T5 alloy with clear etched, anodized satin finish 0.051 mm (.002") satin finish, free from extruding draw marks and surface scratches. Perimeter trim shall be 19 mm (3/4") exposed face, weight of approximately 91 g (.20 lbs) per linear foot. Use A.S.P. Series 200 Trim, or approved equal. Use A.S.P. No. 207 divider bar – aluminum trim for adjacent whiteboard/whiteboard panels, whiteboard/tackboard panels to be 12.7 mm (1/2") exposed face and weight of approximately 113 g (.25 lbs) per linear foot. Use No. 206 map rail over all whiteboards. Use No. 200 perimeter to sides of whiteboard and around fixed tackboard.
 - .8 Use No. 264 marker tray and end caps where whiteboard is located over architectural woodwork. Use No. 212 marker tray and end caps in all other whiteboard locations. Provide recessed marker tray for whiteboards in gymnasium.
 - .9 Accessories manufacturer's standard:

- (1) Map hooks every 90 mm o.c.
- .2 Tackboards
 - .1 All tackboards shall be 12.5 mm (1/2") factory prelaminated. One half the thickness indicated shall be A.S.P. natural cork, fine grain laminated to 6.25 mm (1/4") particleboard or Masonite substrate under mechanical pressure.
 - .2 Maximum panel sizes shall be 1200 mm x 2400 mm (4' x 8'). Use bonding of materials by a waterproof adhesive that will not delaminate or rupture at the contact surfaces for all material bonding.
 - .3 Trim shall be aluminum 6063T5 alloy with clear etched, anodized 0.051 mm (0.002") satin trim 0.051 mm (.002") satin finish, free from extruding draw marks and surface scratches. Weight shall be 90 g (0.20 lbs) per foot.
 - .4 All tackboards shall be mounted as per manufacturer's instructions. See drawing for location. Perimeter trim shall be 19 mm (3/4") exposed face.
 - .5 See plans for tackboard size, location and number.

3 EXECUTION

3.1 EXAMINATION

- .1 Report to the Consultant, in writing, all defects of work prepared by other trades and on unsatisfactory site conditions.
- .2 Do not commence the work of this Division until surfaces, area, conditions specified or indicated on drawings, to receive manufactured specialties, are compatible with the manufacturer's installation requirements.
- .3 Commencement of work implies total acceptance of all preliminary installation requirements by the Contractor installing manufactured specialty items.
- .4 Waive any after claims by failure to comply with the above procedure of examination.

3.2 INSTALLATION

- .1 Install whiteboards and tackboards plumb and level in accordance with manufacturer's instructions, to provide rigid securing writing surface.
- .2 Attachments for all aluminum trims shall be concealed. Use #10 x 1 in. steel wood screws.
- .3 All units shall be anchored solidly to masonry walls, wood studs, steel studs or new blocking within the wall structure. Do not glue.
- .4 Install aluminum trim around markerboard panels. Make mitres and intersecting joints to hairline fit, free of rough edges. Use concealed brackets to reinforce and hold joints tight and flush. No exposed fasteners permitted. Overlap trim 6 mm onto panels.
- .5 Aluminum trim shall be applied to all edges of each piece of whiteboard and tackboard.

3.3 CLEANING AND PROTECTION

- .1 Be responsible for protection of all manufactured specialty work during period of construction.
- .2 Upon completion of installation of all manufactured specialty items remove all excess material, empty cartons, wrappings, etc. and remove any dirt spots and foreign material from the installed items, leaving them in a clean, usable condition.

3.4 CLEAN-UP

- .1 Upon the completion of work, remove from the site all surplus materials and debris caused by this work and leave the site in a clean condition to the satisfaction of the Consultant.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 1.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 INTENT

- .1 The following prefabricated items to be supplied and installed:
 - .1 Toilet partitions
 - .2 Wall Protection (Corner Guards)
 - .3 Toilet Grab bars
- .2 The following items to be supplied by the Durham Catholic District School Board and installed by Section 06 20 00.
 - .1 Paper towel dispensers.
 - .2 Soap dispensers.
 - .3 Toilet tissue dispenser.
- .3 Approved Manufacturers: The manufacturers listed are only approved if they can provide the product as described.

1.3 RELATED SECTIONS

- .1 Section 06 20 00 – Finish Carpentry.

1.4 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings as specified in Section 01 33 00 for all interior specialties included in this Section:

1.5 REJECTIONS

- .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight or errors.
- .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver and store materials undamaged in original cartons or wrappings.

- .3 Store material in a secure, dry area.

2 PRODUCTS

2.1 MATERIALS

- .1 Provide new materials in perfect condition, free from defects impairing strength, durability or appearance.
- .2 Refer to the Architectural plans for location and required quantity of items specified.

2.2 TOILET PARTITIONS, AND URINAL SCREENS

- .1 Partitions, as shown on plans, shall be: floor mounted, headrail braced
 - .1 Model No.: Solid Phenolic
 - .2 Colour: submit laminate manufacturer's colour chart (readily available in Canada) for Owner and Consultant selection.
- .2 Stalls shall be of nominal size indicated on drawings with final dimensions verified on site. Equip each partition with doors hung on adjustable enclosed gravity type hinges; stainless steel hardware including sliding latch, doorstop and keeper, coat hook and bumper.
- .3 Urinal screens to be 1015 mm high, 550 mm wide, with top of screen 1220 mm above finished floor.
- .4 Approved Manufacturers:
 - .1 Bobrick (Solid Phenolic) (416) 298-1611
 - .2 ASI Group Watrous Canada (Solid Phenolic) (866) 858-0083 x30
 - .3 Hadrian Manufacturing Inc. (Solid Phenolic) (416) 333-0300

2.3 TOILET GRAB BARS

- .1 Manufactured by: Bobrick
- .2 Model No.: B550 x 2'-0" (600 mm) long and B-550 x 2'-6" (760 mm) long.
- .3 Or approved equal by ASI Group Watrous Canada

2.4 WALL PROTECTION

- .1 Provide stainless steel corner guards, to 6'-0" above finished floor, where indicated on drawings:
- .2 Approved Manufacturers:
 - .1 IPC
 - .2 Pawling
 - .3 Arden
 - .4 Acrovyn (Construction Specialties)

3 EXECUTION

3.1 EXAMINATIONS

- .1 Report to the Consultant, in writing, all defects of work prepared by other trades and on unsatisfactory site conditions.
- .2 Do not commence the work of this Division until surfaces, area, conditions specified or indicated on drawings, to receive manufactured specialties, are compatible with the manufacturer's installation requirements.
- .3 Commencement of work implies total acceptance of all preliminary installation requirements by the Contractor installing manufactured specialty items.
- .4 Waive any after claims by failure to comply with the above procedure of examination.

3.2 INSTALLATION

- .1 Carry out installation of manufactured specialty items by tradesmen with the necessary training and experience, and certified by the manufacturer or by the Contractor.
- .2 Conform to manufacturer's printed installation instructions and/or shop drawings.

3.3 CLEANING AND PROTECTION

- .1 Be responsible for protection of all manufactured specialty work during period of construction.
- .2 Upon completion of installation of all manufactured specialty items remove all excess material, empty cartons, wrappings, etc. and remove any dirt spots and foreign material from the installed items, leaving them in a clean, usable condition.

3.4 CLEAN-UP

- .1 Upon the completion of work, remove from the site all surplus materials and debris caused by this work and leave the site in a clean condition to the satisfaction of the Consultant.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the Instructions to Bidders, the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01.

1.2 SUMMARY

- .1 Section Includes:
 - .1 Provide all articles, labour, materials, equipment, transportation, hoisting, and incidentals noted, specified or required, to complete the work of this Section including but not limited to the following:
 - (1) Toilet accessories as shown on Drawings and specified herein.
 - (2) Attachment hardware.
 - (3) Work of this Section shall include the furnishing of all necessary screws, special screws, bolts, special bolts, expansion shields and all other devices and accessories necessary for the proper installation of the Work of this Section.
 - .2 Related Sections: The following description of work is included for reference only and shall not be presumed complete:
 - .1 Section 05 50 00 – Metal Fabrications
 - .2 Section 06 10 00 – Rough Carpentry
 - .3 Section 09 21 16 – Gypsum Board Assemblies
 - .4 Section 09 30 00 – Tiling

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section.
 - .1 American Society for Testing and Materials (ASTM):
 - (1) ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - (2) ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - (3) ASTM A269 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - (4) ASTM A1008/A1008M – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - (5) ASTM B456 – Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - .2 Canadian Standards Association (CSA):
 - (1) CAN/CSA B651 – Accessible Design for the Built Environment.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with other work having a direct bearing on the Work of this Section.
 - .2 Provide templates to Contractor for use by installers and fabrications as required for proper installation of the Work of this Section including but not limited to plywood backer boards and built-in anchorage.

1.5 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's technical product data for each type of Product required including on material characteristics, performance, limitations, methods of installation, compliance with applicable reference standards, material safety data sheets, transportation, storage and handling requirements for each product used.
- .2 Samples
 - .1 Submit samples of proposed products for review by Consultant.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver and store materials undamaged in original cartons or wrappings.
- .3 Store material in a secure, dry area.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 ASI Group Watrous; www.asigroupwatrous.ca
 - .2 Bobrick Washroom Equipment Inc., www.bobrick.com
 - .3 Frost Products Ltd; www.frostproductsltd.com
 - .4 Substitution Limitations: Comparable Products from manufacturers not listed herein may be accepted provided they meet requirements of this Specification.

2.2 MATERIALS

- .1 Provide new materials in perfect condition, free from defects impairing strength, durability or appearance.
- .2 Refer to the Architectural plans for location and required quantity of items specified.
- .3 Sheet Steel: ASTM A1008/A1008M.

- .4 Stainless Steel Sheet: ASTM A167, Type 304.
- .5 Tubing: ASTM A269, stainless steel.
- .6 Adhesive: type in conformance with LEED requirements, waterproof.
- .7 Fasteners, Screws, and Bolts: Hot dip galvanized, temper-proof.
- .8 Expansion Shields: type as recommended by accessory manufacturer for component and substrate.
- .9 Grab Bars At Barrier Free Washrooms:
 - .1 No. 1: 1¼ in. diameter stainless steel, 24 in. long straight bar, standard flange position at back of water closet.
 - .2 No. 2: L-shaped bar as detailed, 1¼ in. diameter stainless steel, 30 in. long horizontal and vertical 30 in. at side of water closet.
 - .3 Install No. 1 and No. 2 grab bars at each handicapped water closet.
 - .4 Grab bars to be 18 gauge stainless steel tubing with mandrel bends. Knurled grab bars to be peened grip full length of the tubing to within 4 in. of ends of bends. Secure concealed fastening grab bars with 2½ in. No. 14 screws to solid backing, capable of supporting a 500 lb pull. All accessories must comply with "Building Standards for the Handicapped 1997" of the Ontario Building Code as currently amended.
 - .5 Approved Manufacturers and model:
 - (1) Frost, Model Code 1001 and Code 1003
 - (2) Equivalent by ASI-Watrous
 - (3) Equivalent by Bobrick,
- .10 Swing up grab bars:
 - .1 16 gauge stainless steel tubing, type 304 1-1/4" O.D. (outside diameter) with exposed surfaces in polished satin finish
 - .2 Acceptable product and manufacturers:
 - (1) Frost 1055-S swing up grab bar
- .11 Paper Towel Dispensers:
 - .1 Supplied by Owner, installed by Contractor.
- .12 Hand Dryers: where noted on the drawings with the following features:
 - .1 Surface mounting.
 - .2 Fixed nozzle.
 - .3 Brushed stainless steel finish with automatic activation.
 - .4 Rating of 1450W at 120V.
 - .5 Comac Cat. #SW-100220004

- .13 Soap Dispensers:
 - .1 Supplied by Owner, installed by Contractor.
- .14 Toilet Paper Dispensers:
 - .1 Supplied by Owner, installed by Contractor.
- .15 Napkin disposal:
 - .1 Supplied by Owner, installed by Contractor.
- .16 Mirrors:
 - .1 Refer to Section 08 80 00
- .17 Metal Shelf:
 - .1 Stainless steel, rounded corner, 22 gauge, no. 4 brushed finish shelf welded to stainless steel wall plate. Safety edge on all protruding edges.
 - .2 Size: 457.2mm (18") long x 139.7mm (5.5") deep x 102mm (4") high.
 - .3 All mounting screw holes below shelf.
 - .4 Approved manufacturers and model:
 - (1) Frost, Model 950-4-18
 - (2) Watrous, Model 0694
- .18 Coat Hooks:
 - .1 Robe hook fabricated from 12 ga. Stainless steel type 304, no. 4 brushed finish.
 - .2 Approved manufacturers and model:
 - (1) Frost, Model 1146
 - (2) Equivalent by ASI-Watrous
 - (3) Equivalent by Bobrick,
- .19 Anit-ligature Coat Hooks:
 - .1 12 gauge type 304 stainless steel with a satin finish. Back plate is fabricated of 14 gauge stainless steel. If hook is excessively loaded, it will snap down for safety. Single hooks or strips as shown on Drawings
 - .2 Approved manufacturers and model:
 - (1) ASI-Watrous, Model 112 Clothes Hook or 129 Clothes Hook Strip
 - (2) Equivalent by Bobrick or Frost

3 EXECUTION

3.1 EXAMINATIONS

- .1 Report to the Consultant, in writing, all defects of work prepared by other trades and on unsatisfactory site conditions.
- .2 Do not commence the work of this Division until surfaces, area, conditions specified or indicated on drawings, to receive manufactured specialties, are compatible with the manufacturer's installation requirements.
- .3 Commencement of work implies total acceptance of all preliminary installation requirements by the Contractor installing manufactured specialty items.
- .4 Waive any after claims by failure to comply with the above procedure of examination.

3.2 INSTALLATION

- .1 Carry out installation of manufactured specialty items by tradesmen with the necessary training and experience and certified by the manufacturer or by the Contractor.
- .2 Conform to manufacturer's printed installation instructions and/or shop drawings.

3.3 SITE QUALITY CONTROL

- .1 Non-conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.
 - .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

3.4 CLEANING AND PROTECTION

- .1 Be responsible for protection of all manufactured specialty work during period of construction.
- .2 Upon completion of installation of all toilet accessories, remove all excess material, empty cartons, wrappings, etc. and remove any dirt spots and foreign material from the installed items, leaving them in a clean, usable condition.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with Instructions to Bidders, the General Conditions of the Contract as amended by the Supplementary Conditions including all Sections outlined in Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements.
- .2 Report in writing to the General Contractor any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work. Commencement of work implies acceptance of existing conditions and work by others.

1.2 INTENT

- .1 The following prefabricated items to be supplied and installed:
 - .1 Fire extinguishers.
 - .2 Fire extinguisher cabinets.
- .2 Approved Manufacturers: The manufacturers listed are only approved if they can provide the product as described.

1.3 REJECTIONS

- .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight or errors.
- .2 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.

1.4 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings as specified in Section 01 33 00, specifically provide the following:
 - (1) Fire extinguisher cabinets.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 01 61 00.
- .2 Deliver and store materials undamaged in original cartons or wrappings.
- .3 Store material in a secure, dry area.

2 PRODUCTS

2.1 MATERIALS

- .1 Provide new materials in perfect condition, free from defects impairing strength, durability or appearance.
- .2 Refer to Architectural Plans and Code Analysis Drawings for location and required quantity of items specified.

2.2 FIRE EXTINGUISHERS & CABINETS

- .1 Supply fire extinguisher cabinets suitable for fully recessing in concrete block walls as follows:
 - .1 For 5 lb extinguishers, semi-recessed Model 102RS by National Fire Equipment (125 mm d x 450 mm h x 200 mm w). Door finish: stainless steel #4 satin with 5 mm tempered glass. Cabinet Finish: baked enamel paint.
- .2 Provide fire extinguishers:
 - .1 General Areas: Type A:B:C 5 lb, 3A, 10BC multipurpose dry chemical.
- .3 Approved Suppliers:
 - .1 National Fire Equipment, (905) 761-6355.
 - .2 Becker Fire Service, (519) 896-1999.

3 EXECUTION

3.1 EXAMINATIONS

- .1 Report to the Consultant, in writing, all defects of work prepared by other trades and on unsatisfactory site conditions.
- .2 Do not commence the work of this Division until surfaces, area, conditions specified or indicated on drawings, to receive manufactured specialties, are compatible with the manufacturer's installation requirements.
- .3 Commencement of work implies total acceptance of all preliminary installation requirements by the Contractor installing manufactured specialty items.
- .4 Waive any after claims by failure to comply with the above procedure of examination.

3.2 INSTALLATION

- .1 Carry out installation of manufactured specialty items by tradesmen with the necessary training and experience, and certified by the manufacturer or by the Contractor.
- .2 Conform to manufacturer's printed installation instructions and/or shop drawings.
- .3 Installation height in accordance with Subsection 6.2.4., Div. B of the 2007 Fire Code.

3.3 CLEANING AND PROTECTION

- .1 Be responsible for protection of all manufactured specialty work during period of construction.
- .2 Upon completion of installation of all manufactured specialty items remove all excess material, empty cartons, wrappings, etc. and remove any dirt spots and foreign material from the installed items, leaving them in a clean, usable condition.

3.4 CLEAN-UP

- .1 Upon the completion of work, remove from the site all surplus materials and debris caused by this work and leave the site in a clean condition to the satisfaction of the Consultant.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SECTION INCLUDES

- .1 Supply and install interior manual window coverings.
- .2 Location: All new exterior window locations as indicated on plans.
- .3 Removal of existing blinds and turn blinds removed over to School Board.

1.3 RELATED SECTIONS

- .1 Section 06 20 00 – Finish Carpentry

1.4 REFERENCES

- .1 ASTM B209M-07: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
- .2 ASTM B221M-07: Standard Specification for Aluminum and Aluminum-Alloy Sheet Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .3 NFPA 701-2004: Methods of Fire Tests for Flame Propagation of Textiles and Films.
- .4 ASTM G21: Standard Practice for Determining Resistance of Synthetic Polymeric Materials for Fungi.

1.5 SUBMITTALS

- .1 Submit shop drawings as specified in Section 01 33 00, specifically provide the following:
- .2 Shop Drawings: Indicate location, layout and show assembly and installation details, methods and location of fastenings.

1.6 QUALITY ASSURANCE

- .1 Products shall be installed by manufacturer's authorized and trained personnel. The work shall be done in strict compliance with the manufacturer's recommendations.
- .2 Products will comply with UL listed standard 325, CSA standards and all OBC standards.
- .3 Anti – Microbial Characteristics: "No Growth" per ASTM G21 results for fungi ATCC9642, ATCC 9644, ATCC 9645.

1.7 WARRANTY

- .1 Provide a warranty for roller window shades hardware, fabric, and assembly including parts and labour for period of 5 years from date of project substantial completion.

2 PRODUCTS

2.1 MATERIALS

- .1 Extruded aluminum: to ASTM B221M, 6063 alloy, T5 temper unless otherwise specified.
- .2 Sheet aluminum: to ASTM B209M, 3003 alloy H14 temper.
- .3 Bituminous coating: Fibrous asphalt emulsion.
- .4 Screw Fasteners: Non-corrosive type

2.2 PRODUCTS

- .1 Sunshade fabric to be 1% open weave flame retardant, 100% low V.O.C., Architect to choose colour when shop drawings are submitted. Seams if required, shall be equally spaced vertically to form material with equal widths.
- .2 Sample fabric type, colour and density to be reviewed and approved by the Consultant.
- .3 Manual Sun Shade: Manually operated sun shade shall have fascia and shade holder manually operated by chain and sprocket roller shade system with infinite positions. Each shade consisting of end brackets, shade tube, fascia, hem bar and fabric. Mounting shall be ceiling mounted with aluminum fascia and closure.
- .4 Motorized Sun Shade: Motorized sun shade similar to manual but with electric operating mechanism for gym windows and library windows.

2.3 COMPONENTS

- .1 Shade Roller Tube: Rigid roller tubes shall be all aluminum extruded aluminum available in 1- ½", or 2" to suit with reinforced internal ribs to provide maximum span without tube deflection. Tube size shall be as recommended by the manufacturer and as selected from Sun Projects weights and measures chart.
- .2 Drive Assembly: factory set for size and travel of shades; field adjustable complete with built-in stock absorber designed to prevent chain breakage.
- .3 Drive Chain: No. 10 stainless steel bead chain, continuous loop type, tested for 41 kg. of force.
- .4 Exterior Hem Bar: extruded aluminum with plastic end finials; dark brown finish.
- .5 Cassette: 0.60 galvanized steel snap on brackets for ceiling, wall or mounting brackets recessed mount in ceiling.
- .6 Cassette Box: Cassette design shall be a one-piece aluminum anodized extruded box closed on all four sides, top, back, sides and bottom return. Cassette sections to be square with internal groove to accommodate a self-cleaning brush to ensure fabric maintenance as well as a gap brush on top back side of cassette to provide for a light seal. Cassette end caps shall be 2 mm, Delrin plastic with four countersunk flat headed screw holes.
- .7 Provide appropriate cassette sections to suit window openings as required. Ensure proper clearance at operable window units.

- .8 Chain Drive: Shall consist of a heavy-duty commercial grade sprocket, spring brake assembly system contained within a retainer cap providing a smooth operating action with infinite positioning.
- .9 Operating Chain: Shall be No. 10 qualified heavy-duty stainless-steel bead chain, 90 lbs., load test, formed in a continuous loop with stops at highest and lowest positions to prevent over winding and unrolling.
- .10 Chain Hold Down: Operating chain shall be fully secured to SP spring loaded chain holder, colour: anodized. Chain retainer wall clip shall be provided to secure chain and prevent excess chain from dangling.

2.4 FABRICATION

- .1 Where multiple shades are provided between the frames of a single glazed unit, the shades shall be of equal width within that unit.
- .2 Removal of the shade must not require the disassembly of the shade unit.
- .3 Fabricate units to completely fill openings from head to sill and jamb-to-jamb, unless detailed otherwise.
- .4 Fabricate shade fabric to hang flat without buckling or distortion. Edges shall hang straight without curling or ravelling.

2.5 ASSEMBLY

- .1 Shade unit shall be supplied to site fully assembled complete with shade holder (back fascia).
 - .1 Mounting detail:
 - .1 Ceiling mounted on underside of the ceiling or bulkhead. Typical application unless otherwise required to suit conditions. Review alternate installation method with Architect for approval prior to installation.
 - .2 Shade Orientation:
 - .1 Regular-roll, shade cloth to roll at window side of roller.

2.6 FASTENINGS

- .1 Provide hardware complete with screws, bolts, expansion shields and other fastening devices as required for the satisfactory installation and operating of the hardware.
- .2 Provide fastening devices of the same finish as the hardware that is to be fastened.

2.7 SHOP FINISHES

- .1 Provide hardware of type and finish in accordance with, and equal in all respects to the samples of hardware and finishes approved by the Consultant.
- .2 Metal finishes shall be free from defects, clean and unstained, and of a uniform colour and finish for each type of finish required.
- .3 Exposed Aluminum: Painted to AAMA 2603, one-coat thermosetting fluoropolymer coating 0.02 mm thick, e.g. PPG Duracron; manufacturer's standard dark brown colour.

2.8 APPROVED MANUFACTURERS:

- .1 Altex SunProject Line, Vaughan, ON 888-836-6980
- .2 Solarfective, Toronto, ON 416-421-3800
- .3 Hunter Douglas, Brampton, ON 1-800-265-8000
- .4 Louvolite Roller Shades System, Kitchener, ON 1-519-603-0230

3 EXECUTION

3.1 EXAMINATION

- .1 Verify that the openings are plumb and are dimensioned properly. Ensure adequate support has been provided for the operator header. Proceed with the installation only after conditions have been deemed satisfactory.

3.2 INSTALLATION

- .1 Install units to comply with the Manufacturer's instructions for the type of mounting and operation required. Provide units plumb, true and securely anchored in place with recommended hardware and accessories to provide smooth operation without binding.
- .2 Install units within the following tolerances:
 - .1 Maximum variation of gap at window opening perimeter: ¼", per 8' (+/- 1/8") of shade height.
 - .2 Maximum offset from level: 1/8"
 - .3 Follow Manufacturer's edge-clearance specifications for shades where the width-to-height (W:H) ratio exceeds 1:3.
- .3 Roller shades shall be installed level, plumb, square and true.
- .4 Adjust equipment to ANSI 156.10. Adjust and balance to operate smoothly, easily, safely and free from binding or malfunction throughout entire operational range.
- .5 Review with Architect, mounting locations and details at specified openings for approval to proceed.
- .6 Provide additional concealed wood blocking or other materials as required to anchor units to walls or underside of steel lintel as required.
- .7 Clean roller shade surfaces after installation, according to manufacturers written instructions.

3.3 ADJUSTING

- .1 Adjusting units for smooth operation. Adjust shade and shade cloth to hang flat without buckling or distortion. Replace any units or components which do not hang properly for operate smoothly.

3.4 CLEANING

- .1 Touch up damaged finishes and repair minor damage in order to eliminate evidence of repair. Remove and replace work that cannot be satisfactorily repaired.
- .2 Clean exposed surfaces, including metal and shade cloth, using non-abrasive materials and methods recommended by the shade cloth Manufacturer. Remove and replace work which cannot be satisfactorily cleaned.

3.5 DEMONSTRATION

- .1 Demonstrate operation method and instruct Owner's personnel in the proper operation and maintenance of the window shade system.
- .2 Demonstrate proper care of hardware to Owner as specified in Section 01 79 00, including:
 - .1 lubrication,
 - .2 adjustments,
 - .3 cleaning, and
 - .4 general maintenance.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 This Section specifies requirements and instructions that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.3 DEFINITIONS

- .1 Refer to Division 01. The following are definitions of words found in mechanical work Sections of the Specification and on associated drawings:
 - .1 "concealed" – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, walls and partitions
 - .2 "exposed" – means work normally visible, including work in equipment rooms and similar spaces
 - .3 "provide" (and tenses of provide) – means supply and install complete
 - .4 "install" (and tenses of install) – means install and connect complete
 - .5 "supply" – means supply only
 - .6 "finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished
 - .7 "governing authority" and/or "regulatory authority" and/or "Municipal authority" – means all government departments, agencies, standards, rules and regulations that apply to and govern the mechanical work and to which the work must adhere
 - .8 "Consultant" – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner
 - .9 "Equal to" – if products supplied by an "Equal to" manufacturer are proposed for use the "Equal to" product must be equivalent in quality, size and weight, performance, and operating characteristics (including energy efficiency), to the specified product, and acceptance or rejection of an "Equal to" product will be made by the Consultant
- .2 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is "indicated", "shown", "listed", or "noted" on the drawings.
- .3 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is "approved by", "inspected by", etc., the Consultant.
- .4 In the mechanical specification, singular may be read as plural, and vice-versa.

1.4 SUBMITTALS

- .1 Refer to Section 01 78 39, Project Record Documents. As specified in this Section, submit the following to the Consultant:
 - .1 project close-out documentation: O & M Manuals, record as-built drawings, and all associated data
 - .2 progress payment breakdown: a detailed breakdown of the mechanical work cost
 - .3 Extended Warranties: copies of all extended warranties specified, dated, signed, and in the name of the Owner
 - .4 Contractor's P. Eng. Documentation: the name, qualifications, and evidence of current liability insurance for all professional engineers to perform work associated with the Contract

1.5 JOURNEYPERSON/APPRENTICE TRADESMEN

- .1 All mechanical work is to be done by tradesmen who perform only the work that their certificates permit. Apprentice tradesmen must work under direct on-site supervision of an experienced journeyperson tradesperson.
- .2 Unless otherwise specified, the journeyperson/apprentice ratio is to be in accordance with governing regulations.

1.6 CODES, REGULATIONS, AND STANDARDS

- .1 All Codes, Regulations, and Standards referred to in this Section and in Sections to which this Section applies are the latest edition of the Codes, Regulations, and Standards in effect at the time the building permit is obtained, or at the time of bid closing for the Project, whichever comes first.
- .2 All work is to be in accordance with requirements with Codes, Regulations, and Standards applied by governing authorities Included but not limited to the following:
 - 1) Ontario Building (OBC)
 - 2) Ontario Fire Code (OFC)
 - 3) Ontario Electric Safety Code (OESC)
 - 4) Canadian Standards Association (CSA)
 - 5) Underwriters Laboratory Canada (ULC)
 - 6) National Fire Prevention Association (NFPA)
- .3 All mechanical piping system work, including equipment, must comply in all respects with requirements of local technical standards authorities and CSA B51, Boiler, Pressure Vessels and Pressure Piping Code. Pressure vessels and fittings defined in Clause 4.3 of CSA B51 must bear a Canadian Registration Number (CRN).
- .4 Where any governing Code, Regulation, or Standard requires preparation and submission of applications, special details, or drawings for review, prepare and submit them. Pay all associated costs associated with these submittals.

- .5 All electrical items associated with mechanical equipment are to be certified and bear the stamp or seal of a recognized testing agency such as CSA, UL, ULC, or ETL, or bear a stamp to indicate special electrical utility approval.
- .6 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

1.7 IMPERIAL AND METRIC MEASUREMENTS

- .1 Conform to requirements of CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .2 Both Metric and Imperial units of measurement are indicated in the mechanical Specification. Metric measurements are "soft" and have been rounded off.

1.8 EXAMINATION OF SITE AND DOCUMENTS

- .1 When estimating the cost of the work and prior to submitting a bid for the work, carefully examine all of the bid documents and visit the site to determine and review all existing site conditions that will or may affect the work, and include for all such conditions in the bid price.

1.9 DRAWINGS AND SPECIFICATION

- .1 The mechanical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building are to be taken at the site.
- .2 The mechanical drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details but not shown on the drawings.
- .3 The locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of the equipment and/or materials, other equipment or systems being installed, and of the building, all at your cost.
- .4 The mechanical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.
- .5 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the costliest arrangement will take precedence.
- .6 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the costliest arrangement will take precedence.

1.10 PLANNING AND LAYOUT OF THE WORK, AND ASSOCIATED DRAWINGS

- .1 Properly plan, coordinate, and establish the locations and routing of services with all trades affected prior to installation such that the services will clear each other as well as any obstructions, including structural components of the building. Unless otherwise specified, the order of right-of-way for services is to be as follows:
 - .1 piping requiring uniform pitch
 - .2 piping 100 mm (4") diameter and larger

- .3 large ducts (main runs)
 - .4 electrical cable tray and bus duct
 - .5 conduit 100 mm (4") diameter and larger
 - .6 piping less than 100 mm (4") diameter
 - .7 smaller branch ductwork
 - .8 conduit less than 100 mm (4") diameter
- .2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install piping, ductwork, and similar services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate, prior to installation of the work.
 - .3 Locate all shut-off valves, balancing devices, air vents, equipment, and similar products, particularly such products located above suspended ceilings, for easy access for servicing and/or removal.
 - .4 Layout Drawings: Prepare layout drawings for mechanical work with locations of equipment and routing of services generally in accordance with the Contract Documents. Confirm inverts, coordinate with and make allowances for the work of other trades, accurately layout the work, and be entirely responsible for all work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with the Contract Documents, notify the Consultant prior to proceeding with the work.
 - .5 Interference Drawings: Prepare dimensioned working interference drawings, supplementary to the Contract Documents, for all areas where multiple services and/or equipment occur, or where the work due to architectural and structural considerations requires special study and treatment. Review interference drawings with the Consultant before the work is installed. Where your work has been installed in such areas without preparation of interference drawings and conflicts occur, revise your work to suit at no additional cost.

1.11 GENERAL RE: INSTALLATION OF EQUIPMENT

- .1 Unless otherwise specified or indicated, install all equipment in accordance with the equipment manufacturer's recommendations and instructions. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.

1.12 WORKPLACE SAFETY

- .1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required, and maintain 1 copy at the site in a visible and accessible location available to all personnel.
- .2 Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/insurance board and fall protection regulations.
- .3 If at any time during the course of the work asbestos containing materials, black mould, lead paint, or any other such materials are encountered or suspected, and not previously identified, immediately report the discovery to the Consultant and cease all work in the area in question. Do not resume work in affected areas until the situation has been properly corrected and without written approval from the Owner.

1.13 SHOP DRAWINGS AND PRODUCT DATA SHEETS

- .1 Submittals under all Division 20 shall be in accordance with General Conditions and Section 01 33 00 – Submittal Procedures.
- .2 Submit for review, shop drawings and/or product data sheets indicating in detail the design, construction, and performance of products as requested in Sections of this Specification. The number of copies of shop drawings and/or product data sheets will be as later directed.
- .3 Shop drawings are those prepared specifically for the Project. Product data sheets are copies of manufacturer's standard catalogue, etc., literature.
- .4 Endorse each copy of each shop drawing or product data sheet "Correct for Review By Consultant", or "Certified to Be In Accordance With All Requirements" and include your company name, the submittal date, and the signature of an officer of your company to indicate your review and approval.
- .5 "This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all sub-trades."

1.14 CHANGES OR REVISIONS TO THE WORK

- .1 Whenever the Consultant proposes in writing to make a change or revision to the design, arrangement, quantity, or type of any work from that required by the Contract, prepare and submit to the Consultant for approval, a quotation being your proposed cost for executing the change or revision.
- .2 Your quotation is to be a detailed and itemized estimate of all products, material, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.
- .3 Unless otherwise stated in the Contract, the following requirements apply to all quotations submitted:
 - .1 when the change or revision involves deleted work as well as additional work, the cost of the deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from the cost of the additional work before overhead and profit percentages are applied to the additional work
 - .2 material and labour costs are not to exceed those published in local estimating price guides, less applicable trade discounts, and labour costs for journey person and apprentice labour must not exceed prevailing rates at the time of execution of the Contract, and must reflect the actual personnel performing the work
 - .3 costs for rental tools and/or equipment are not to exceed local rental costs
 - .4 if overhead and profit percentages are not specified in the General Conditions of the Contract, Supplementary Conditions, or elsewhere in the Specification, but allowable under the Contract, then allowable percentages for overhead and profit are to be 20% for overhead and 10% for profit
 - .5 the overhead percentage will be deemed to cover all quotation costs other than actual site labour, product and materials and rentals

- .6 all quotations, including those for deleted work, must include a figure for any required change to the Contract time.
- .4 Failure to submit a proper quotation to enable the Consultant to expeditiously process the quotation and issue a Change Order will not be grounds for any additional change to Contract time.

1.15 SCAFFOLDING, RIGGING, AND HOISTING

- .1 Unless otherwise specified or directed, supply, erect and operate all scaffolding, rigging, hoisting equipment and associated hardware required for your work. Immediately remove from the site all scaffolding, rigging, and hoisting equipment when no longer required.
- .2 Do not place major erection loads on any portion of the structure without approval from the Consultant.
- .3 Submit for review, rigging and hoisting plans, contemplated dates, permits, equipment, safety measures, and personnel prior to hoisting operations.

1.16 PROJECT CLOSEOUT SUBMITTALS

- .1 Refer to Section 01 77 00, Closeout Procedures.
- .2 Prior to application for Substantial Performance, submit all required items and documentation specified, including the following:
 - .1 Operating and Maintenance Manuals
 - .2 as-built record drawings and associated data
 - .3 extended warranties for equipment as specified
 - .4 all operating test certificates, i.e. Sprinkler Test Certificate
 - .5 final commissioning report and TAB report
 - .6 identified keys for mechanical equipment and/or panels for which keys are required, and all other items required to be submitted
 - .7 other data or products specified
- .3 Operating and Maintenance Manuals: Submit 3 hard copies of operating and maintenance manuals consolidated in hardcover 3 "D" ring binders, each binder sized to include approximately 25% spare space for future data, and identified permanently with the Project name, "MECHANICAL OPERATING AND MAINTENANCE MANUAL" wording, and the date. Manuals are to include the following:
 - .1 an Introduction sheet listing the Consultant's, Contractor's, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses
 - .2 a Table of Contents sheet, and corresponding index tab sheets
 - .3 a copy of each shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, and the email address for local source of parts and service
 - .4 pressure test reports, and certificates issued by governing authorities
 - .5 Operating Data: Operating data is to include:
 - .1 a description of each system and its controls

- .2 control schematics for equipment/systems including building environmental controls
- .3 if applicable, the building automation system (BAS) architecture and all required operating data
- .4 description of operation of each system at various loads together with reset schedules and seasonal variances
- .5 operation instructions for each system and each component
- .6 description of actions to be taken in event of emergencies and/or equipment failure
- .7 valve tag schedule, and flow diagrams to indicate valve locations
- .6 Maintenance Data: Maintenance data is to include:
 - .1 servicing maintenance, operation and trouble-shooting instructions for each item of equipment and each system
 - .2 schedules of tasks, frequency, tools required, and estimated task time
 - .3 complete parts lists with numbers
- .7 Performance Data: Performance data is to include:
 - .1 equipment and system start-up data sheets
 - .2 equipment performance verification test results, and final commissioning report
 - .3 final testing adjusting and balancing reports
- .8 Review Submittal: Assemble one copy of the O & M Manual and submit to the Consultant for review prior to Owner training and instructions, and assembling the remaining copies. Incorporate all comments into the final submission.
- .9 Digital O & M Manuals: Submit digital versions of the hard copy manual using the latest version of Adobe Acrobat Portable Document Format and enhanced with bookmarks, internet links, and internal document links. The digital copies are to indicate the project name, date, the Consultant's name, and "Operating & Maintenance Manual for Mechanical Systems".
- .4 Record "As-Built" Drawings and Data: As work progresses at the site, clearly mark in red in a neat and legible manner on a set of white prints of the Contract Drawings, all significant changes and deviations from the routing of services and locations of equipment shown on the Contract Drawings and resulting from the issue of Addenda, Site Instructions, Change Orders, and job conditions. Use notes marked in red as required. Maintain the white print red line as-built set at the site for the exclusive use of recording as-built conditions, keep the set up-to-date at all times, and ensure that the set is always available for periodic review. The as-built set is also to include the following:
 - .1 the dimensioned location of all inaccessible concealed work
 - .2 the locations of control devices with identification for each
 - .3 the location of all piping system air vents and water hammer arrestors
 - .4 the location and tag identification for all tagged valves

- .5 for underground piping, including service entrance/exit piping, record dimensions, invert elevations, all offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks that will be preserved after construction is complete
- .6 for fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings
- .7 the location of all concealed services terminated for future extension
- .5 Digital Record "As-Built" Drawings: When work on site is complete, transfer all the as-built red line information from the site as-built drawings to a recordable and identified CAD disc with CAD work of equal quality to the Contract Drawings. Obtain a CAD disc as described below.
- .6 Obtaining CAD Digital Files: The mechanical drawings have been prepared on a CAD system using the latest Release of AutoCad software. For the purpose of producing final as-built drawings, digital files of the Contract Drawings will be supplied by the Consultant for a nominal fee.
- .7 Review and Submittal: Prior to inspection for Substantial Performance of the work, submit for review, the red line site as-built white prints, a CAD digital file of the as-built drawings, and a bound set of white prints (of equal quality to the Contract Drawings) made from the digital file. The Consultant will review the drawings and, if necessary, return the disc and the marked-up white prints for corrections or further revisions, in which case complete the corrective and/or revision work and resubmit the disc and white prints until they are determined to be acceptable, all prior to issue of a Certificate of Substantial Performance.

1.17 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

- .1 All professional engineers retained by you to perform consulting services with regard to your work, i.e. seismic engineer, fire protection engineer, structural engineer, are to be members in good standing with the local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of the governing authorities in the locale of the work.
- .2 Your engineer's professional liability insurance is to protect your Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss or damage resulting from the professional services rendered by your Consultants, Sub-Consultants, and their respective servants, agents, and employees in regards to the work of this Contract.
- .3 Liability insurance requirements are as follows:
 - .1 coverage is to be a minimum of \$2,000,000.00 inclusive of any one occurrence
 - .2 the insurance policy is not to be cancelled or changed in any way without the insurer giving the Owner a minimum of thirty days written notice
 - .3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the location of the work
 - .4 evidence of the required liability insurance in such form as may be required is to be issued to the Owner, the Owner's Consultant, and Municipal Authorities as required prior to commencement of your Consultant's services

1.18 EXTENDED WARRANTIES

- .1 All extended warranties specified in mechanical work Sections of the Specification are to be full parts and labour warranties, at the site, and in accordance with requirements of the Contract warranty, but direct and in writing from the equipment manufacturer/supplier to the Owner.
- .2 Submit signed and dated copies of extended warranties which clearly state requirements specified above.

1.19 EQUIPMENT AND MATERIAL MANUFACTURER REQUIREMENTS

- .1 Equipment and materials scheduled or specified on the drawings or in the Specification have been selected to establish a performance and quality standard.
- .2 In most cases acceptable equipment and material manufacturers are listed for any product specified. Unless otherwise stated the bid price may be based on products supplied by any of the manufacturers named as acceptable for the particular product. If acceptable manufacturers are not listed for a particular product, base the bid price on the products supplied by the specified manufacturers.
- .3 If products supplied by a manufacturer named as acceptable are used in lieu of the products specified by manufacturer's name and model number, ensure that the product is equivalent in performance and operating characteristics (including energy efficiency if applicable) to the specified product. Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a manufacturer other than the specified manufacturer. In addition, in equipment spaces where products named as acceptable are used in lieu of the specified products and the dimensions of such products differ from the specified products prepare and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.

1.20 EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION

- .1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for the equipment/system manufacturer's authorized representative to visit the site to examine the installation, and when any required corrective measures have been made, to certify in writing to the Consultant that the equipment/system installation is complete and in accordance with the equipment/system manufacturer's instructions.

1.21 EQUIPMENT AND SYSTEM START-UP

- .1 When installation of equipment/systems is complete, but prior to commissioning, perform start-up for equipment/systems as specified in mechanical work Sections in accordance with the following requirements:
- .2 submit a copy of each equipment/system manufacturer's blank start-up report sheet to the Consultant for review, and incorporate any comments
- .3 under direct on-site supervision and involvement of the equipment/system manufacturer's representative, start-up the equipment/systems, make any required adjustments, document the procedures, leave the equipment/systems in proper operating condition, and submit a complete set of start-up documentation sheets signed by the manufacturer/supplier and the Contractor

1.22 EQUIPMENT AND SYSTEM COMMISSIONING

- .1 After successful start-up and prior to Substantial Performance, commission the mechanical work in accordance with requirements of CSA Z320, Building Commissioning. Use commissioning sheets included with the CSA Standard, and any supplemental commissioning sheets required. Submit final commissioning data sheets, TAB reports, project closeout documents, and other required submittals.

1.23 EQUIPMENT AND SYSTEM O & M DEMONSTRATION & TRAINING

- .1 Train the Owner's designated personnel in all aspects of operation and maintenance of equipment and systems as specified in mechanical work Sections of the Specification. All demonstrations and training is to be performed by qualified technicians employed by the equipment/system manufacturer/supplier. The number of hours of training and the number of Owner's personnel to be involved will be specified in the mechanical work Sections to which this Section applies.
- .2 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Operating and Maintenance Manuals are to be used during the training sessions, and training modules are to include:
 - .1 Operational Requirements and Criteria: Requirements and criteria are to include but not be limited to equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations.
 - .2 Troubleshooting: Troubleshooting is to include but not be limited to diagnostic instructions, test and inspection procedures.
 - .3 Documentation: Documentation is to include but not be limited to equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like.
 - .4 Maintenance: Maintenance requirements are to include but not be limited to inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools.
 - .5 Repairs: Repair requirements are to include but not be limited to diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.
- .3 Assemble the training modules into a training manual and submit a copy to the Consultant for review prior to scheduling training. Ensure that each participant in each training session has all required training material.
- .4 Schedule demonstrations and training at mutually agreed to times with a minimum of 7 working days notice.
- .5 Training Session DVD: For equipment/system demonstration and training sessions as specified in mechanical work Sections, submit an identified DVD of the session prepared by a professional photographer with construction project technical training session experience.
- .6 Demonstration and Training Confirmation: Obtain a list of personnel to receive demonstration and training from the Consultant, and have each participant sign the list to confirm that he/she understood the demonstration and training session.

2 PRODUCTS

NOT APPLICABLE

3 EXECUTION

NOT APPLICABLE

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 This Section specifies products, common criteria and characteristics, and methods and execution that are common to one or more mechanical work Sections of the Specification, and it is intended as a supplement to each Section and is to be read accordingly.

1.3 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Submit product data sheets for:
 - .1 pressure gauges and thermometers
 - .2 drain valves
 - .3 flexible connections
 - .4 equipment support assemblies, other than concrete pads
- .3 Samples:
 - .1 submit a sample of each proposed type of access door, and samples of materials and any other items as specified in mechanical work Sections of the Specification
- .4 Access door locations: submit white prints of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations in walls and ceilings in finished areas
- .5 List of equipment nameplates: submit a list of equipment identification nameplates indicating proposed wording and sizes
- .6 Pipe & duct identification: submit a list of pipe and duct identification colour coding and wording
- .7 Valve tag chart: submit a proposed valve tag chart and a list of proposed valve tag numbering and identification wording
- .8 Waste management and reduction plan: submit a waste management and reduction plan prior to commencing work and as per requirements specified in this Section
- .9 Drive belts: as specified in Part 2 of this Section, submit a spare belt set, tagged and identified, for each belt driven piece of equipment
- .10 Additional submittals: submit any other submittals specified in this Section or other mechanical work Sections of the Specification

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 As listed in materials specified in this section.
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 Pipe Sleeves
 - .1 Galvanized Sheet Steel: Minimum #16 gauge galvanized steel with an integral flange at one end to secure the sleeve to formwork construction.
 - .2 Polyethylene: Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.
 - .3 Galvanized Steel or Cast Iron Pipe: Schedule 40 mild galvanized steel, or Class 4000 cast iron.
- .2 Firestopping And Smoke Seal Materials
 - .1 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in the mechanical work Section entitled Firestopping and Smoke Seal Systems and the work is to be done as part of the mechanical work.
- .3 Pipe Escutcheon Plates
 - .1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the pipe sleeve or building surface opening, and to fit tightly around the pipe or pipe insulation.
- .4 Piping Hangers And Supports
 - .1 General: Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with the Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to the following requirements:
 - .1 Unless otherwise specified, all ferrous hanger and support products are to be electro-galvanized.

- .2 Hangers and supports for insulated piping are to be sized to fit around the insulation and the insulation jacket.
- .2 Horizontal Suspended Piping: Hangers and supports are to be:
 - .1 Adjustable steel clevis hanger – MSS Type 1.
 - .2 Adjustable swivel ring band type hanger – MSS Type 10.
- .3 Horizontal Pipe On Vertical Surfaces: Epoxy coated steel pipe stays are not permitted. Supports are to be:
 - .1 Carbon steel offset pipe clamp to support pipe away from the support surface.
 - .2 Heavy-duty steel pipe bracket – MSS type 26.
 - .3 Single steel pipe hook .
- .4 Floor Supports For Vertical Risers: Supports are to be:
 - .1 Copper tubing riser clamp (plastic coated) – MSS Type 8.
 - .2 Heavy-duty steel riser clamp – MSS Type 8.
- .5 Vertical Piping on Vertical Surfaces: Epoxy coated steel pipe stays are not permitted. Supports are to be:
 - .1 Carbon steel offset pipe clamp to support pipe away from the support surface.
 - .2 Heavy-duty steel pipe bracket or soil pipe bracket – MSS Type 26.
 - .3 Extension split pipe clamp – MSS Type 12.
- .6 Horizontal Pipe On Racks: Unistrut or equal galvanized steel pipe racks with pipe securing hardware as follows:
 - .1 Standard galvanized steel U-bolts/clamps supplied by the rack manufacturer.
- .7 Special Hangers and Supports: Special hangers and supports for various applications are as follows:
 - .1 For groups of pipes having the same slope – welded steel brackets - MSS SP-58 and SP-69 Type 32, universal carbon steel channel trapeze assemblies with hanger rods and hardware, or Unistrut or equal support assemblies, all with U-bolts, clamps, etc., to secure pipes in place.
 - .2 For sections of piping connected to vibration isolated equipment – hangers and supports as specified above but complete with MSS Type 48 spring cushions.
 - .3 For piping on an existing roof – equal to Portable Pipe Hangers (Canada) Inc. "PP" Series prefabricated portable pipe support system components to suit the pipe, complete with all required accessories including bases, galvanized structural steel frames, and galvanized steel pipe hangers and/or supports conforming to MSS SP-58.

- .4 For piping on new roofs – Lexcor "Flash-Tite" or Thaler Roofing Specialties Products Inc. "MERS" Series insulated aluminum support risers with diameter, height, securement method and flashing to suit the application, all required accessories, channel type aluminum cross members, and galvanized steel pipe hangers and/or supports conforming to MSS Type SP-58, complete with all required accessories.
- .5 For plastic piping above ground – generally as specified above but in accordance with the pipe manufacturer's printed recommendations.
- .6 For fire protection piping – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of the NFPA Standard applicable to the piping system.
- .7 For bare horizontal copper piping – generally as above but factory vinyl coated to prevent direct copper/steel contact.
- .8 For bare copper vertical piping – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate the pipe from the clamp.
- .9 Insulation protection shields to & including 40 mm (1½") diameter – galvanized steel shields with ribs to keep the shield centred on the hanger – MSS SP-58 Type 40.
- .8 Hanger Rods: Electro-galvanized carbon steel (unless otherwise specified), round, threaded, complete with captive machine nuts with washers at hangers, sized to suit the loading in accordance with Table 3 in MSS SP-58, but, in any case, minimum 9.5 mm (3/8") diameter and in accordance with ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength, and ASME B18.31.3, Threaded Rods (Inch Series).
- .5 Piping Drain Valves
 - .1 Minimum 2070 kPa (300 psi) water rated, 20 mm (¾") diameter, straight pattern full port bronze ball valves, each complete with a lever handle, threaded outlet suitable for coupling connection of 20 mm (¾") diameter garden hose, and a cap and chain.
- .6 Access Doors
 - .1 Prime coat painted steel (unless otherwise specified) flush access doors, each complete with a minimum #16 gauge frame, minimum #18 gauge door panel, heavy-duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing features to suit the particular construction in which it is to be installed.
 - .2 Access door sizes are to suit the concealed work for which they are supplied, and wherever possible they are to be of a standard size for all applications, but, in any case, they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.
 - .3 Access doors in fire rated construction are to be ULC listed and labelled and of a rating to maintain the fire separation integrity.
 - .4 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout, and constructed of stainless steel with a #4 finish.
- .7 Equipment Belt Drives

- .1 ANSI/RMA Standard V-belt type rated at minimum 1.5 times the motor nameplate rating, and in accordance with the following requirements:
 - .1 Belts are to be reinforced cord and rubber, and multiple belts are to be matched sets.
 - .2 Sheaves are to be cast iron or steel, secured to shafts with removable keys unless otherwise specified, standard adjustable pitch ($\pm 10\%$ range) for motors under 10 HP, fixed pitch type with split tapered bushing and keyway for motors 10 HP and larger, and, if required, replaced as part of the mechanical work to suit system air/water quantity testing and balancing work.
 - .3 Motor slide rail adjustment plates are to allow for centre line adjustment.
- .2 Supply a spare belt set (tagged and identified) for each belt drive and hand to the Owner upon Substantial Performance of the work.
- .8 Equipment Drive Guards And Accessories
 - .1 For V-belt drives - removable, four sided, fully enclosed, galvanized sheet steel guards to OSHA standards, cleaned, factory primed and painted with yellow equipment enamel, complete with a 2-piece full length hinged front panel to permit belt maintenance or replacement without removing the guard, and 40 mm ($1\frac{1}{2}$ ") diameter tachometer openings at each shaft location.
 - .2 For flexible couplings - removable "U" shaped galvanized steel guards to OSHA Standards with a 2.3 mm ($3/32$ ") thick frame and expanded mesh face.
 - .3 For unprotected fan inlets & outlets - unless otherwise specified, removable 20 mm ($\frac{3}{4}$ ") galvanized steel wire mesh with galvanized steel frames, all to OSHA Standards.
- .9 Electric Motors
 - .1 Unless otherwise specified, motors are to conform to EEMAC Standard MG1, applicable IEEE Standards, and applicable CSA C22.2 Standards, and are to meet NEMA standards for maximum sound level ratings under full load. Confirm motor voltages prior to ordering.
 - .2 Vertically mounted and submersible motors are to be purposely designed for mounting in this attitude.
 - .3 AC Motor Efficiency: The efficiency of single phase AC motors to 1 HP is to be in accordance with CAN/CSA C747. The efficiency of all three phase motors 1 HP and larger is to be in accordance with CAN/CSA C390 or IEEE 112B.
 - .4 Single Phase AC Motors: Unless otherwise specified, AC motors smaller than $\frac{1}{2}$ HP are to be 115 volt, continuous duty capacitor start type with an EEMAC 48 or 56 frame size, solid base, heavy-gauge steel shell with solid die-cast end shields, dynamically balanced die-cast rotor, integral automatic reset thermal overload protection, Class "B" insulation, and a 1.15 service factor at 40°C (105°F) ambient temperature.
 - .5 Two-Speed AC Motors: Two-speed motor(s) are to be as specified above but two-speed, single or double winding type as specified and/or scheduled.
 - .6 Motors for VFD's: Motors for equipment with variable frequency drives are to be generally as specified above but inverter duty type to NEMA Standard MG-1, Section IV, Part 31, quantified by CSA for operation from a variable frequency drive of the type specified, and complete with Class "H" insulation and a shaft grounding bearing protection ring.

- .7 Corrosion Protection: Motors for equipment which is scheduled or specified with a corrosion resistant coating or constructed from corrosion resistant materials are to be factory coated with a primer and epoxy paint finish.
- .8 Acceptable Manufacturers: Acceptable motor manufacturers are:
 - .1 Westinghouse Canada Inc.
 - .2 Canadian General Electric
 - .3 Baldor Electric Co.
 - .4 U.S. Electrical Motors
 - .5 Weg Electric Corp.
 - .6 Marathon Electric
 - .7 Magna-Tech Canada
 - .8 Toshiba Corp.
 - .9 Leeson Canada
- .10 Mechanical Work Identification Materials
 - .1 In accordance with existing identification at the site.

3 EXECUTION

3.1 INSTALLATION

- .1 General Piping And Ductwork Installation Requirements
 - .1 Unless otherwise specified, locate and arrange horizontal pipes and ducts above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, with Consultant's approval.
 - .2 Unless otherwise specified, install all work concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer to and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.
 - .3 Install all pipes and ducts parallel to building lines and to each other.
 - .4 Neatly group and arrange all exposed work.
 - .5 Service and Maintenance Access: Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all valves, dampers and any other equipment which will or may need maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate the accessories at the floor level.
 - .6 Dissimilar Metal Pipe Connections: Make all connections between pipes of different materials using proper approved adapters. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.

- .7 Cleaning: Carefully clean all ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.
 - .8 Insulation Clearance: Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around the pipe or duct, except for ductwork at fire barriers, in which case the insulation will be terminated at each side of the duct fire damper.
 - .9 Surfaces To Receive Your Work: Inspect surfaces and structure prepared by other trades before performing your work. Verify that surfaces or the structure to receive your work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your work will constitute acceptance of such surfaces as being satisfactory.
 - .10 Piping Rust and Dirt: Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both is to be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean the piping prior to being concealed.
 - .11 Drain Pans: Provide continuous galvanized sheet metal drip pan under all drain, water and water solution piping extending through all rooms with electrical equipment such as electrical, elevator equipment and transformer rooms, and all other spaces provided primarily for the installation of electrical equipment. Drip pans are to be complete with a drain pipe connection and drain piping is to be extended to the closest drain.
 - .12 Repair of Finished Surfaces: For factory applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work is to match the original finish. This requirement also applies to galvanized finishes.
 - .13 Unions and Flanges: Whether shown or specified on the drawings or not, provide screwed unions or flanges in all piping connections to equipment, and in regular intervals in new piping runs in excess of 12 m (40') to permit removal of sections of piping.
 - .14 Elbows and Eccentric Reducers: Unless otherwise specified and except where space limitations do not permit, all piping elbows are to be long radius. Eccentric reducers are to be installed with the straight side at the top of the piping.
- .2 Pipe Joint Requirements
- .1 Do not make pipe joints in walls or slabs.
 - .2 Ream all piping ends prior to making joints.
 - .3 Screwed Steel Piping: Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After the pipe has been screwed into the fitting, valve, union, or piping accessory, not more than 2 pipe threads are to remain exposed.
 - .4 Welded Steel Piping: Site bevel steel pipe to be welded or supply mill bevelled pipe. Remove all scale and oxide from the bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.

- .5 Welding Requirements: Welding is to be TSSA registered. Welded joints are to be made by CWB certified, licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed. Each weld is to be identified with the welder's identification symbol, and welds are not to be concealed until they have been inspected and approved. Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.
- .6 Flanged Joints: Unless otherwise specified, make all flanged joints with EDPM gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than the length necessary to screw the nut up flush to the end of the bolt. Bolts used for flanged connections in all piping with a working pressure of 690 kPa (100 psi) and greater are to be ASTM A-193, Grade B-7, with heavy hexagon nuts to ASTM A-194, CL-2H. Provide suitable washers between each bolt head and the flange and between each nut and the flange.
- .7 Examination of Flanged Joints: A random check of bolted flanged connections will be made to verify that flanged connections are properly mated with no shear force acting on bolts. Supply all labour to disconnect and reconnect the selected flanged joints. If improperly mated joints are found, remove and reinstall the affected piping so that the flanges mate properly. If improperly mated joints are found, additional joints will be checked, and you will be responsible for the repair of any other improper joints discovered.
- .8 Soldered Joints: Unless otherwise specified make all soldered joints in copper piping using flux suitable for and compatible with the type of solder being used. Clean the outside of the pipe end and the inside of the fitting, valve, or similar accessory prior to soldering. Comply with requirements of ASTM B828, Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
- .9 Mechanical Joints: Install mechanical joint fittings and couplings in accordance with the manufacturer's instructions.
- .10 Grooved Pipe & Coupling Joints: Make arrangements with the coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to the manufacturer's instructions with respect to pipe grooving, support, type of gasket required, anchoring and guiding the grooved piping system.
- .11 Pressure Crimped Piping Joints: If pressure crimped couplings and fittings are used, ensure that gaskets are fully compatible with the piping fluid, and that all valves and piping accessories are suitable. Use only fitting manufacturer supplied crimping equipment. Comply with the manufacturer's latest published specification, instructions, and recommendations with respect to pipe, coupling, and fitting preparation and installation, and support, anchoring and guiding of the piping system.
- .12 PVC Piping Solvent Weld Joints: Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with the manufacturer's recommendations, ASTM D2855, and CSA requirements.
- .13 PVC Piping Gasketed Joints: Install PVC piping with gasketed joints in accordance with the manufacturer's current published specifications, instructions and recommendations, and CSA requirements.
- .3 Installation Of Pipe Sleeves
 - .1 Except as specified below, where pipes pass through new concrete and/or masonry surfaces provide pipe sleeves as follows:

- .1 In poured concrete slabs: unless otherwise specified - minimum #16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves.
- .2 In concrete or masonry walls: Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe.
- .2 Sleeves In Fire Rated Construction: Where sleeves are required in fire rated construction they are to be Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe
- .3 Size sleeves, unless otherwise specified, to leave 12 mm ($\frac{1}{2}$ ") clearance around the pipes, or where the pipe is insulated, a 12 mm ($\frac{1}{2}$ ") clearance around the pipe insulation.
- .4 Pack and seal the void between the pipe sleeves and the pipe or pipe insulation in non-fire rated construction for the length of the sleeves as follows:
 - .1 Interior construction: pack sleeves in interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound.
 - .2 Exterior walls above grade: pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified.
 - .3 Exterior walls below grade: seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below.
- .5 Where sleeves are required in masonry work, accurately locate and mark the sleeve location, and hand the sleeves to the mason for installation.
- .6 Terminate piping for sleeves that will be exposed so that the sleeve is flush at both ends with the building surface concerned so that the sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above the finished floor.
- .7 "Gang" type sleeving will not be permitted.
- .8 Where sleeves are provided in non-fire rated construction for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of the sleeved opening.
- .4 Duct Openings
 - .1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by the trade responsible for the particular construction in which the opening is required.
 - .2 Ensure that openings for fire dampers to 600 mm (24") high are sized to suit the damper arrangement with the folding blade out of the air stream.
 - .3 For all duct openings except where fire dampers are required, pack and seal the space between the duct or duct insulation and the duct opening as specified above for pipe openings in non-fire rated construction.
- .5 Sleeve And Formed Opening Location Drawings
 - .1 Prepare and submit for review, white print drawings indicating the size and location of all required sleeves, recesses and formed openings in new poured or precast concrete work.

- .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.
- .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.
- .6 Installation Of Pipe Escutcheon Plates
 - .1 Provide escutcheon plates suitable secured over all new exposed piping passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.
 - .2 Install the plates so that they are tight against the building surface concerned, and ensure that the plates completely cover pipe sleeves and/or openings, except where waterproof sleeves extend above floors, in which case the plate is to fit tightly around the sleeve.
- .7 Installation Of Fastening And Securing Hardware
 - .1 Provide all fastening and securing hardware required for mechanical work to maintain installations attached to the structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products.
 - .2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.
 - .3 Where the floor, wall or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure that is to support the products. Provide reinforcing or connecting supports where required to distribute the loading to the structural components. Submit support details for review prior to installation.
 - .4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CSA Standards CAN3-Z166.1 and CAN3-Z166.2.
 - .5 Do not attach fasteners to steel deck without written consent from the Consultant.
- .8 Installation Of Pipe Hangers And Supports
- .9 Provide all required pipe hangers and supports.
 - .1 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from the structure only.
 - .2 For Insulated Pipe: Size the hanger or support to suit the diameter of the insulated pipe and install the hanger or support on the outside of the insulation and insulation finish.
 - .3 Horizontal Above Ground Piping: Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe to and including 25 mm (1") diameter are to be clevis type or adjustable ring type, and hangers for suspended pipe 40 mm (1½") diameter and larger are to be adjustable clevis type. Space hangers and supports in accordance with the following:
 - .1 Cast iron pipe: hang or support at every joint with maximum 2.4 m (8') spacing.

- .2 Plastic pipe: conform to pipe manufacturer's recommended support spacing.
- .3 Copper and steel pipe: hang or support at spacing in accordance with the following schedule:

PIPE DIA.	MAX. SPACING STEEL (meters)	MAX. SPACING COPPER (meters)
to 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3½")	3.6 m (12')	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')
250 mm (10")	6.0 m (20')	
300 mm (12")	6.7 m (22')	

- .4 Flexible grooved pipe/coupling joint piping: as above but with not less than 1 hanger or support between joints.
- .5 Changes in direction: where pipes change direction, either horizontally or vertically, provide a hanger or support on the horizontal pipe not more than 300 mm (12") from the elbow, and where pipes drop from tee branches, support the tees in both directions not more than 50 mm (2") on each side of the tee.
- .6 Grouped piping: when pipes with the same slope are grouped and a common hanger or support is used, space the hanger or support to suit the spacing requirement of the smallest pipe in the group and secure pipes in place on the common hanger or support.
- .4 Vertical Piping: Unless otherwise shown or specified, support vertical piping by means of supports specified in Part 2 of this Section, spaced in accordance with the following:
 - .1 Support vertical pipes at maximum 3 m (10') intervals or at every floor, whichever is lesser.
 - .2 For sections of vertical piping with a length less than 3 m (10'), support the pipe at least once.
 - .3 For all vertical cast iron plain end pipe (mechanical joint type), secure the riser or pipe clamp around the pipe under a flange integral with the pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support.
 - .4 For all vertical steel pipe risers in excess of 3 m (10'), weld shear lugs to the pipe to carry the load.
 - .5 For vibration isolated piping risers, provide rubber-steel-rubber vibration isolation pads between the riser clamps and the floor.
 - .6 For piping subject to vertical movement exceeding 40 mm (1½") due to vertical pipe expansion, provide suitable engineered constant support hangers.

- .5 Piping On The Roof: Support piping on the roof as follows:
 - .1 On existing roof - provide support members as specified in Part 2 of this Section spaced as per the schedule above and of a type to suit the application, and, for each support, carefully scrape away the roofing gravel, bed the support in a heavy covering of roofing mastic, then scrape the gravel back up around the support - secure pipes to supports.
 - .2 On new roof - supply manufactured roof supports as per Part 2 of this Section to accommodate the piping involved and support spacing specified above, and hand the supports to the roofing trade on the roof for installation as part of the roofing work, then secure piping in place on the supports.
- .6 Isolation for Bare Copper Tubing: Each hanger, support or securement for horizontal bare copper tubing is to be plastic coated to prevent direct contact between the pipe and the ferrous hanger. Each wall or floor clamp for vertical bare copper piping is to be isolated from the pipe by means of strips of flexible rubber inserts. The use of painted ferrous hangers and supports, including those painted with copper coloured paint, is not acceptable. Site application of tape or other types of isolation is not acceptable.
- .7 Insulation Protection Shields: For insulated horizontal piping to and including 40 mm (1½") diameter, provide galvanized steel insulation protection shields between the insulation and the hanger or support. Install shields immediately after the pipe is insulated.
- .8 Pipe Support from Steel Deck: Do not support piping from steel deck without written consent from the Consultant.
- .10 Installation Of Equipment Drains And Piping Drain Valves
 - .1 Unless otherwise shown or specified, provide minimum 40 mm (1½") diameter type DWV copper drain piping from equipment overflows, condensate drain pans, pump bases, fresh air intake plenum drains, etc., to a floor drain location. Equip the drain piping with deep seal traps located in heated areas.
 - .2 Provide a drain valve at the bottom of piping risers, at all other piping low points, and wherever else shown and/or specified.
 - .3 Locate drain valves so that they are easily accessible.
- .11 Supply Of Access Doors
 - .1 Supply access doors to give access to all mechanical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on the drawings.
 - .2 Locate access doors as inconspicuously as possible in walls and partitions and arrange mechanical work such that it is clearly within view and accessible for inspection and servicing, and to suit access door locations shown on the reviewed and approved white prints of reflected ceiling plan and elevation drawings submitted as per Part 1 of this Section.
 - .3 Group piping and ductwork to ensure the minimum number of access doors is required. Access doors will be installed by the trades responsible for the particular type of construction in which the doors are required.
 - .4 Submit a sample of each proposed access door for review prior to ordering.
- .12 General Re: Installation Of Valves

- .1 Generally, valve locations are indicated or specified on drawings or specified in Sections of the Specification where the valves are specified, however, regardless of locations shown or specified, the following requirements apply:
 - .1 Provide shut-off valves to isolate all systems, at the base of all vertical risers, in branch take-offs at mains and risers on all floors, to isolate all equipment, to permit work phasing as required, and wherever else required for proper system operation and maintenance.
 - .2 Install shut-off valves with handles upright or horizontal, not inverted, and located for easy access.
 - .3 Unless otherwise specified, provide a check valve in the discharge piping of each pump.
 - .4 Valve sizes are to be the same as the connecting pipe size.
 - .5 Valves are to be permanently identified with the size, manufacturer's name and figure number, and wherever possible, valves are to be the product of the same manufacturer.
 - .6 The manufacturer's name, valve model or figure number, and the pressure rating are to be clearly marked on each valve.
 - .7 For valves in insulated piping, the design of the valve stem, handle and operating mechanism is to be such that the insulation does not have to be cut or altered in any manner to permit valve operation.
- .13 Installation Of Equipment Drive Guards And Accessories
 - .1 Provide OSHA guards for all exposed accessible rotating parts such as belt drives, couplings, fan wheels, and shaft ends on all mechanical equipment.
 - .2 Install belt guards to allow movement of motors for adjusting belt tension.
 - .3 Provide a means to permit lubrication and use of test instruments with guards in place.
 - .4 Secure guards to the equipment or equipment base but do not bridge sound or vibration isolation.
 - .5 Where equipment oil level gauges, oil reservoirs, grease cups, or grease gun fittings are integral with the equipment but are not easily accessible for service, extend to an accessible location using aluminium or copper tubing.
- .14 Mechanical Work Identification
 - .1 Identify all new/relocated mechanical work in accordance with existing identification standards at the site.
- .15 System Flow Diagrams
 - .1 Prepare AutoCAD, coloured, 1200 mm x 900 mm (48" x 36") flow diagrams of mechanical systems to identify all equipment and valves.
 - .2 Install framed and glazed diagrams in equipment rooms housing the system equipment. Confirm location prior to installation.
 - .3 Include reduced size copies of the diagrams in each copy of the O & M Manuals.
- .16 Finish Painting Of Mechanical Work

- .1 Finish painting of exposed mechanical work is specified in Division 09 and is part of the work of Division 09.

.17 Pipe Leakage Testing

- .1 Before new piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test all piping for leakage.
- .2 Tests are to be witnessed by the Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.
- .3 When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.
- .4 Gravity Drainage & Vent Piping: Securely close all openings and pipe ends and fill piping with water up to the highest level, and ensure that the water stands at the same level for a minimum of 2 hours. After the fixtures and fittings are set and the pipes connected to the building drain or drains, turn on water into all pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Make a smoke test if required by the Municipality. At your option, drain and vent piping may be pressure tested with cold water at 345 kPa (50 psi) for 2 hours with zero leakage.
- .5 Domestic Water Piping: Test piping with cold water at a pressure of 1½ times normal working pressure and maintain the pressure for a minimum of 2 hours.
- .6 Sprinkler System Piping: Test all system piping in accordance with requirements of NFPA No. 13, "INSTALLATION OF SPRINKLER SYSTEMS", and in accordance with any additional requirements of governing authorities.
- .7 Natural Gas Piping: Test piping in accordance with the requirements of CAN/CSA - B149.1. After completion of the verification test, locate the required tag stating the results of the verification test at the point of entry of the gas main into the building, affixed to the pipe in a secure manner. Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.
- .8 General Re: All Testing: The following requirements apply to all testing:
 - .1 Ensure that all piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing.
 - .2 Temporarily remove or valve off all piping system specialties or equipment which may be damaged by test pressures prior to pressure testing the systems, and flush piping to remove foreign matter.
 - .3 When testing is carried out below the highest level of the particular system, increase the test pressure by the hydrostatic head of 7 kPa (1 psi) for every 600 mm (24") below the high point.
 - .4 Include for temporary piping connections required to properly complete the tests.
 - .5 Piping under test pressure is to have zero pressure drop for the length of the test period.
 - .6 Make tight leaks found during tests while the piping is under pressure, and if this is impossible, remove and refit the piping and reapply the test until satisfactory results are obtained.

- .7 Where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions.
 - .8 Tests are to be done in reasonably sized sections so as to minimize the number of tests required.
 - .9 In addition to the leakage tests specified above, demonstrate proper flow throughout the systems including mains, connections and equipment, as well as proper venting and drainage, and Include for any necessary system adjustments to achieve the proper conditions.
- .18 Supply Of Motor Starters And Accessories
- .1 Motor starters for mechanical equipment, except for starters integral with packaged equipment and starters factory installed in equipment power and control panels, will be provided as part of the electrical work.
- .19 Electrical Wiring Work For Mechanical Work
- .1 Unless otherwise specified or indicated, the following electrical wiring work for mechanical equipment will be done as part of the electrical work:
 - .1 "Line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from the starters or disconnects to the equipment.
 - .2 "Line" side power wiring to individual wall mounted starters, and "load" side wiring from the starters to the equipment.
 - .3 "Line" side power wiring to pre-wired power and control panels and variable frequency drives, and "load" side power wiring from the panels and VFD's to the equipment.
 - .4 Provision of receptacles for plug-in equipment.
 - .5 Provision of disconnect switches for all motors that are in excess of 10 m (30') from the starter location, or that cannot be seen from the starter location, and all associated power wiring.
 - .6 All motor starter interlocking in excess of 24 volts.
 - .7 Wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts.
 - .8 Provision of dedicated 120 volt, 15A-1P circuits terminated in junction boxes in mechanical equipment rooms for automatic control and building automation system wiring connections to be made as part of the automatic controls work.
 - .9 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers.
 - .10 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units.
 - .11 120 volt wiring connections to duplex receptacles integral with air handling unit control panels.

- .2 Mechanical wiring work not listed above or specified herein or on the drawings to be done as part of the electrical work is to be installed in conduit and is to be done as part of the mechanical work in accordance with wiring requirements specified for the electrical work.
- .20 Interruption To And Shut-Down Of Mechanical Services And Systems
 - .1 Co-ordinate all shut-down and interruption to existing mechanical systems with the Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning.
 - .2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.
 - .3 Prior to each shut-down or interruption, inform the Owner and Consultant in writing 72 hours in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.
 - .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.
 - .5 Pipe Freezing: Pipe freezing may be used to connect new piping to existing piping without draining the existing piping. Pipe freeze equipment is to be equal to "NORDIC FREEZE" CO² equipment supplied by Mag Tool Inc.
- .21 Installation Of Equipment Bases And Supports
 - .1 Steel Framework Supports: Where indicated, support base mounting smaller HVAC equipment such as heat pumps, condensing units, and fan equipment on galvanized steel adjustable tubular steel framework support assemblies.
- .22 Cutting, Drilling, And Patching For Mechanical Work
 - .1 Do all cutting, drilling and patching of the existing building for the installation of your work. Perform all cutting and drilling with proper tools and equipment. Confirm the exact location of cutting and drilling with the Consultant prior to commencing the cutting and/or drilling work.
 - .2 Patch surfaces, where required, to exactly match existing finishes using tradesmen skilled in the particular trade or application worked on.
 - .3 Where new pipes pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around the pipes or pipe insulation.
 - .4 Prior to drilling or cutting an opening in poured concrete construction, determine the location, if any, of existing services concealed in the construction to be drilled or cut. X-ray or Ferro Scan Test the walls or slabs if required.
 - .5 You will be responsible for the repair of any damage to existing services, exposed or concealed, caused as a result of your cutting or drilling work.
- .23 Packing And Sealing Core Drilled Pipe Openings
 - .1 Pack and seal the void between the pipe opening and the pipe or pipe insulation for the length of the opening as follows:

- .1 Non-fire rated interior construction: pack openings in non-fire rated interior construction with mineral wool and seal both ends of the opening with non-hardening silicone base caulking compound to produce a water-tight seal.
- .24 Cleaning Mechanical Work
 - .1 Refer to cleaning requirements specified in Division 01.
 - .2 Clean all mechanical work prior to application for Substantial Performance of the work.
 - .3 Include for vacuum cleaning the interior of air handling units and ductwork systems.
- .25 Use Of Mechanical Systems For Temporary Heating
 - .1 Permanent mechanical systems in the building may be used for temporary heating during construction subject to the following conditions:
 - .1 Each entire system is complete, pressure tested, cleaned, and flushed out.
 - .2 Building has been closed in and areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .3 There is no possibility of damage from any cause.
 - .4 Supply ventilation systems are protected by minimum MERV 7 filters, which are to be inspected every other day, and changed every 2 weeks, or more frequently as required.
 - .5 Return air systems have approved construction filters over all openings, inlets, and outlets.
 - .6 All systems are operated as per the manufacturer's recommendations or instructions, and are monitored on a regular and frequent basis.
 - .7 Warranties are not affected in any way.
 - .8 Regular preventive and all other manufacturer's recommended maintenance routines are performed.
 - .9 Before substantial performance, each entire system is to be refurbished, cleaned internally and externally, restored to "as-new" condition, and filters in air systems replaced.
 - .10 Energy costs are to be paid by the Contractor.
- .26 Maintaining Equipment Prior To Acceptance
 - .1 Maintain all equipment in accordance with the manufacturer's printed instructions prior to start-up, testing and commissioning.
 - .2 Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.
 - .3 Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminium tubing.
 - .4 All filters are to be new upon Substantial Performance of the work. This is in addition to any spare filters specified.
- .27 Connections To Other Equipment

- .1 Carefully examine the Contract Documents during the bidding period and include for mechanical work piping and/or ductwork connections to equipment requiring such connections.
- .28 Waste Management And Disposal
 - .1 Separate and recycle waste materials in accordance with requirements of Canadian Construction Association Standard Document CCA 81, A Best Practices Guide to Solid Waste Reduction.
 - .2 Prepare a waste management and reduction plan and submit a copy for review prior to work commencing at the site.
 - .3 Place materials defined as hazardous or toxic waste in designated containers.
 - .4 Ensure emptied containers are sealed and stored safely for disposal.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 This Section specifies thermal insulation requirements that are common to mechanical work Sections of the Specification. It is a supplement to each Section and is to be read accordingly.

1.3 REFERENCES

- .1 Definitions:
 - .1 "concealed" means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces
 - .2 "exposed" means exposed to normal view during normal conditions and operations
 - .3 "domestic water" means all piping (cold, hot, tempered) extended from the building Municipal supply main
 - .4 "WHMIS sheets" means Workplace Hazardous Materials Information System sheets
 - .5 "mineral fibre" means a type of insulation manufactured from molten rock, slag, or glass in accordance with requirements of ASTM C547
 - .6 "PEX" means cross-linked polyethylene
 - .7 "insulation system" means insulation material, fasteners, jacket, and any other accessory.
 - .8 "TIAC" means Thermal Insulation Association of Canada.
- .2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strap for Pressure Vessels and for General Applications
 - .2 ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - .3 ASTM C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
 - .4 ASTM C547 - Standard Specification for Mineral Fibre Pipe Insulation
 - .5 ASTM C552 – Standard Specification for Cellular Glass Thermal Insulation
 - .6 ASTM C553 – Standard Specification for Mineral Fibre Blanket Thermal Insulation
 - .7 ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation

- .8 ASTM C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
- .9 ASTM C1290 – Standard Specification for Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
- .10 ASTM D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- .2 Thermal Insulation Association of Canada (TIAC):
 - .1 Best Practices Guide
 - .2 TIAC Quality Standard 1501
- .3 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S101 – Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC-S114 – Test for Non-Combustibility

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data Sheets & WHMIS Sheets:
 - .1 Submit a product data sheet and a WHMIS sheet for each insulation system product. Product data sheets must confirm that the product conforms to requirements of referenced Codes, Standards, and material properties.

1.5 QUALITY ASSURANCE

- .1 Mechanical insulation requirements specified in this Section are based on the Thermal Insulation Association of Canada Best Practices Guide.
- .2 Qualifications:
 - .1 Installer's:
 - .1 The company with the sub-contract for mechanical insulation work is to be a member in good standing of the Thermal Insulation Association of Canada.
 - .2 Mechanical insulation is to be applied by journeyman tradespersons in the Heat and Frost Insulation Trade. Registered apprentice tradespersons must be under direct, daily, on-site supervision of a journeyman.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:

- .1 Acceptable insulation product manufacturers are listed in Section 4, Products, of the TIAC Best Practices Guide
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of valve from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 Fire Hazard Ratings:
 - .1 Unless otherwise specified, all insulation system materials inside the building and above ground must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 Thermal Performance:
 - .1 Unless otherwise specified, thermal performance, i.e. conductivity, of insulation is to meet or exceed the values given in the National Energy Code of Canada for Buildings, and ASHRAE/IES Standard 90.1.
- .3 Pipe Insulation Materials:
 - .1 Horizontal Pipe Insulation at Hangers & Supports: Insulated pipe support inserts consisting of minimum 150 mm (6") long, premoulded, rigid, sectional phenolic foam or fiberglass insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a 180° captive galvanized steel saddle. Acceptable products are:
 - .1 Belform Insulation Ltd. "Koolphen K-Block"
 - .2 Shur-Fit Products Ltd. "Pro-Pipe Supports"
 - .2 Specialty Insulation for Piping: Factory fabricated foamed glass or closed cell foamed plastic insulation fittings specifically made for pipe mechanical joint fittings and couplings, and pipe risers at riser clamps. Acceptable manufacturers are:
 - .1 Shur-Fit Products Ltd.
 - .2 Armacell Canada Inc.
 - .3 Owens Corning "FOAMGLASS"
 - .3 TIAC Standard 1501, Code A2, Preformed Mineral Fibre: Rigid, sectional, sleeve type insulation to ASTM Standard C 547, Standard Specification for Mineral Fibre Pipe Insulation, supplied in 915 mm (3') lengths with a factory applied vapour barrier jacket and adhesive jacket closure.to ASTM C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation, with a minimum thermal conductivity of 0.033 W @ 24° C.

- .4 Barrier-Free Lavatory/Sink Piping Insulation Kits:
 - .1 Removable, flexible, reusable, white, moulded PVC insulation kits with internal fasteners for barrier-free fixture drain piping and domestic water supplies exposed under the fixture.
- .5 Ductwork System Insulation Materials:
 - .1 TIAC Standard 1502, Code A2, Rigid Mineral Fibre Board: Preformed board type insulation to ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation, with a factory applied reinforced aluminum foil and Kraft paper facing to ASTM C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation, a minimum thermal conductivity of 0.033 W @ 24° C., and a minimum density of 48 kg/m³.
 - .2 TIAC Standard 1502, Code B2, Flexible Mineral Fibre: Roll form insulation to ASTM C1290, Standard Specification for Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts, with a factory applied vapour barrier facing to ASTM C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation, a minimum thermal conductivity of 0.042 W @ 24° C., and a minimum density of 12 kg/m³.
 - .3 Flexible Foam Elastomeric Sheet: Sheet form, CFC free, closed cell, self-adhering elastomeric EDPM rubber insulation in accordance with requirements ASTM C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular form, with all required installation accessories.
- .6 Equipment Insulation Materials:
 - .1 TIAC Standard 1503, Code A1D, Semi-Rigid Mineral Fibre: Roll form insulation to ASTM Standard C553, Standard Specification for Mineral Fibre Blanket Thermal Insulation, (Types I, II, & III), with a factory applied vapour barrier facing.
- .7 Insulating Coatings:
 - .1 Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:
 - .1 Anti-condensation coating, "No Sweat-FX".
 - .2 Thermal insulating coating, "ThermaLite".
- .8 Insulation Fastenings:
 - .1 Wire: Minimum #15 gauge galvanized annealed wire.
 - .2 Stainless Steel Banding: Equal to Childers Products Co. "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.
 - .3 Duct Insulation Fasteners: Weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1½") square zinc plated steel self-locking washers.
 - .4 Tape Sealant: Equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match the surface being sealed.
 - .5 Adhesive - Mineral Fibre Insulation: Clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with the type of material to be secured, and WHMIS classified as non-hazardous.
 - .6 Adhesive – Flexible Elastomeric Insulation: Armacell "Armaflex" #520 air-drying contact adhesive.

- .7 Adhesive – Closed Cell Foamed Glass Insulation: Equal to Pittsburgh Corning PC88 multi-purpose two-component adhesive.
- .8 Sheet Metal Screws: No. 10 stainless steel sheet metal screws.
- .9 Insulation Jackets and Finishes:
 - .1 TIAC Code C1, PVC: Roll form sheet and fitting covers in accordance with ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds, minimum 15 mil thick, white, PVC, 25/50 rated, complete with installation and sealing accessories.
 - .2 TIAC Code C2, Rigid Aluminium: Equal to Childers Metals "Lock-on" 0.406 mm (5/32") thick embossed aluminum jacket material to ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate, factory cut to size and complete with moisture barrier and continuous modified Pittsburgh Z-Lock, and "Fabstraps" and butt straps to cover end to end joints. Fittings are to be 2-piece epoxy coated pressed aluminum with weather locking edges.
 - .3 Protective Coating - Flexible Foam Elastomeric Insulation: Equal to Armacell "WB Armaflex" weatherproof, water-based latex enamel finish.
- .10 Removable/Reusable Insulation Covers:
 - .1 Valve, Etc. Covers: Equal to No Sweat Valve Wrap Inc. "NO SWEAT" reusable insulation wraps with vapour barrier jacket and self-sealing ends and longitudinal seam, with a length to suit the application and an insulation thickness equal to the adjoining insulation.

3 EXECUTION

3.1 INSTALLATION

- .1 General Insulation Application Requirements:
 - .1 Unless otherwise specified, do not insulate the following:
 - .1 Factory insulated equipment and piping.
 - .2 Branch domestic water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories.
 - .3 Exposed chrome plated domestic water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories.
 - .4 PEX piping.
 - .5 Domestic water and heating system expansion tanks.
 - .6 Fire protection pump casings.
 - .7 Manufactured expansion joints and flexible connections.
 - .8 Acoustically lined ductwork and/or equipment.
 - .9 Domestic hot and tempered water and heating system piping unions.
 - .10 Flexible branch ductwork from sheet metal ducts to grilles or diffusers.

- .2 Do not apply insulation unless leakage tests have been satisfactorily completed.
- .3 Ensure that all surfaces to be insulated are clean and dry.
- .4 Ensure that the ambient temperature is minimum 13° C (55° F) for at least one day prior to the application of insulation, and for the duration of insulation work, and that relative humidity is and will be at a level such that mildew will not form on insulation materials.
- .5 All insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from the site and replaced.
- .6 Install insulation directly over pipes and ducts and not over hangers and supports.
- .7 Install piping insulation and jacket continuous through pipe openings and sleeves.
- .8 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.
- .9 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect the insulation jacketing from the action of condensation at its junction with the metal.
- .10 When insulating vertical piping risers 75 mm (3") diameter and larger, use insulation support rings welded directly above the lowest pipe fitting, and thereafter at 4.5 m (15') centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.
- .11 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover the exposed end of the insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.
- .12 Where there is interference between weld bead, mechanical joints, etc., and insulation, use purpose made insulation fittings or otherwise neatly and properly insulate these items to maintain the insulation value of the work. Seal all exposed surfaces of insulation.
- .13 Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in the insulation and provide a suitable grommet in the opening.
- .14 Where existing insulation work is damaged as a result of a new mechanical work, repair the damaged insulation work to new work standards.
- .2 Insulation For Pipe Mechanical Joint Fittings & Couplings, Etc.:
 - .1 Provide manufactured insulation fittings, the same thickness as the adjoining pipe insulation, for mechanical joint fittings and couplings, and for piping at riser clamps through the floor. Cover with purpose made PVC covers with joints sealed with tape.
- .3 Insulation For Horizontal Pipe At Hangers And Supports:
 - .1 At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply the insulation sections to the piping installers for installation as the pipe is erected.

.4 Pipe Insulation Requirements – Inside Building & Above Ground:

.1 Insulate pipe inside the building and above ground, as scheduled below, in accordance with TIAC Quality Standard 1501, Piping, as follows:

.1 Material: Type A3 mineral fibre.

.2 Insulation application:

.1 1501-H for hot piping.

.2 1501-C for cold piping.

.3 Insulation finish: CPF/1 canvas jacket or CPF/4 PVC jacket for exposed piping.

PIPE SERVICE	DIAMETER	INSULATION THICKNESS
Domestic Cold Water	to 100 mm	25 mm
	larger than 100 mm	40 mm
Domestic Hot Water, Supply & Recirculation	to 40 mm	25 mm
	larger than 40 mm	50 mm
Tempered Domestic Water	all	25 mm
Storm Drainage From Roof Drains (See Note #1)	all	25 mm
Plumbing Vent, 3 M Back From Roof Penetration	all	25mm
Condensate Drain From A/C Equipment Drain Pans	all	25 mm
Piping To Be Traced With Heating Cable	all	50 mm

Notes:

#1 Insulate storm drainage piping from roof drains from the roof drain to the point where the piping extends straight down, without offsets, and connects to a horizontal main.

.5 Ductwork System Insulation Requirements – Inside Building:

.1 Insulate duct systems inside the building and above ground, as scheduled below, in accordance with TIAC Quality Standard 1502, Ductwork and Plenums, as follows:

.1 Material:

.1 Type A2 rigid mineral fibre for exposed rectangular ducts, and all plenums

.2 Type B2 flexible mineral fibre for concealed rectangular ducts, and concealed and exposed round or oval ducts

.2 Insulation application:

- .1 CER/1 for heating and ventilating system rigid insulation
- .2 CER/2 for heating and air conditioning system rigid insulation
- .3 CEF/1 for heating and ventilation system flexible insulation
- .4 CEF/2 for heating and air conditioning system flexible insulation
- .3 Insulation finish:
 - .1 CRF/1 for exposed rectangular duct systems
 - .2 CRD//1 for exposed round/oval duct systems

DUCT SYSTEM SERVICE	INSULATION THICKNESS	
	Rigid Insulation	Flexible Insulation
Mixed Air Supply Ducts (Except Where Exposed In Area Served)	25 mm	40 mm
3 M Of Exhaust Discharge Ducts Downstream (Back) From Exhaust Openings To Atmosphere	25 mm	40 mm
Exhaust Air Casings And Plenums Within 3 M Of Exhaust Openings To Atmosphere	25 mm	n/a
Heat Recovery System Fresh Heated Air	25 mm	40 mm

Notes:

#1 Provide commercial quality corner bead only on exposed rigid duct, plenum and casing insulation in all equipment rooms, corridors, and similar areas where the insulation is subject to damage.

- .6 Common Duct System Insulation application Requirements:
 - .1 At duct connection flanges insulate the flanges with neatly cut strips of the rigid insulation material secured with adhesive to side surfaces of the flange with a top strip to cover the exposed edges of the side strips, then butt the flat surface duct insulation up tight to the flange insulation, or alternatively, increase the insulation thickness to the depth of the flange and cover the top of the flanges with tape sealant.
 - .2 The installation of fastener pins and washers is to be concurrent with the duct insulation application.
 - .3 Cut insulation fastener pins almost flush to the washer and cover with neatly cut pieces of tape sealant.
 - .4 Accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers.
 - .5 Prior to concealment of insulation by either construction finishes or jacket material, patch all vapour barrier damage by means of tape sealant.

- .6 At trapeze hanger locations for rectangular duct install insulation between the duct and the hanger.
- .7 At each duct hanger for round duct provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between the duct and the hanger.
- .7 Application Of Insulating And Protective Coatings:
 - .1 Apply insulating and protective coatings in accordance with the manufacturer's instructions. Remove any splatter from adjacent surfaces. Apply insulating/protective coating to the following surfaces:
 - .1 Paint all bare metal surfaces clear of "cold" piping and/or equipment insulation for a distance of from 300 mm (12") to 600 mm (24") clear of the pipe or equipment insulation, with "No Sweat-FX" anti-condensation coating.
 - .2 Paint all bare metal surfaces associated with mechanical systems with an operating temperature 60°C (140°F) with "ThermaLite" insulating coating.
 - .3 Coat elastomeric foamed insulation (pipe & duct) with 1 coat of the specified coating on all insulation inside the building and 2 coats (with 24 hours between coats) of the specified coating on all insulation outside the building.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 This Section specifies requirements, criteria, methods and execution for mechanical demolition work that are common to one or more mechanical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - .1 CAN/CSA-S350 – Code of Practice for Safety in Demolition of Structures.

1.4 SUBMITTALS

2 PRODUCTS

2.1 MATERIALS

Not Applicable

3 EXECUTION

3.1 REMOVALS

- .1 Disconnection and Removal of Existing Mechanical Work:
 - .1 Where indicated on the drawings, disconnect and remove existing mechanical work, including hangers, supports, insulation, and similar items. Disconnect at the point of supply, remove obsolete connecting services and make the system safe.
 - .2 Cut back obsolete piping behind finishes, identify, and cap water-tight unless otherwise specified.
 - .3 The scope and extent of the demolition or revision work is only generally indicated on the drawings. Estimate the scope, extent and cost of the work at the site during the bidding period scheduled site visit(s).
 - .4 Where deemed necessary by the Owner and Consultant, existing shafts, walls, and inaccessible ceilings will be opened by the Owner to permit site visit inspection of services to be removed/revised as part of the work but usually concealed behind such construction.
 - .5 Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at the site during bidding period site visits will not be allowed.
 - .6 If existing isolation valves are not available to isolate sections of piping to be removed, provide such valves as required. Determine this requirement at the site during the bidding period.

- .7 Where existing valves are removed, remove the valve tags, revise existing valve tag charts, and hand the obsolete tags to the Owner.
 - .8 If any re-design is required due to discrepancies between the mechanical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between the mechanical drawings and actual site conditions are of a minor nature, the required modifications are to be done at no additional cost.
 - .9 Where existing mechanical services extend through, or are in an area to serve items which are to remain, maintain the services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during the renovation work, so as to be concealed behind new or existing finishes.
 - .10 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused.
- .2 Roofing Work:
- .1 Where roof revisions and/or replacements are part of the project, include for disconnecting, lifting, or temporarily removing mechanical equipment on the roof as required to permit completion of the roofing work, and for re-installing the equipment when the roofing work is complete.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 This Section specifies mechanical system testing, adjusting, and balancing requirements that are common to mechanical work Sections of the Specification and it is a supplement to each applicable Section and is to be read accordingly.

1.3 REFERENCES

- .1 Definitions:

- .1 The following are definitions of words used in this Section:

- .1 "TAB" – means testing, adjusting and balancing to determine and confirm quantitative performance of equipment and systems and to regulate the specified fluid flow rate and air patterns at the terminal equipment, e.g., reduce fan speed, throttling, etc.
- .2 "air systems" – includes all outside air, supply air, return air, exhaust air, and relief air systems
- .3 "flow rate tolerance" – means the allowable percentage variation, minus to plus, of actual flow rate values in the Contract Documents
- .4 "report forms" – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form the permanent record to be used as the basis for required future testing, adjusting and balancing
- .5 "terminal" – means the point where the controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods
- .6 "main" – means the duct or pipe containing the system's major or entire fluid flow
- .7 "sub-main" – means the duct or pipe containing part of the systems' capacity and serving two or more branch mains
- .8 "branch main" – means duct or pipe servicing two or more terminals
- .9 "branch" – means duct or pipe serving a single terminal

- .2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.

- .1 Standards: Testing, adjusting and balancing of the complete mechanical systems is to be performed over the entire operating range of each system in accordance with 1 of the following publications:

- .1 National Standards For A Total System Balance published by the Associated Air Balance Council

- .2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by the National Environmental Balancing Bureau
- .3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Name and Qualifications of Testing and Balancing Agency: Within 30 days of work commencing at the site, submit the name and qualifications of the proposed testing and balancing agency in accordance with requirements of the article below entitled Quality Assurance.
- .3 Sample Test Forms: Submit sample test forms, if other than those standard forms prepared by the Canadian Associated Air Balance Council (CAABC) or National Environmental Balancing Bureau (NEBB) are proposed for use.
- .4 Drawing Evaluation Report: Submit a report by the Agency to indicate the Agency's evaluation of the mechanical drawings with respect to service routing and location or lack of balancing devices. Include the set of drawings used and marked-up by the Agency to prepare the report.
- .5 Site Visit Reports: Submit a report by the Agency after each site visit made by the Agency during the construction phase of this Project.
- .6 Draft and Final Reports: Submit a draft report and a final report as specified in Part 3 of this Section.

1.5 CLOSEOUT SUBMITTALS

- .1 Submittals under this Section shall be in conformance with Section 01 77 00.
- .2 Warranty: Submit a testing and balancing warranty as specified in Part 3 of this Section.
- .3 Post Construction Site Visit Reports: Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.6 QUALITY ASSURANCE

- .1 Testing Agencies:
 - .1 Testing and Balancing Agency: Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems to produce the design objectives.
 - .2 The testing, adjusting and balancing agency is to have successfully completed testing, adjusting and balancing of mechanical systems for a minimum of five projects similar to this Project within the past 3 years, and is to be certified as an independent agency in all required categories by 1 of the following:
 - .1 CAABC - Canadian Associated Air Balance Council
 - .2 NEBB - National Environmental Balancing Bureau

2 PRODUCTS

Not applicable.

3 EXECUTION

3.1 SCOPE OF WORK

- .1 Perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and comfort conditions, and recording and reporting the results.
- .2 Mechanical systems to be tested, adjusted and balanced include:
 - .1 Domestic Water Systems: TAB of domestic water systems is to include:
 - .1 Domestic hot water recirculation piping.
 - .2 Tempered water piping system equipment and tempered water temperatures and flows.
 - .2 Air Handling Systems: TAB of air handling systems is to include all equipment and ductwork air temperatures, capacities and flows.

3.2 TESTING, ADJUSTING AND BALANCING

- .1 General Requirements: Conform to the following requirements:
 - .1 As soon as possible after award of Contract, the Agency is to carefully examine a white print set of mechanical drawings with respect to routing of services and location of balancing devices, and is to issue a report listing the results of the evaluation.
 - .2 The set of drawings examined by the Agency is to be returned with the evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices.
 - .3 After review of the mechanical work drawings and specification, the Agency is to visit the site at frequent, regular intervals during construction of the mechanical systems, to observe routing of services, locations of testing and balancing devices, workmanship, and anything else that will affect testing, adjusting and balancing.
 - .4 After each site visit, the Agency is to report results of the site visit indicating the date and time of the visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing.
 - .5 Testing, adjusting and balancing is not to begin until:
 - .1 Building construction work is substantially complete and doors have been installed.
 - .2 Mechanical systems are complete in all respects, and have been checked, started, and adjusted.
 - .6 All mechanical systems to be tested, adjusted and balanced are to be maintained in full, normal operation during each day of testing, adjusting and balancing.
 - .7 Obtain copies of reviewed shop drawings of all applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences.
 - .8 The Agency is to walk each system from the system "head end" equipment to terminal units to determine variations of installation from design, and the system installation trades will accompany the Agency.

- .9 The Agency is to check all valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment.
 - .10 Wherever possible, the Agency is to lock all balancing devices in place at the proper setting, and permanently mark settings on all devices.
 - .11 For belt-driven equipment, the Agency is to report to the Commissioning Agent who in turn is to inform the Contractor and Consultant of any situation where sheaves have to be replaced to suit testing and balancing, and replacements are to be done by the Contractor at no cost.
 - .12 Noise: the Agency is to balance all systems with due regard to objectionable noise which is to be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at the design conditions, the Agency is to immediately report the problem and submit data, including sound readings, to permit an accurate assessment of the noise problem to be made.
 - .13 Stratification: the Agency is to check all supply air handling system mixing plenums for stratification, and where the variation of mixed air temperature across coils is found to be in excess of $\pm 5\%$ of design requirements, the Agency is to report the problem and issue a detail sketch of plenum baffle(s) required to eliminate the stratification.
 - .14 Tolerances: the Agency is to perform testing, adjusting and balancing to within $\pm 5\%$ of design values, and make and record measurements which are within $\pm 2\%$ of actual values.
 - .15 Filters for all air handling systems equipped with air filters, test and balance the systems with simulated 50% loaded (dirty) filters by providing a false pressure drop.
 - .16 Seasonal requirements: test, adjust and balance air conditioning systems during the summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8°C (5°F) wet bulb temperature of maximum summer design condition, and within 5.5°C (10°C) dry bulb temperature of minimum winter design condition, and take final temperature readings during seasonal operation.
- .2 Preparation of Reports: Prepare reports as indicated below:
- .1 Draft Reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on CAABC or NEBB forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
 - .2 Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. Use units of measurement (SI or Imperial) as used on the Project Documents.
 - .3 Report Format: Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, 3-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the divisions listed below, separated by divider tabs:
 - .1 General Information and Summary
 - .2 Plumbing Systems
 - .3 Air Systems
 - .4 Report Contents: The Agency is to provide the following minimum information, forms and data:

- .1 Inside cover sheet to identify the Agency, the Contractor, and Project, including addresses, e-mail addresses and contact names and telephone numbers and a listing of the instrumentation used for the procedures along with the proof of calibration.
- .2 The remainder of the report is to contain the appropriate forms containing as a minimum, the information indicated on the standard CAABC or NEBB report forms prepared for each respective item and system.
- .3 The Agency is to include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying all equipment, terminals, and accessories.
- .4 The Agency is to include report sheets indicating building comfort test readings for all rooms.
- .3 Verification of Reports: After the final testing and balancing report has been submitted, the Agency is to visit the site with the Contractor and Consultant to spot check results indicated on the balancing report. The Agency is to supply all labour, ladders, and instruments to complete spot checks. Note that if results of spot checks do not, on a consistent basis, agree with the final report, the spot check procedures will stop and the Agency is to then rebalance the systems involved, resubmit the final report, and again perform spot checks with the Contractor and Consultant.
- .4 Certification and Warranty: When the final report has been accepted, the Contractor is to submit to the Owner, in the name of the Owner, a certificate equal to the CAABC National Guaranty Certification or a NEBB Quality Assurance Program Bond, and in addition, the Contractor is to submit a written extended warranty from the Agency covering 1 full heating season and 1 full cooling season, during which time any balancing problems which occur, with the exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by the Agency and reported on to the Owner, and if it is determined that the problems are a result of improper testing, adjusting and balancing, they are to be immediately corrected without additional cost to the Owner.
- .5 Post Balancing Site Visits: After acceptance of the final report, the Agency is to perform post testing and balancing site visits in accordance with the following requirements:
 - .1 Post-testing and balancing site visits are to be made:
 - .1 Once during the 1st month of building operation.
 - .2 Once during the 3rd month of building operation.
 - .3 Once between the 4th and 10th months in a season opposite to the 1st and 3rd month visit.
 - .2 During each return visit and accompanied by the Owner's representative, the Agency is to spot rebalance terminal units as required to suit building occupants and eliminate complaints.
 - .3 The Agency is to schedule each visit with the Contractor and the Owner, and inform the Consultant.
 - .4 After each follow-up site visit, the Agency is to issue to the Contractor and Consultant a report indicating any corrective work performed during the visit, all abnormal conditions and complaints encountered, and recommended corrective action.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 This Section specifies fire stopping and smoke seal requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S101, Standard Method of Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC-S115 - Standard Method of Fire Tests of Firestop Systems

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data & WHMIS Sheets:
 - .1 Submit a product data sheet and a WHMIS sheet for each firestopping and smoke seal product. Identify each product with the manufacturer's name and type, the ULC designation, and the proposed use.
- .3 Name & Experience of Proposed Applicator:
 - .1 Submit for approval the full company name and experience of the proposed firestopping and smoke seal system applicator.
- .4 Letter of Certification:
 - .1 Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Applicator:
 - .1 The applicator is to have a minimum of 3 years of successful experience on projects of similar size and complexity and is to be approved by the Consultant.

1.6 PROJECT CONDITIONS

- .1 Ambient Conditions:

- .1 Environment Conditions: Comply with the firestopping and smoke seal product manufacturer's recommendations regarding suitable environment conditions for product installation.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 A/D Fire Protection Systems "FIREBARRIER"
 - .2 Tremco Inc. Fire Protection Systems Group "TREMstop"
 - .3 3M Canada "Fire Barrier"
 - .4 Hilti (Canada) Ltd. Firestop Systems
 - .5 Specified Technologies Inc.
 - .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
 - .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
 - .4 Single source responsibility: Obtain each type of valve from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 DESCRIPTION

- .1 Regulatory requirements:
 - .1 OBC
 - .2 OFC
 - .3 NFPA
 - .4 ULC

2.3 MATERIALS

- .1 Firestopping and Smoke Seal System Materials:
 - .1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN/ULC-S115, Standard Method of Fire Tests of Firestop Systems and CAN/ULC-S101, Standard Method of Fire Endurance Tests of Building Construction and Materials for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding fire rated construction.
 - .2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with the firestopping manufacturer's recommendations and the ULC tested assembly.

- .3 Pipe insulation forming part of a fire and smoke seal assembly is specified in the Mechanical Insulation Section.

3 EXECUTION

3.1 INSTALLATION

- .1 Installation of Firestopping and Smoke Seal Materials:
 - .1 Where mechanical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials to seal the penetrations, installed in accordance with requirements of CAN/ULC-S115 (ratings F, FT, FH, and FTH as required), CAN/ULC-S101, all other governing authorities, and the product manufacturer's instructions.
 - .2 Preparation: Abide by the following requirements:
 - .1 Report any unsuitable or unsatisfactory conditions to the Consultant in writing, prior to commencement of work, and note that commencement of work will mean acceptance of conditions and surfaces.
 - .2 Mask where necessary to avoid spillage and over coating onto adjoining surfaces, and remove stains on adjacent surfaces.
 - .3 Application: Conform to the following application requirements:
 - .1 Provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing.
 - .2 Tool or trowel exposed surfaces to a neat, smooth, consistent finish.
 - .3 Remove excess compound promptly as work progresses and upon completion.
 - .4 At all fusible link damper locations, seal the perimeter of the angle iron framing on both sides of the wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal.
 - .4 Inspection: Notify the Consultant when the work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of the work by the Municipal Building Inspector prior to concealing or enclosing work. Make any corrections required.
 - .5 Certification: On completion of the firestopping and smoke sealing installation submit a letter of assurance to the Consultant certifying that the firestopping and smoke sealing installation has been carried out throughout the building to all mechanical service penetrations and that the installation has been done in strict accordance with the requirements of governing Codes and Regulations, ULC requirements, and the manufacturer's instructions.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide fire protection system, including but not limited to the following:
 - .1 Wet sprinkler systems
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 21 20 05 – Fire Extinguishers

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI):
 - .1 ANSI/ASME B16.4, Grey Iron Threaded Fittings (Classes 125 and 250)
 - .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded
 - .2 ASTM A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
 - .3 ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
 - .3 Canadian Standards Association (CSA):
 - .1 CSA B64.10, Selection and Installation of Backflow Preventers
 - .2 CSA B137.2, PVC Injection-Molded Gasketed Fittings for Cold-Water Pressure Services
 - .3 CSA B137.3, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications
 - .4 CAN/CSA B64.10, Backflow Preventers and Vacuum Breakers
 - .4 National Fire Protection Association (NFPA):
 - .1 NFPA 13, Standard for the Installation of Sprinkler Systems
 - .2 NFPA 14, Standard for the Installation of Standpipes and Hose Systems
 - .5 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S1001, Integrated Systems Testing of Fire Protection and Life Safety Systems

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
 - .1 Shop Drawings/Product Data: Submit shop drawings/product data sheets to the regulatory authority for review and approval prior to submitting to the Consultant. Conform to the following requirements:
- .2 Shop Drawings
 - .1 submit complete CAD white print layout drawings indicating source of water supply with pipe size and test flow and pressure, "head-end" equipment piping schematic, pipe routing and sizing, and risers, all signed and sealed by the design P. Eng.
 - .2 submit copies of all calculations stamped and signed by the design P. Eng., and a listing of all design data used in preparing the calculations, system layout and sizing
- .3 Product Data:
 - .1 product data sheets are to include all products specified in this Section except pipe and fittings, each clearly marked to indicate the manufacturer, model number, construction and performance of the products being supplied, and each stamped and signed by the system design P. Eng.
- .4 in addition to submitting shop drawings/product data to the regulatory authority as specified above, shop drawings must be submitted to and approved by the Owner's insurer prior to being submitted to the Consultant for review.
- .5 Samples:
 - .1 If requested, submit samples of sprinkler / standpipe materials for review.
- .6 Test and Evaluation Reports:
 - .1 Weekly Inspection Reports: Submit copies of the system design P. Engineer's bi-weekly inspection reports as specified below.
 - .2 Test Certificates: Submit completed NFPA system material and test certificate(s) as specified in Part 3 of this Section, and documentation to confirm successful testing and commissioning in accordance with CAN/ULC-S1001.
 - .3 Backflow preventer test reports in accordance with CSA B64.10.
- .7 Final Completion Signoff Letter: Following completion of the system, the design P.Eng. responsible for the review is to provide a stamped signoff letter.

1.5 MAINTENANCE MATERIALS SUBMITTALS

- .1 Extra stock materials:
 - .1 Spare Sprinkler Head Cabinet:
 - .1 Surface wall mounted, red enamelled steel, identified cabinet with hinged door, shelves with holes for mounting sprinkler heads, a wrench or wrenches suitable for each type of sprinkler head, and a full complement of spare sprinkler heads.

- .2 The cabinet is to be sized to accommodate a minimum of 4 spare heads for each type of head used on the Project, however, each cabinet is to be full of spare heads.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Site Personnel: All site personnel are to be Sprinkler Fitters or Sprinkler and Fire Protection Installers licensed in the jurisdiction of the work and under the continuous supervision of a site foreman who is a journeyman.
 - .2 System Installer: The system installer is to be an experienced fire protection system company and a member in good standing of the Canadian Automatic Sprinkler Association and is to be certified to CSA-W47.1 for welding.
 - .3 Dimensions and Coordination: Check and verify all dimensions and conditions at the site and ensure that the work can be performed as indicated. Co-ordinate work with all trades at the site and accept responsibility for and the cost of making adjustments to piping and/or spacing to avoid interference with other building components.
 - .4 Bi-Weekly Inspection Reports: The design P. Eng. is to conduct bi-weekly site inspections for quality control, and prepare and submit an inspection report after each site inspection.
 - .5 All system components must be UL and/or ULC listed and labelled, and FM approved.
 - .6 Existing System: Verify the working condition of all existing fire protection system equipment which has direct interface with the new work and is to remain. Replace with new equipment where necessary.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Fire Suppression System Design and Installation
 - .1 Classic Fire and Life Safety
 - .2 Western Fire Protection
 - .3 Vipond
 - .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
 - .3 Substitution Limitations:
 - .1 Comparable Products from manufacturers not listed herein may be accepted provided they meet requirements of this Specification.

2.2 PERFORMANCE/DESIGN CRITERIA

- .1 System Designer: Fire protection work to be installed is to be designed by a fully qualified mechanical P. Eng. registered and licensed in the jurisdiction of the Project. Refer to the mechanical work Section entitled Mechanical Work General Instructions for requirements governing the employment of the Engineer.
- .2 Water Flow and Pressure Test Data: If water supply flow and pressure test data is not available, conduct Municipal main water flow and pressure tests at the nearest fire hydrant to obtain criteria to be used in system design. Include the hydrant location and flow and pressure test data with system design calculations.
- .3 Sprinkler System Design Criteria: Fire protection sprinkler work is to be designed in accordance with NFPA 13 and Provincial Standards, and, where required, local building and fire department requirements and, if required, the standards of the Owner's Insurer.
- .4 Sprinkler /System Occupancy – Hazard Design requirements: As per NFPA 13 occupancy-hazard density requirements, unless otherwise specified.

2.3 MATERIALS

- .1 Pipe, Fittings and Joints:
 - .1 Pipe, fittings and joints are to be as follows, with exceptions as specified in Part 3 of this Section:
 - .1 Schedule 40 Black Steel – Grooved Coupling Joints: North American produced Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 005 rigid coupling joints. Strap-on fittings such as Victaulic "Snap-Let" strap type fittings are not acceptable.
 - .2 Schedule 40 Black Steel – Screwed and Welded Joints: North American produced Schedule 40 mild black carbon steel, ASTM A53, Grade B. Screwed piping is to be complete with Class 125 cast iron screwed fittings to ANSI/ASME B16.4. Welded piping is to be complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, long sweep pattern wherever possible.
 - .3 Schedule 10 Black Steel – Grooved Coupling Joints: North America produced Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 005 rigid coupling joints.
 - .4 Schedule 10 Black Steel – Screwed Joints: North America produced Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with mill or site threaded ends, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.
 - .5 "Lightwall" Black Steel – Grooved Coupling Joints: North America produced, commercial quality, "Lightwall" rolled mild carbon steel pipe to ASTM A135, Grade A, complete with a galvanized exterior, grooved ends, and fittings and couplings equal to Victaulic "Fire Lock" grooved fittings and Victaulic Style 005 rigid coupling joints.
 - .6 "Lightwall" Black Steel – Screwed Joints: North America produced, commercial quality, "Lightwall" rolled mild carbon steel pipe to ASTM A135, Grade A, ULC listed, mill or site threaded, complete with galvanized exterior, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.
 - .7 Flexible Pipe: Flexible metallic hose sprinkler head connections, each complete with an attachment bracket or connector.

.2 Sprinkler Heads:

- .1 Sprinkler heads are to be as specified/scheduled on the drawings.
- .2 Recessed sprinkler heads in finished areas are to be chrome plated unless otherwise specified. Concealed sprinkler head ceiling plates are to match the ceiling colour.
- .3 Where exposed pendent heads occur in areas with suspended ceilings, they are to be complete with chrome plated escutcheon plates. Similarly, sidewall heads with concealed piping are to be complete with chrome plated escutcheon plates.
- .4 Sprinkler heads which are exposed in areas where they may be subject to damage are to be complete with wire guards, chrome plated where in finished areas.
- .5 Sprinkler heads located in areas or over equipment where high ambient temperature is present are to be, unless otherwise specified, 74° C (165° F) heads. All other heads, unless otherwise specified or required, are to be 57° C (135° F) rated.

.3 Spare Sprinkler Head Cabinet:

- .1 Surface wall mounting, red enamelled steel, identified cabinet with hinged door, shelves with holes for mounting sprinkler heads, a wrench or wrenches suitable for each type of sprinkler head, and a full complement of spare sprinkler heads.
- .2 The cabinet is to be sized to accommodate a minimum of 4 spare heads for each type of head used on the Project, however, each cabinet is to be full of spare heads.

3 EXECUTION

3.1 INSTALLATION

.1 Piping Installation Requirements

- .1 Provide all required fire protection system piping. Do all piping work in accordance with "Reviewed" shop drawings and NFPA requirements. Unless otherwise specified, piping is to be as follows:
 - .1 for "wet" system piping inside building and above ground, Schedule 40 grooved end black steel with Victaulic or equal fittings and coupling joints, or, for piping to and including 50 mm (2") diameter, screwed fittings and joints, or piping 65 mm (2½") diameter and larger, welding fittings and welded joints
 - .2 for "wet" sprinkler piping downstream of "head end" alarm valve(s) and equipment: Schedule 10 or "Lightwall" black steel pipe with Victaulic or equal fittings and coupling joints or screwed fittings and joints
 - .3 for branch sprinkler piping to heads in suspended ceilings, etc.: flexible piping installed in accordance with the manufacturer's instructions
- .2 All pipe sizes, pipe routing, equipment quantities and locations, and layout of work shown on the drawings are to assist you during the tendering period. Ensure adequate fire protection system coverage. Do not reduce the size of the fire protection system main or re-route the main unless approved.
- .3 All pipe, fittings, couplings, flanges and similar components are to be cleaned after erection is complete. Any ferrous pipe, fitting, coupling, flange, hanger, support and similar component which exhibits rust is to be wire brush cleaned and carefully coated with suitably coloured primer.

- .4 Slope all horizontal piping so that it may be completely drained. Provide capped drain points.
- .2 Sprinkler Heads:
 - .1 Provide all required sprinkler heads.
 - .2 Sprinkler head locations must be carefully coordinated with all drawings, including architectural reflected ceiling plan drawings, and, where applicable, electrical drawings. Coordinate sprinkler head locations in areas with suspended ceilings with the location of lighting, grilles, diffusers, and similar items recessed in or surface mounted on the ceiling as per the reflected ceiling plans. In areas with lay-in tile, centre the sprinkler head both ways in the lay-in tile wherever possible. Confirm locations prior to roughing-in.
 - .3 Maintain maximum headroom in areas with no ceilings.
 - .4 Provide guards for heads where they are subject to damage.
 - .5 Provide high temperature heads in equipment rooms and similar areas over heat producing or generating equipment.
- .3 Spare Sprinkler Head Cabinet:
 - .1 Supply a full complement (to fill cabinet) of spare sprinkler heads of the types used (minimum four of each type) and place in a wall mounting storage cabinet located adjacent to the sprinkler system "head end" equipment where later directed.

3.2 TESTING AND COMMISSIONING

- .1 Test and commission the fire protection system in accordance with requirements of CAN/ULC-S1001.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide fire extinguishers, including but not limited to the following:
 - .1 Fire Extinguishers
 - .2 Fire Extinguisher Cabinets
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 21 12 00 – Fire Protection Systems

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 National Fire Code of Canada
 - .2 National Fire Protection Association (NFPA):
 - .1 NFPA 10, Standard for Portable Fire Extinguishers
 - .3 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S508-02 (including Amendments 1 and 2), Standard for the Rating and Fire Testing of Fire Extinguishers

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Wilson & Cousins

.2 National

.2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.

.3 Substitution Limitations:

.1 Comparable Products from manufacturers not listed herein may be accepted provided they meet requirements of this Specification.

2.2 MATERIALS

.1 General:

.1 All fire extinguishers are to be pressurized (stored pressure) rechargeable type, in accordance with NFPA 10, and UL and/or ULC listed and labelled for the class of fires and hazard locations for which they are specified.

.2 Each extinguisher is to be complete with:

.1 a bilingual manufacturer's identification label indicating the extinguisher model number, rating, and operating instructions

.2 an anodized aluminum or chrome plated forged brass valve with positive squeeze grip on-off operation and a pull-pin safety lock

.3 discharge hose with nozzle or horn and hose securing clip

.4 for wall mounted extinguishers, a wall mounting bracket

.2 10B:C Rated Carbon Dioxide Extinguishers

.1 10 B:C carbon dioxide extinguishers are to be 175 mm (6½") diameter, 6.8 kg (15 lb.), each complete with a steel cylinder with a safety red baked enamel finish.

.3 3A10B:C Rated Dry Chemical Extinguishers

.1 Multi-purpose 3A10B:C dry chemical extinguishers are to be 100 mm (4") diameter, 2.27 kg (5 lb.), each complete with a steel cylinder with a safety red baked enamel finish and a waterproof stainless steel pressure gauge.

.4 Fire Extinguisher Cabinets

.1 Surface Mounted: Rectangular break-glass type enclosures sized to suit the extinguishers to be housed, constructed of #18 gauge corrosion resistant steel with a baked white enamel finish, front glass panel, break-glass mechanism, and keyed alike cylinder lock.

.2 Recessed: Rectangular cabinets sized to suit the extinguishers to be housed, with a #18 gauge corrosion resistant white enamelled steel tub, #14 gauge cleaned and prime coat painted steel door and adjustable trim assembly with rounded corners, semi-concealed piano hinge, safety glass panel, and flush stainless steel door latch. Where recessed cabinets are located in fire rated construction the cabinet construction is to maintain the fire rating.

3 EXECUTION

3.1 INSTALLATION

.1 Fire Extinguishers:

- .1 Provide fire extinguishers of the type(s) specified and as per requirements of NFPA 10.
- .2 Unless otherwise shown or specified, wall mount extinguishers using wall brackets supplied with the extinguishers.
- .3 Do not install extinguishers until after wall finishing work is complete.
- .4 This division will be responsible for fire extinguishers until after Substantial Performance of the Work.
- .5 If extinguishers are indicated adjacent to a door, locate the extinguishers at the strike side of the door.
- .2 Fire Extinguisher Cabinets:
 - .1 Provide wall cabinets for fire extinguishers where shown.
 - .2 Unless otherwise shown or specified, locate cabinets so that the centreline is approximately 1.2 m (4") above the finished floor.
 - .3 Confirm exact locations prior to installation.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide domestic water piping and valves.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 22 11 19 – Domestic Water Piping Specialties

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 National Sanitation Foundation (NSF):
 - .1 NSF/ANSI/CAN 61 – Drinking Water System Components-Health Effects

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.
- .3 Test and Evaluation Reports:
 - .1 Water Purity Testing: Submit laboratory water purity test results indicating chlorine residual prior to application for Substantial Performance.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers listed throughout Part 2 are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification.
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.

- .4 Single source responsibility: Obtain each type of valve from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 All products specified in this Section that are in contact with domestic water are to be NSF/ANSI/CAN 61 certified.
- .2 Pipe, Fittings and Joints
 - .1 Hard Copper - Solder Joint: Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper solder type fittings to ASME/ANSI B16.22 and soldered joints using NSF/ANSI 61 certified silver alloy lead-free solder for cold water pipe, and 95% tin/5% Antimony or silver alloy lead free solder for other services, with flux to ASTM B813.
 - .2 Copper Pressure Coupled Joint: Type "L" hard drawn seamless copper to ASTM B88 with Viega "ProPress" copper fittings with "Smart Connect" feature, EDPM seals, and pressure type crimped joints made by use of a Rigid Tool Co. Model 330-B or Model 330-C electro-hydraulic crimping tool.
 - .3 Stainless Steel: Schedule 10 Type 304/304L to ASTM A312/A312M, threaded with screwed stainless steel fittings to ASTM A403/A403M for piping to 65 mm (2½") diameter, roll grooved with Victaulic Co. factory grooved end Type 304/304M stainless steel fittings and cast stainless steel coupling joints with gaskets meeting NSF/ANSI 61 requirements and Type 316 stainless steel bolts, Victaulic Style 807N rigid type or Style 877N flexible type as required by the location and application.
 - .4 Semi-Rigid Polyethylene Tubing: Equal to Versa Fittings and Mfg. Inc. 12 mm (½") diameter, high density, semi-rigid polyethylene tubing, 1380 kPa (200 psi) rated.
 - .5 CPVC: Iplex "AquaRise" SDR 11 CPVC pipe and fittings to CAN/CSA B137.6, 25/50 flame spread and smoke developed rated in accordance with CAN/ULC S102.2, certified to NSF/ANSI 61, complete with primer/solvent weld joints, and with a pressure rating of 690 kPa (100 psi) at 82.2° C (180° F).
 - .6 PEX Tubing: Non-barrier type cross-linked polyethylene piping in accordance with CAN/CSA-B137.5, NSF 372, and ASTM F876, and tested for compliance by an independent third-party agency. The piping is to be complete with brass inserts and crimp-ring joint fittings and couplings.
- .3 Dielectric Unions
 - .1 Lead-free dielectric unions, each complete with a thermoplastic liner and rated minimum 1725 kPa (250 psi) at 120° C (250° F).
- .4 Shut-Off Valves
 - .1 Brass & Bronze Ball Valves: Lead free, Class 600, 4140 kPa (600 psi) non-shock WOG rated, 2-piece, full port ball type valves, each complete with a forged brass or bronze body, blowout-proof stem, solid forged brass or bronze chrome plated ball, "Teflon" or "PTFE" seat, a removable coated steel lever handle marked with valve identification, and ends to suit the piping being connected. Valves in insulated piping are to be complete with stem extensions. Acceptable manufacturers are:
 - .1 Toyo Valve Co.

- .2 Milwaukee Valve Co.
- .3 Kitz Corporation
- .4 Combraco Industries Inc. Apollo
- .5 Watts Water Technologies Inc.
- .2 CPVC Ball Valves: Ipex "AquaRise" One-Piece CPVC ball valves, 15 mm to 25 mm (½" to 1") diameter, 1600 kPa (232 psi) rated at 23° C (73° F).
- .5 Check Valves
 - .1 Horizontal: Class 125, bronze, lead-free with identifying tag, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with ends to suit the connecting piping. Acceptable products are:
 - .1 Toyo Valve Co.
 - .2 Milwaukee Valve Co.
 - .3 Kitz Corporation
 - .4 Combraco Industries Inc. Apollo
 - .5 Watt Water Technologies Inc.
 - .2 Vertical: Equal to Kitz Corp. Code 26, bronze, lead-free, 1725 kPa (250 psi) WOG rated vertical lift check valve with ends to suit the connecting piping.
- .6 Balancing Valves:
 - .1 Solder or flanged end type as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter. Acceptable products are:
 - .1 S.A. Armstrong Model CBV Series
 - .2 Tour and Andersson Model ST Series
 - .3 Watts Industries (Canada) Inc. Model CSM Series
 - .4 ThermOmega Tech Inc. "CircuitSolver CSUA
- .7 Drain Valves:
 - .1 Refer to Part 2 of the mechanical work Section entitled Basic Mechanical Materials and Methods
- .8 Chlorine
 - .1 Sodium hypochlorite to AWWA B-300, Hypochlorites.

3 EXECUTION

3.1 PREPARATION

- .1 Demolition / Removal :

- .1 Do all required domestic water system demolition work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

3.2 INSTALLATION

- .1 Piping Installation Requirements
 - .1 Provide all required domestic water piping.
 - .2 Piping, unless otherwise specified, is to be as follows:
 - .1 for pipe inside the building and above ground in sizes to 100 mm (4") diameter- Ipex "AquaRise" rigid CPVC
 - .2 for branch hot and cold piping above ground from mains and risers to fixtures, fittings, and equipment where fire rated construction is not penetrated, and at your option, PEX tubing installed and joined in strict accordance with the manufacturer's printed instructions
 - .3 for pipe inside building and above ground - Type "L" hard copper with solder joints or, **at your option**, Type "L" hard copper with pressure coupled mechanical joints, or Type 304/304L stainless steel with screwed joints or grooved end coupling joints
 - .3 Slope all piping so that it can be completely drained.
 - .4 Provide proper dielectric unions in all connections between copper pipe and ferrous pipe or equipment.
 - .5 Secure trap seal primer tubing embedded in concrete to reinforcing steel in a secure manner and be present during the concrete pour to ensure that the tubing is not damaged or dislodged.
- .2 Installation Of Shut-Off And Check Valves
 - .1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.
 - .2 Valves to and including 100 mm (4") diameter are to be ball type.
 - .3 Valves in CPVC rigid piping are to be Ipex "AquaRise" CPVC ball valves.
- .3 Installation Of Balancing Valves
 - .1 Provide balancing valves in domestic hot water recirculation piping where shown or required.
 - .2 Locate each valve such that it is easily accessible.
- .4 Installation of Drain Valves
 - .1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.
- .5 Installation Of Partition Stops
 - .1 Provide partition stops in domestic water piping to each group of suite washroom plumbing fixtures. Locate partition stops in piping near the floor level in inconspicuous but accessible locations. Confirm exact locations prior to roughing-in.

3.3 SYSTEM STARTUP

- .1 Flushing and Disinfecting Piping:

- .1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.
- .2 Isolate new piping from existing piping prior to flushing and disinfecting procedures.
- .3 Flush piping until all foreign materials have been removed and the flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.
- .4 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with requirements of the Ministry of Environment document entitled Procedure for Disinfection of Drinking Water in Ontario, all under supervision of a P. Eng. authorized by the Professional Engineers of Ontario to perform such work.
- .5 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of the test results and fill the systems.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide domestic water piping specialties.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 22 11 16 – Domestic Water Piping and Valves

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 National Sanitation Foundation (NSF):
 - .1 NSF/ANSI/CAN 61 – Drinking Water System Components-Health Effects

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

1.5 MAINTENANCE MATERIALS SUBMITTALS

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers listed throughout Part 2 are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification.
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 All products specified in this Section that are in contact with domestic water are to be NSF/ANSI/CAN 61 certified to NSF/ANSI/CAN 61, Drinking Water Components-Health Effects.
- .2 Floor Drain Trap Seal Primers:
 - .1 Primer Valve Type: Brass trap primer valve, activated by water flow or by a 70 kPa (10 psi) water pressure drop, complete with:
 - .1 "O" ring seals
 - .2 a testable "assembly" such as a Pressure Vacuum Breaker is required to comply with the CSA Standard B64 for severe hazard 12 mm (½") diameter inlet and outlet connections
 - .3 #60 mesh stainless steel screen
 - .4 for priming 2 traps from the same primer, a copper/brass dual outlet distribution unit
 - .2 Electronic Type: Surface wall mounting, CSA certified, 115 volt, 1 phase, 60 Hz., electronic, automatic trap priming manifolds, each sized to suit the number of drain traps or interceptors serviced, and each complete with:
 - .1 a EEMAC 1 galvanized steel cabinet with screw-on cover and ANSI 61 grey polyester powder paint finish
 - .2 20 mm (¾") diameter NPT copper pipe inlet with shut-off valve and water hammer arrestor
 - .3 a solenoid valve
 - .4 a testable "assembly" such as a Pressure Vacuum Breaker is required to comply with the CSA Standard B64 for severe hazard
 - .5 discharge manifold with 12 mm (½") diameter compression type copper tube connections on 40 mm (1½") centres with quantity to suit the number of items to be primed
 - .6 a control panel with circuit breaker, test switch 5 ampere fuse, 24 hour timer, and manual override toggle switch.
 - .3 Acceptable manufacturers are:
 - .1 Mifab
 - .2 J.R. Smith
 - .3 Watts
 - .4 Zurn
- .3 Water Hammer Arrestors:
 - .1 Piston type, sealed, pressurized water hammer arrestors suitable for either horizontal or vertical installation, each complete with a hard drawn copper body, "O"-ring piston seals, an air charge, and an inlet opening equal to the diameter of the pipe in which the arrestor is required.
- .4 Air Vents:

- .1 Cast brass, 1035 kPa (150 psi) rated, float type automatic air vent with anti-drip hygroscopic cap to automatically close when in contact with water, EDPM seal, and 15 mm (½") diameter NPT threaded connection.

3 EXECUTION

3.1 INSTALLATION

.1 Trap Seal Primers

- .1 Provide all required accessible trap seal primers to automatically maintain a water seal in floor drain traps, whether shown on the drawings or not.
- .2 Water Closet Flush Valves: Water closet flush valves may be used for priming washroom floor drain traps if the flush tube is properly tapped and primer tubing exposed in the washroom is chrome plated.
- .3 Trap Primer Valves: Provide trap primer valves to prime single or multiple (1 to 6) traps. Install trap primer valves in domestic cold water piping to frequently used plumbing fixtures. Where from 2 to 6 traps are to be primed from the same primer valve, provide the appropriate supply and distribution tube assemblies. Ensure that primer valves are accessible and provide a shut-off valve in the cold water connection to the primer.
- .4 Packaged Electronic Trap Primers: Provide 115 volt, electronic, surface wall mounting trap primer assemblies for multiple (4 to 30) traps. Include for a 115 volt 15 ampere panel breaker (with "lock-on") and wiring in conduit from the closest panelboards to each primer assembly, all to the wiring standards of the electrical work. Adjust primer water flow and timing to suit the number of traps served.
- .5 Whether shown on the drawings or not, provide a shut-off valve in water piping connections to trap primer devices.
- .6 Ensure that trap primer piping is secured to floor drain primer tappings and not terminated through the tapping in the throat of the drain.

.2 Water Hammer Arrestors

- .1 Provide accessible water hammer arrestors in domestic water piping in locations as follows:
 - .2 in headers at groups of plumbing fixtures
 - .3 line size at the top of risers
 - .4 at ends of long horizontal runs of piping
 - .5 in piping connecting solenoid valves or equipment with integral solenoid valves
 - .6 wherever else shown or required by Code
- .7 Install each unit in a piping tee complete with a shut-off valve, either horizontally or vertically in the path of potential water shock in accordance with the manufacturer's published instructions and details.

.3 Air Vents

- .1 Provide accessible air vents with shut-off valves in domestic water piping where shown to prevent air binding.

- .2 Locate exact vent locations on as-built record drawings.

3.2 SYSTEM STARTUP

- .1 Flushing and Disinfecting Piping:
 - .1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.
 - .2 Isolate new piping from existing piping prior to flushing and disinfecting procedures.
 - .3 Flush piping until all foreign materials have been removed and the flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.
 - .4 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with requirements of the Ministry of Environment document entitled Procedure for Disinfection of Drinking Water in Ontario, all under supervision of a P. Eng. authorized by the Professional Engineers of Ontario to perform such work.
 - .5 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of the test results and fill the systems.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide drainage waste and vent piping and valves.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 22 13 18 – Drainage and Vent Piping Specialties

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - .2 ASTM B306 - Standard Specification for Copper Drainage Tube (DWV)
 - .2 Canadian Standards Association (CSA):
 - .1 CAN/CSA-B70 -
 - .2 CAN/CSA B182.2 - PVC Sewer Pipe and Fittings (PSM Type)
 - .3 CAN/CSA-B602 -
 - .3 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S102.2 – Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.
 - .2 CAN/ULC-S115 - Standard Method Of Fire Tests Of Firestop Systems

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers listed throughout Part 2 are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification.
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of valve from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 Pipe, Fittings and Joints:
 - .1 Above Ground PVC - DWV: Rigid IPS PVC drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating less than 25 and a smoke developed rating less than 50 when tested to CAN/ULC-S102-2, solvent weld joints, and, for fire barrier penetration, approved firestop conforming to CAN4-S115.
 - .2 Copper- Solder Joint: Type DWV hard temper to ASTM B306, with forged copper solder type drainage fittings and 50% lead - 50% tin solder joints.
 - .3 Cast Iron: Class 4000 cast iron pipe and fittings to CAN/CSA-B70, cast iron soil pipe, fittings, and means of joining, and mechanical coupling joints to CAN/CSA-B602, Mechanical couplings for drain, waste, and vent pipe and sewer pipe, equal to Anaco "Husky" Series 400, 4-strap type for pipe to 100 mm (4") and 6-strap type for piping larger than 100 mm (4").
 - .4 Galvanized Steel - Victaulic Coupling Joint: Schedule 40 mild steel, galvanized, ASTM A53, factory or site rolled grooved, complete with Victaulic galvanized ductile iron grooved end fittings and, unless otherwise specified, Victaulic Style 77 hot dip galvanized mechanical joint couplings with Grade M gaskets.
 - .5 Carrier & Containment Exposed PVC: Rigid IPS PVC drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating less than 25 and, where required, a smoke developed rating less than 50 when tested to CAN/ULC-S102-2, and solvent weld joints.

3 EXECUTION

3.1 PREPARATION

- .1 Demolition / Removal:
 - .1 Do all required drainage and vent piping demolition work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

3.2 INSTALLATION

- .1 Drain and Vent Piping Installation Requirements:

- .1 Provide all required drainage and vent piping. Pipe, unless otherwise specified, is to be as follows:
 - .1 for pipe inside the building and above ground in sizes to and including 65 mm (2½") diameter - type DWV copper
 - .2 for pipe inside the building and above ground in sizes 75 mm (3") diameter and larger - Class 4000 cast iron with 4-strap couplings for pipe to and including 100 mm (4") diameter, and 6-strap couplings for piping larger than 100 mm (4") diameter, all with torque wrench tightened bolts, and, where pipe riser/building expansion will or may be a problem, cast iron pipe expansion joints equal to Bibby-Ste-Croix 654 Series
 - .3 for pipe inside the building and above ground in lieu of type DWV copper and cast iron, at your option and where permitted by governing Codes and Regulations – 25/50 rated rigid IPS PVC drain, waste and vent pipe
 - .4 for piping inside the building above equipment in areas such as Electrical Rooms, Communication Rooms, etc., PVC carrier/containment piping, 25/50 rated where required
- .2 Unless otherwise specified, slope horizontal drainage piping above ground in sizes to and including 75 mm (3") diameter 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") diameter and larger 25 mm (1") in 2.4 m (8').
- .3 Unless otherwise specified, slope horizontal branches of vent piping down to the fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4').
- .4 Extend vent stacks up through the roof generally where shown but with exact locations to suit site conditions and in any case a minimum of 3 m (10') from fresh air intakes. Terminate vent stacks a minimum of 330 mm (13") above the roof (including roof parapets) in vent stack covers.
- .5 Provide mechanical joint couplings at connections between copper pipe and ferrous pipe or equipment. Fitting shall include interior shoulder which provides a smooth surface for drainage and prevents contact between dissimilar metals.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide drainage and vent piping specialties.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 22 13 16 – Drainage Waste and Vent Piping and Valves

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C32 – Standard Specification for Sewer and Manhole Brick
 - .2 Canadian Standards Association (CSA):
 - .1 CAN/CSA-B79 – Commercial and residential drains and cleanouts
 - .2 CAN/CSA-S157 – Strength Design in Aluminum

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 For floor cleanout terminations:
 - .1 Zurn Industries Ltd.
 - .2 Watts Canada,
 - .3 Mifab Inc.,

- .4 J. R. Smith Mfg. Co.,
 - .5 Wade Canada
- .2 For floor, area, roof, etc., drains:
 - .1 Zurn Industries Ltd.,
 - .2 Watts Canada,
 - .3 Mifab Inc.,
 - .4 J. R. Smith Mfg. Co.,
 - .5 Wade Canada
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of drainage component from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 All drainage products (floor drains, roof drains, cleanouts, etc.) specified in this Section are to be in accordance with requirements of CSA B79, Commercial and Residential Drains and Cleanouts.
- .2 Cleanouts:
 - .1 Horizontal Piping: TY pipe fitting with an extra heavy brass plug screwed into the fitting.
 - .2 Vertical Piping: Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.
 - .3 Urinal(s): Stainless steel wall access cleanout assemblies, each complete with:
 - .1 a tapered plug
 - .2 threaded brass insert
 - .3 urethane rubber seal
 - .4 polished stainless steel access cover with vandal-proof stainless steel securing screw
- .3 Floor Cleanout Terminations:
 - .1 Factory finished cast iron terminations, each adjustable and complete with:
 - .1 a cast iron body with neoprene sleeve

- .2 solid, gasketed, round (except as noted) polished nickel-bronze scoriated top access cover to suit the floor finish
 - .3 a seal plug
 - .4 captive, vandal-proof, stainless steel securing hardware
- .2 All cleanout terminations in areas with a tile or sheet vinyl floor finish are to be as above but with a square top in lieu of a round top.
- .4 Floor Drains:
 - .1 Unless otherwise specified or scheduled, floor drains are to be vandal-proof adjustable drains in accordance with CSA B79 and the drawing schedule, each complete with:
 - .1 a cast iron body with outlet to suit connecting piping, reversible membrane clamp with weepholes, and latex based paint or epoxy protective coating
 - .2 a 12 mm (½") diameter trap seal primer connection
 - .3 a round (except as noted) strainer with securing hardware
 - .2 All strainers in areas with a tile or sheet vinyl floor finish are to be as above but with a square top in lieu of a round top.
- .5 Roof Drains:
 - .1 Unless otherwise specified/scheduled, roof drains are to be in accordance with the drawing schedule and complete with:
 - .1 a cast iron body with wide serrated flashing flange, an outlet to suit the piping connection, and a latex based paint or epoxy coating
 - .2 a flashing clamp device with integral gravel stop
 - .3 an aluminium self-locking dome

3 EXECUTION

3.1 INSTALLATION

- .1 Cleanouts:
 - .1 Provide cleanouts in drainage piping in locations as follows:
 - .1 in the building drain or drains as close as possible to the inner face of the outside wall, and, if a building trap is installed, locate the cleanout on the downstream side of the building trap;
 - .2 at or as close as practicable to the foot of each drainage stack
 - .3 at maximum 15 m (50') intervals in horizontal pipe 100 mm (4") diameter and smaller
 - .4 at maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") diameter
 - .5 in the wall at each new urinal or bank of urinals in a washroom
 - .6 wherever else shown on the drawings

- .2 Cleanouts are to be the same diameter as the pipe in piping to 100 mm (4") diameter, and not less than 100 mm (4") diameter in piping larger than 100 mm (4") diameter.
- .3 Where cleanouts in vertical piping are concealed behind walls or partitions, install the cleanouts near the floor and so that the cover is within 25 mm (1") of the finished face of the wall or partition.
- .2 Floor Cleanout Terminations:
 - .1 Where cleanouts occur in horizontal inaccessible underground piping, extend the cleanout TY fitting up to the floor, and provide a cleanout termination set flush with the finished floor.
 - .2 In waterproof floors, ensure that each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit the floor finish.
 - .3 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.
 - .4 Ensure that cleanout termination covers in tiled floor are square in lieu of round.
- .3 Floor Drains:
 - .1 Provide floor drains where shown on the drawings.
 - .2 Equip each drain with a trap and trap seal primer piping.
 - .3 In equipment rooms and similar areas, exactly locate floor drains to suit the location of mechanical equipment and equipment indirect drainage piping. In washrooms, exactly locate floor drains to avoid interference with toilet partitions.
 - .4 Confirm the exact location of drains prior to roughing in. Where floor drains occur in washrooms coordinate locations with toilet partition installations.
 - .5 Temporarily plug and cover floor drains during construction procedures. Remove plugs and covers during final cleanup work and when requested, demonstrate free and clear operation of each drain. Replace any damaged grates, and refinish any areas of the drain where the cast iron finish has been damaged or removed, including rusted areas.
- .4 Roof Drains:
 - .1 Supply roof drains and place roof drain bodies in position for flashing into roof construction as part of the roofing work. Connect with piping and provide accessories.
 - .2 Protect roof drains from damage and entrance of debris until roofing work is complete, and refinish any areas where the cast iron factory finish has been damaged or removed, including rusted areas.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide plumbing fixtures and fittings.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 22 11 16 – Domestic Water Piping and Valves

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - .1 CSA B125.3 - Plumbing Fittings
 - .2 ASSE 1070/ASME A112.1070/CSA B125.70 - Performance Requirements for Water Temperature Limiting Device
 - .3 CAN/CSA-B651 - Accessible Design for the Built Environment
 - .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-19.22
 - .3 American National Standards Institute (ANSI):
 - .1 ANSI/ISEA Z358.1 - Standard for Emergency Eye Wash and Shower Stations
 - .4 American Society of Mechanical Engineers (ASME):
 - .1 ASME A112.18.1/CSA B125.1 - Plumbing Supply Fittings
 - .2 ASME A112.18.2/CSA B125.2 - Plumbing Waste Fittings
 - .3 ASME A112.18.6/CSA B125.6 - Flexible Water Connections
 - .4 ASME A112.14/CSA B125.14 - Manually Operated Valves for Use in Plumbing Systems
 - .5 American Society of Sanitary Engineering (ASSE):
 - .1 ASSE 1037/ASME A112.1037/CSA B125.37 - Performance Requirements for Pressurized Flushing Devices for Plumbing Fixtures
 - .6 National Sanitation Foundation (NSF):
 - .1 NSF/ANSI/CAN 61 - Drinking Water Components-Health Effects

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Vitreous China Water Closets, Lavatories, Urinals, And Similar Fixtures:
 - .1 American Standard
 - .2 Zurn Industries Ltd.
 - .3 Kohler Co.
 - .4 Toto Ltd.
 - .2 Stainless Steel Fixtures:
 - .1 American Standard
 - .2 Novanni Stainless Inc.
 - .3 Elkay Manufacturing Co.
 - .4 Franke Kindred Canada Ltd.
 - .3 Acrylic Fixtures:
 - .1 Mirolin Industries
 - .2 Fiat Products
 - .3 Acritec Industries Corp.
 - .4 Fixture Fittings:
 - .1 Zurn Industries Ltd.
 - .2 Moen Inc.
 - .3 Kohler Co.
 - .4 American Standard
 - .5 Delta Faucet

- .5 Flush Valves:
 - .1 Zurn Industries Ltd.
 - .2 Sloan Valve Co.
 - .3 Kohler Co.
 - .4 American Standard
- .6 Emergency Fixtures:
 - .1 Bradley Corp.
 - .2 Haws Co.
 - .3 TENAQUIP Ltd.
 - .4 Acorn Engineering Co.
- .7 Refrigerated Drinking Fountains:
 - .1 Elkay Manufacturing Co.
 - .2 Haws Co.
 - .3 Oasis International
 - .4 Sunroc Corp.
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 General RE: Plumbing Fixtures And Fittings:
 - .1 Unless otherwise specified, all vitreous china, porcelain enamelled, and acrylic finished fixtures are to be white.
 - .2 Unless otherwise specified, all fittings and piping exposed to view are to be chrome plated and polished.
 - .3 All fittings located in areas other than private washrooms are to be vandal-resistant
 - .4 Fixture Carriers: All fixture carriers are to be suitable in all respects for the fixture they support and the construction in which they are located.

- .5 Water Closet Floor Flanges: Floor flanges for floor mounted water closets are to be cast iron or brass, secured to the floor to prevent movement and complete with a wax seal and brass or stainless steel bolts, nuts, and washers. Plastic floor flanges will not be acceptable.
- .6 Water Closet Wall Seals: Proper seal to mate with the fixture carrier flange and produce a water-tight installation.
- .7 Fixture Exposed Traps and Wastes: Exposed traps and wastes for fixtures not equipped with integral traps, such as wall mounted lavatories/sinks and free-standing sinks, are to be adjustable chrome plated cast brass "P" traps with cleanouts, minimum #17 gauge chrome plated tubular extensions, and chrome plated escutcheons, all to suit the fixture type and drain connection.
- .8 Fixture Concealed Traps and Wastes: Concealed traps and wastes for fixtures not equipped with integral traps, such as counter sinks, are to adjustable cast brass with cleanout plugs, all to suit the fixture type and drain connection.
- .9 Fixture Exposed Supplies: Exposed supplies for fixtures which do not have supply trim/fittings with integral stops, i.e. lavatories, are to be solid chrome plated brass angle vales with screwdriver stops for public areas, wheel handle stops for private areas, flexible stainless steel risers, and stainless steel or chrome plated steel escutcheons, all arranged and sized to suit the fixture. Dahl Brothers Canada Ltd, chrome plated "mini-ball" valve assemblies will be acceptable.
- .10 Fixture Concealed Supplies: Water piping as specified, complete with ball type shut-off valves as specified with the water piping or Dahl Bros. Canada Ltd. ¼ turn "mini ball" valves.
- .2 Plumbing Fixtures And Fittings:
 - .1 Plumbing fixtures and fittings are to be in accordance with the drawing schedule.

3 EXECUTION

3.1 INSTALLATION

- .1 Installation Of Plumbing Fixtures And Fittings:
 - .1 Provide all required plumbing fixtures and fittings.
 - .2 Where new fixtures and fittings are to be connected to existing piping, include for all required piping revisions.
 - .3 Connect plumbing fixtures and fittings with piping sized in accordance with the drawing schedule.
 - .4 Confirm the exact location of all plumbing fixtures and trim prior to roughing-in. Refer to architectural plan and elevation drawings.
 - .5 When installation is complete, check and test the operation of each fixture and fitting. Adjust or repair as required.
 - .6 Barrier-Free Fixtures: Comply with mounting height and other requirements of the governing Code(s).
 - .7 Counter Mounted Fixtures and Trim: Supply templates for all counter mounted fixtures and trim and hand to the trades who will cut the counter. Ensure openings in the counter are properly located.

- .8 Refrigerated Drinking Fountains: Install in accordance with manufacturer's instructions. Plug into a wall receptacle provided as part of the electrical work. Coordinate receptacle installation with electrical trade on site.
- .9 Emergency Showers: Install so that the bottom of the shower head is approximately 2083 mm (82") above the floor, and approximately 400 mm (16") out from the wall. Wall mount the mixing valve approximately 1.5 m (5') above the floor and adjacent the shower head. Set the valve temperature limit stop to 35° C (95° F). Ensure that the valve is open, and that all exposed piping is chrome plated or stainless steel.
- .10 Emergency Eye Wash Fixtures: Install eye wash fixtures in accordance with the manufacturer's printed instructions. Ensure that exposed piping is painted.
- .11 Mixing Valves For Emergency Fixtures: Wall mount mixing valves for emergency fixtures approximately 1.5 m (5') above the floor and secure in place. Check and confirm valve operation and the temperature of the tempered water supply. Provide cabinets where shown. Identify each cabinet and hand three identified cabinet keys to the Consultant prior to Substantial Performance.
- .12 Mop Service Basins: Set mop service basins on the floor over drain piping and connect to the roughed-in service. Install wall supply trim and any accessories specified.
- .13 Urinals: Prior to rough-in, confirm urinal locations and mounting heights on architectural drawings.
- .2 Commissioning:
 - .1 Commission plumbing fixtures and fittings by proving proper operation.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide a natural gas piping system

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - .1 CAN/CSA-B149.1, Natural Gas and Propane Installation Code, as amended by local Gas Codes
 - .2 CSA/ANSI Z21.80/CSA 6.22, Line Pressure Regulators

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers are as noted throughout Part 2
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

.1 Pipe, Fittings And Joints:

- .1 Uncoated Black Steel - Screwed Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with malleable cast iron screwed fittings to ANSI B2.1, and screwed joints.
- .2 Uncoated Black Steel - Welded Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, mill or site bevelled, complete with factory made forged steel butt welding fittings and welded joints.
- .3 Copper-Uncoated: Type "G" seamless copper tubing to ASTM B837, hard temper with wrought copper capillary brazed joint type fittings to ASTM B.61, and brazed joints made with "Sil-Fos" or "Sil-Fos 5" brazing alloy, or, soft temper with flared brass fittings of a single 45° flare type, forged or with a machined long nut and copper to copper threaded connectors, and, where required, flared brass copper to NPS adapters.

.2 Piping Unions:

- .1 Screwed Piping: Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260° C (500° F).
- .2 Flanged Piping: Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.
- .3 Copper to Steel: Equal to Kamco Products "Copper Stopper".

.3 Shut-off Valves:

- .1 Ball Type: CSA certified, minimum 3100 kPa (450 psi) WOG rated, 1/4 turn, full port non-lubricated brass ball valves, each complete with:
 - .1 A Teflon PTFE seat.
 - .2 Chrome plated solid ball.
 - .3 Removable identified lever handle.
 - .4 Screwed ends.

3 EXECUTION

3.1 INSTALLATION

.1 Natural Gas Piping Installation Requirements:

- .1 Provide all required natural gas distribution piping and connect gas fired or operated equipment, and provide all required vent piping to atmosphere, including vent piping from pressure regulators. Do all piping work in accordance with requirements of CAN/CSA-B149.1.
- .2 Piping is to be as follows:
 - .1 For above ground piping, uncoated Schedule 40 black steel, hard temper or soft copper, or, if permitted, flexible stainless steel.
- .3 Slope gas piping in the direction of flow to low points.

- .4 Ensure that supports for roof mounted piping are sized (height) to accommodate the roof slope and the required piping slope, and to permit the installation of low point dirt pockets.
 - .5 Provide full pipe diameter 150 mm (6") long drip pockets at the bottom of all vertical risers, at all piping low points, and wherever else shown and/or required.
 - .6 Identify all natural gas piping above ground with 2 coats of safety yellow enamel applied over primer, and SMS Ltd. or equal coil type vinyl identification makers with arrows.
- .2 Installation Of Shut-Off Valves:
- .1 Provide CSA approved ball type or lubricated plug type shut-off valves to isolate equipment, and wherever else shown.
 - .2 Ensure that valves are located for easy accessibility and maintenance.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide standard ductwork
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 23 31 06 – Special Systems Ductwork
 - .2 Section 23 31 07 – Ductwork Cleaning
 - .3 Section 23 32 00 – Casings and Plenums
 - .4 Section 23 33 00 – Duct System Dampers and Accessories
 - .5 Section 23 33 05 – Silencers

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI):
 - .1 ANSI/SMACNA HVAC Duct Construction Standards- Metal and Flexible
 - .2 American Society of Testing and Materials (ASTM):
 - .1 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Coated (Galvannealed) by the Hot-Dip Process
 - .3 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC-S110, Standard Methods of Test for Air Ducts
 - .2 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .4 National Fire Protection Association (NFPA):
 - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilation Systems

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:

- .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for duct and fittings.

- .3 Test and Evaluation Reports:

- .1 Duct Pressure Tests

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

- .1 Acceptable Manufacturers:

- .1 Flexible Ductwork

- .1 Flexmaster

- .2 Continental

- .3 Wiremold

- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.

- .3 Substitution Limitations:

- .1 No further substitutions will be permitted.

- .4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 Galvanized Steel Ductwork:

- .1 General: Galvanized steel sheet is to be hot dipped in accordance with requirements of ASTM A653. Galvanizing for bare uncovered duct to be finish painted is to be G60. All other galvanizing is to be G90.

- .2 Rectangular: Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.

- .3 Round: Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings and couplings.

- .4 Flat Oval: Factory machine fabricated, single wall, 4-ply spiral lock seam duct, fittings and couplings.

- .2 Flexible Metallic Ductwork

- .1 Bare: Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, ANSI/SMACNA Form "M-UN", ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, and supplied in 3 m (10') lengths.

- .2 Insulated: Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, ANSI/SMACNA Form "M-I", ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, supplied in 3 m (10') lengths and factory covered with 40 mm (1½") thick, 12 kg/m³ (0.75 lb/ft³) density, minimum 6 R-value fibreglass insulation with a vinyl jacket meeting flame spread and smoke developed requirements of CAN/ULC-S102.
- .3 Metal Duct System Joint Sealant
 - .1 ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 maximum flame spread rating of 5 and smoke developed rating of 0.
- .4 Acoustic Lining
 - .1 Minimum 25 mm (1") thick acoustic lining material meeting NFPA 90A requirements and flame spread and smoke developed fire hazard ratings of CAN/ULC-S102, flexible for round ducts, board type for rectangular ducts, consisting of a bonded fiberglass mat coated on the inside (airside) face with a black fire-resistant coating.

3 EXECUTION

3.1 INSTALLATION

- .1 Demolition:
 - .1 Do all required standard ductwork system demolition/revision work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.
- .2 Fabrication And Installation Of Galvanized Steel Ductwork:
 - .1 Provide all required standard galvanized steel ductwork, rectangular and/or round and/or flat oval as shown. Note that where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.
 - .2 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit the duct pressure class designation of minimum 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so that the ductwork does not "drum". Duct system sealing is to meet ANSI/SMACNA Seal Class A requirements.
 - .3 Variable air volume ductwork from supply fans to boxes is to be as above but rectangular duct take-offs are to be double side straight taper type with a take-off length equal to 0.5 times the branch duct width but minimum 150 mm (6") length, and the double taper side is to have an included angle of minimum 60°.
 - .4 Duct Routing and Dimensions: Confirm the routing of all ductwork at the site and site measure ductwork prior to fabrication. Note that duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by the Consultant. Duct routing and/or dimension revisions to suit conditions at the site are not grounds for a claim for an extra cost.
 - .5 Ducts Run Within or Through OWSJ: Refer to structural drawings. Where ductwork is to be run within or through open web steel joists, note that ductwork shown on the mechanical drawings is schematic only and is to be altered as required to suit the steel joist configuration, spacing, panel points, and cross-bridging at no additional cost.

- .6 Ductwork Located at Sprayed Fireproofing: Wherever ductwork is required at locations where sprayed fireproofing is applied to building construction, install the ductwork only after the fireproofing work is complete and do not compromise the fire rating of the sprayed fireproofing.
 - .7 Automatic Control Components: Install (but do not connect) all duct system mounted automatic control components supplied as part of the automatic control work.
 - .8 Heat Transfer Equipment Connections: Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.
 - .9 Rectangular Duct Support Inside Building: Support horizontal rectangular ducts inside the building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with, unless otherwise specified, galvanized steel channels, and galvanized steel hanger rods for all ducts that are exposed, and all concealed ducts wider than 500 mm (20").
 - .10 Round and Flat Oval Duct Support Inside Building: Support round and flat oval ducts inside the building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at the top of the duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If the duct is insulated, size the strap to suit the diameter of the insulated duct.
 - .11 Flanged Duct Joints: Where flanged duct joints are used, do not locate the joints in wall or slab openings, or immediately at wall or slab openings. Do not use flanged joints for exposed uninsulated ducts in finished areas.
 - .12 Support of Roof Mounted Ducts: As specified in the mechanical work Section entitled Duct System Dampers and Accessories.
 - .13 Application of Sealants: Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of the sealant.
 - .14 Connection of Dissimilar Metal Ducts: Where dissimilar metal ducts are to be connected, isolate the ducts by means of flexible duct connection material as specified in the Section entitled Duct System Dampers and Accessories.
- .3 Installation Of Flexible Ductwork:
- .1 Provide maximum 3 m (10') long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles and diffusers. Do not install flexible ductwork through walls, even if shown on the drawings.
 - .2 Stretch out lengths of duct prior to cutting and installation.
 - .3 At rectangular galvanized steel duct, accurately cut holes and provide flanged or "Spin-in" round flexible duct connection collars. Seal joints with duct sealer.
 - .4 Install flexible ducts as straight as possible and support in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, and secure at each end with nylon or stainless steel gear type clamps, and seal joints. Provide long radius duct bends where they are required.
 - .5 Do not penetrate fire barriers with flexible duct.

- .4 Installation Of Acoustic Lining:
 - .1 Provide acoustic lining in ductwork in locations as follows:
 - .1 Wherever shown and/or specified on the drawings.
 - .2 Supply ductwork downstream of air terminal boxes for a distance of 2.4 m (8') measured along the duct and outward from the box in all directions.
 - .3 For all transfer air ducts.
 - .2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel as per the detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.
- .5 Duct System Protection, Cleaning And Start-Up:
 - .1 Temporarily cover all open ends of new ducts during construction.
 - .2 Vacuum all dirt and foreign matter from the entire duct systems and clean duct system terminals and the interior of air handling units prior to operating fans.
 - .3 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.
 - .4 Provide cheesecloth over all duct system inlets and outlets and run the system for twenty-four hours, after which remove the cheesecloth, the construction filters, and install new permanent filters.
 - .5 Include all labour for a complete site walk-through with testing and balancing personnel following the route of all duct systems to be tested, adjusted and balanced for the purpose of confirming the proper position and attitude of dampers, the location of pitot tube openings, and any other work affecting the testing and balancing procedures. Perform all corrective work required as a result of this walk-through.
- .6 Testing, Adjusting And Balancing:
 - .1 When work is complete and equipment is operating as intended, test, adjust and balance air flows and temperatures in accordance with requirements specified in the mechanical work Section entitled Testing, Adjusting, and Balancing.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide duct system dampers and accessories
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 23 31 05 – Standard Ductwork
 - .2 Section 23 31 07 – Ductwork Cleaning
 - .3 Section 23 32 00 – Casings and Plenums
 - .4 Section 23 33 05 – Silencers

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI):
 - .1 ANSI/SMACNA HVAC Duct Construction Standards- Metal and Flexible
 - .2 American Society of Testing and Materials (ASTM):
 - .1 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Coated (Galvannealed) by the Hot-Dip Process
 - .3 Underwriters Laboratories Canada (ULC):
 - .1 CAN/ULC-S110, Standard Methods of Test for Air Ducts
 - .2 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .4 National Fire Protection Association (NFPA):
 - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilation Systems

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers listed throughout Part 2 are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 Round To Rectangular Duct Connections:
 - .1 Galvanized steel, flared, flanged or notched as required, "SPIN-IN" type round duct take-off collars with locking dampers in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 Splitter Dampers:
 - .1 Minimum #20 gauge damper blade constructed of the same material as the duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to Dyn Air Inc. #Q-50 "DYN-A-QUAD S-S" quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.
- .3 Air Turning Vanes:
 - .1 For square elbows - multiple-radius turning vanes, interconnected with bars, adequately reinforced to suit the pressure and velocity of the system, constructed of the same material as the duct they are associated with, and in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
 - .2 For short branch ducts at grille and diffuser connections - air extractor type, each equipped with a matching bottom operated 90° opposed blade volume control damper, constructed of the same material as the duct it is associated with and in accordance with requirements and details in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .4 Manual Balancing (Volume) Dampers:
 - .1 Flanged and drilled, low leakage, single or parallel blade (depending on damper size) manual balancing dampers with AMCA certified maximum leakage through a 1.2 m x 1.2 m (4' x 4') damper of 52 L/s/m² (110 ft³/min) against 1 kPa (0.145 psi) differential static pressure, each constructed of the same material as the connecting ductwork unless otherwise specified, each designed to maintain the internal free area of the connecting duct, and each complete with:
 - .1 Rectangular dampers: such as a Nailor Industries Inc. Model 1010 and 1020 damper, maximum size 1.2 m x 1.2 m (4' x 4') for a single damper and complete with:

- .1 #16 gauge hat channel frame with reinforced corners and #16 gauge blades, galvanized steel for galvanized steel ductwork, Type 304 stainless steel for other ductwork unless otherwise specified.
- .2 Dual durometer bulb type extruded PVC blade seals, and compression type cambered metal jamb seals.
- .3 A hexagonal or square shaft extension through the frame.
- .4 Non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers, with an outboard support bearing and outboard support bearing bracket.
- .5 Blade stops for single blade dampers, designed to prevent the blade from moving more than 90°.
- .6 Plated steel linkage for multiple blade dampers, totally enclosed within the frame and out of the airstream.
- .7 A locking hand quadrant damper operator with, for insulated ducts 50 mm standoff mounting.
- .2 Round dampers: such as a Nailor Industries Inc. Model 1090 butterfly style damper, maximum 600 mm (24") diameter, equipped with:
 - .1 A #20 gauge frame with stiffening beads.
 - .2 2 #20 gauge blades laminated together, equivalent to #14 gauge, 90° rotation, with open/close end stops and a cross-linked polyethylene blade steel.
 - .3 12 mm (½") diameter drive shaft bolted to the blade and extended approximately 100 mm (6") beyond the frame.
 - .4 "Celcon" or equal bearings.
 - .5 A locking hand quadrant damper operator with, for insulated ducts 50 mm standoff mounting.
- .2 Acceptable manufacturers are:
 - .1 Nailor Industries Inc.
 - .2 T.A. Morrison & Co. Inc. "TAMCO"
 - .3 NCA Manufacturing Ltd.
 - .4 Greenheck Fan Corp.
 - .5 Ruskin Co.
- .5 Backdraft Dampers:
 - .1 Counterbalanced backdraft dampers such as a T. A. Morrison & Co. Inc. "TAMCO" Series 7000, sized as shown and complete with:
 - .1 Extruded aluminium frame and blades, with captive extruded silicone blade and frame seals.
 - .2 Hard aluminum alloy crank arms, pivot rods, and linkage rod located out of the airstream.

- .3 Maintenance free bearing system with an aluminum pivot point rotating in a "Celcon" or equal bearing.
- .2 Acceptable manufacturers are:
 - .1 T.A. Morrison & Co. Inc. "TAMCO"
 - .2 Nailor Industries Inc.
 - .3 NCA Manufacturing Ltd.
 - .4 Greenheck Fan Corp.
 - .5 Ruskin Co.
- .6 Fusible Link Dampers:
 - .1 Curtain blade type, dynamic, galvanized steel (unless otherwise specified) fusible link dampers, ULC classified to Standard CAN/ULC-S112 and in accordance with NFPA 90A requirements, factory tested for closure under airflow, 1 1/2 hour or 3 hour rated as required, and complete with:
 - .1 A constant force type 301 stainless steel closure spring.
 - .2 A blade lock assembly.
 - .3 A steel sleeve.
 - .4 Retaining angles.
 - .5 Unless otherwise specified, a 74°C (165°F) rated standard fusible link.
 - .2 Fusible link dampers are to be Type "B" or Type "C" (as required) with the folded curtain blade out of the air stream except where damper size or location requires the use of type "A" dampers with the curtain blade in the air stream.
 - .3 Acceptable fusible link damper manufacturers are:
 - .1 Nailor Industries Inc.
 - .2 Greenheck Fan Corp.
 - .3 Pottorff
 - .4 Ruskin Co.
- .7 Flexible Connection Material:
 - .1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber. Acceptable products are:
 - .1 Duro Dyne Canada Inc. "DUROLON"
 - .2 Dyn Air Inc. "HYPALON"
- .8 Duct Access Doors:

- .1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, with sizes suitable in all respects for the purpose for which they are provided, and, unless otherwise specified, constructed of the same material as the duct they are associated with.
- .9 Ductwork Drain Points:
 - .1 Equal to Ductmate Canada Ltd. "DUCTMATE MOISTURE DRAIN", 20 mm ($\frac{3}{4}$ ") diameter moisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut and cap.
- .10 Instrument Test Ports:
 - .1 Equal to Duro-Dyne of Canada Ltd. #IP1 or #IP2 (to suit insulation thickness where applicable) gasketed, leak-proof instrument test ports for round or rectangular ducts as required, each complete with a neoprene expansion plug and a plug securing chain.
- .11 Wire Mesh (Bird Screen):
 - .1 Heavy-gauge galvanized steel or aluminum mesh, 12 mm x 12 mm ($\frac{1}{2}$ " x $\frac{1}{2}$ ") secured in a rigid galvanized steel or aluminum framework, sized as indicated on the drawings, and constructed so as to be removable.

3 EXECUTION

3.1 INSTALLATION

- .1 Installation Of Round To Rectangular Duct Connections:
 - .1 Cut round holes in rectangular ducts using a purpose made hole cutter and provide round to rectangular "Spin-In fittings with dampers for connection of flexible round ductwork. Seal the cut duct around the fitting.
- .2 Installation Of Splitter Dampers:
 - .1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified on the drawings. Install splitter dampers so they cannot vibrate and rattle and so that the damper operation mechanisms are in an easily accessible and operable location. Ensure that operators for dampers in insulated ducts are equipped with stand-off mounting brackets.
- .3 Installation Of Turning Vanes:
 - .1 Provide turning vanes in ductwork elbows where shown on the drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
 - .2 Provide volume extractor type turning vanes in short branch supply duct connections off mains to grilles and diffusers where shown and/or specified.
- .4 Installation Of Manual Balancing (Volume) Dampers:
 - .1 Provide manual balancing dampers in all open end ductwork, in all duct mains, and wherever else shown and/or specified.

- .2 Install the dampers so that the operating mechanism is accessible and positioned for easy operation, and so that the dampers cannot move or rattle. Ensure that operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.
- .3 Dampers in fresh air ducts, exterior wall/roof openings, etc., are to be insulated type.
- .4 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing five additional dampers at no additional cost.
- .5 Installation Of Backdraft Dampers:
 - .1 Provide backdraft dampers where shown.
 - .2 Install and secure the dampers so that they cannot move or rattle.
- .6 Installation Of Fusible Link Dampers:
 - .1 Provide fusible link dampers where shown and/or specified on the drawings. Ensure that the damper rating (1½ or 3 hr.) is suitable for the fire barrier it is associated with.
 - .2 Install dampers with retaining angles on all 4 sides of the sleeve on both sides of the damper and connect with ductwork in accordance with the damper manufacturer's instructions and details to meet Code requirements.
 - .3 Provide expansion clearance between the damper or damper sleeve and the opening in which the damper is required. Ensure that the openings are properly sized and located, and that all voids between the damper sleeve and the opening are properly sealed to maintain the rating of the fire barrier.
- .7 Installation Of Flexible Connection Material:
 - .1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums, and/or casings connect to fans, and wherever else shown or specified.
 - .2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of the flexible fabric and to the fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure that connections to the flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.
- .8 Installation Of Duct Access Doors:
 - .1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Install in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
 - .2 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure that the doors are properly located for damper maintenance.
 - .3 When requested, submit a sample of proposed duct access doors for review.
 - .4 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce the ductwork to suit the access door installed.
- .9 Installation Of Instruments Test Ports:

- .1 Provide instrument test ports in all main ducts at connections to fans, plenums or casings, in all larger branch duct connections to mains, and wherever else required for proper air quantity balancing and testing.
- .2 Locate test ports where recommended by personnel performing air quantity testing and balancing work.
- .10 Installation Of Wire Mesh (Bird Screen):
 - .1 Provide framed, removable wire mesh panels over openings in ducts and/or walls where shown and/or specified on the drawings. Rigidly secure in place but ensure the panels are removable.
 - .2 Provide wire mesh panels for open-end return air ducts in ceiling spaces whether shown on the drawings or not.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide centrifugal inline fans
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 23 31 05 – Standard Ductwork
 - .2 Section 23 33 00 – Duct System Dampers and Accessories

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI):
 - .1 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating
 - .2 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans
 - .2 Air Movement and Control Association (AMCA):
 - .1 AMCA Standard 211, Product Rating Manual for Fan Air Performance
 - .2 AMCA Standard 311, Product Rating Manual for Fan Sound Performance
 - .3 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:

- .1 Twin City Fan and Blower Co.
 - .2 Loren Cook Co.
 - .3 Greenheck Fan Corp.
 - .4 JencoFan
 - .5 Carnes Company Inc.
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
- .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 Centrifugal Inline Fans:
- .1 Centrifugal, ULC listed, factory run tested rectangular inline fans as per the drawing schedule.
 - .2 Housing: Heavy-gauge galvanized steel with removable side panels to permit removal of the power assembly without disturbing duct connections, universal mounting brackets and hardware including spring vibration isolators to accommodate horizontal or vertical mounting as required, a flanged inlet panel with inlet venturi, a flanged outlet panel, both with duct connection collars, and galvanized steel wire grid fan inlet/outlet guard(s).
 - .3 Fan Wheel: Non-overloading aluminium wheel with backward inclined blades with matching inlet venturi, statically and dynamically balanced as an assembly.
 - .4 Motor and Disconnect Switch: TEFC motor conforming to requirements specified in the mechanical work Section entitled Basic Mechanical Materials and Methods, mounted out of the airstream, complete with a cover, and factory prewired to a NEMA 4 disconnect switch.
 - .5 Accessories: For fans as scheduled, factory supplied accessories as follows:
 - .1 For fans as scheduled, housing insulation (lining), consisting of neoprene spray coated glass fibre semi-rigid insulation meeting NFPA 90A requirements and 25/50 smoke developed/flame spread requirements of CAN/ULC S102, permanently secured in place with no exposed edges.
 - .2 For fans as scheduled, a galvanized steel filter box with frame suitable for 25 mm (2") thick MERV 7 disposable panel type filters.

3 EXECUTION

3.1 INSTALLATION

- .1 Installation Of Centrifugal Inline Fans:
- .1 Provide inline centrifugal fans where shown.

- .2 Secure each fan in place from the structure with vibration isolation, either horizontally or vertically as indicated, independent of connecting ductwork and in accordance with the fan manufacturer's published instructions.
- .3 Ensure that duct connections are made using flexible connection material.
- .4 Equipment and System Manufacturer's Certification: Refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.
- .5 Start-Up: Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.
- .6 Commissioning: Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.
- .7 Demonstration and Training: Refer to the article entitled Equipment and System O & M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 4 hours of on-site operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide roof-mounted exhaust fans.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 23 31 05 – Standard Ductwork
 - .2 Section 23 33 00 – Duct System Dampers and Accessories

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI):
 - .1 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating
 - .2 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans
 - .2 Air Movement and Control Association (AMCA):
 - .1 AMCA Standard 211, Product Rating Manual for Fan Air Performance
 - .2 AMCA Standard 311, Product Rating Manual for Fan Sound Performance
 - .3 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Twin City Fan and Blower Co.

- .2 Loren Cook Co.
- .3 Greenheck Fan Corp.
- .4 JencoFan
- .5 Carnes Company Inc.
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 Roof-Mounted Exhaust Fans:
 - .1 Centrifugal, ULC listed, factory run tested roof-mounted exhaust fans as per the drawing schedule.
 - .2 Curb Cap and Housing: Spun aluminium with deep venturi inlet, aluminium curb cap with continuously welded corners, pre-punched mounting holes, galvanized steel or aluminium bird screen, and EMT conduit chase to the motor compartment.
 - .3 Fan Wheel: Centrifugal, non-overloading aluminum wheel with backward inclined blades matched to the inlet venturi, statically and dynamically balanced as an assembly.
 - .4 Motor and Disconnect Switch: Motors are to conform to requirements specified in the mechanical work Section entitled Basic Mechanical Materials and Methods, mounted on vibration isolation in a compartment outside of the airstream, and factory prewired to a NEMA 4 disconnect switch.
 - .5 Roof Mounting Curb: Prefabricated, minimum 300 mm (12") high heavy-duty aluminum roof mounting curb with factory installed wood nailer, 40 mm (1½") thick insulation, continuously welded seams, and damper tray.
 - .6 Accessories: For fans as scheduled, factory supplied accessories as follows:
 - .1 A gravity backdraft damper with #20 gauge galvanized steel frame and #26 gauge aluminum blades with felt edge blade seals.
 - .2 A continuous non-corrosive piano type curb hinge to permit access to the fan, damper and connecting duct, complete with retaining chain and a security hasp to prevent removal of the unit from the curb cap and prevent building entry through connecting ductwork.

3 EXECUTION

3.1 INSTALLATION

- .1 Installation Of Roof-Mounted Exhaust Fans:
 - .1 Provide roof-mounted exhaust fans where shown.

- .2 Supply a roof mounting curb with each fan and hand the curbs to the roofing trade on the roof for mounting and flashing into roof construction as part of the roofing work. Secure fans in place on the curbs.
- .3 Install dampers in the curb damper tray and secure in place.
- .4 Equipment and System Manufacturer's Certification: Refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.
- .5 Start-Up: Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.
- .6 Commissioning: Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.
- .7 Demonstration and Training: Refer to the article entitled Equipment and System O&M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 4 hours on-site operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide air terminal units
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 23 31 05 – Standard Ductwork
 - .2 Section 23 33 00 – Duct System Dampers and Accessories

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI):
 - .1 ANSI/ASHRAE Standard 130, Laboratory Methods of Testing Air Terminal Units
 - .2 Air Conditioning, Heating, and Refrigeration Institute (AHRI):
 - .1 AHRI Standard 880, Standard for Performance Rating for Air Terminals
 - .3 Underwriters Laboratories (UL):
 - .1 UL 1995/CA C22.2 No. 236, Heating and Cooling Equipment

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Price Industries Inc.
 - .2 Titus

- .3 Nailor Industries Inc.
- .4 Krueger Division of Air System Components Inc.
- .5 Johnson Controls "York"
- .6 Trane Technologies
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 Variable Air Volume Terminal Boxes:
 - .1 Single duct, controller type, pressure independent variable air volume boxes as per the drawing schedule, each individually field adjustable to minimum and maximum air volumes. Terminal box sound power levels with an attenuator or lined discharge duct in place are not to exceed sound power levels, in decibels, of 61, 53, 48, 44, 42 and 41 in octave bands 2 to 7 respectively at specified air quantities and 370 kPa (55 psi) entering static pressure. Each box is to be complete with:
 - .1 Housing: #22 gauge galvanized steel, sealed and gasketed, internally lined with 25 mm (1") thick glass fibre duct lining material with a neoprene coating meeting NFPA 90A and CAN/ULC-S102 25/50 flame spread and smoke developed requirements, and complete with:
 - .1 Exposed cut edges of the liner material factory coated with NFPA 90A and CAN/ULC-S102 approved sealant.
 - .2 A 50 mm (2") long, round inlet duct connection.
 - .3 A rectangular discharge opening with slip and drive cleat duct connection facilities.
 - .4 A protective galvanized steel shroud for the controller and damper actuator.
 - .2 Air valve damper: normally open, galvanized steel blade with peripheral gasket, pivoting in self-lubricating bearings and with air leakage past a closed damper of 2% or less of rated capacity at 750 Pa (3" wc) inlet static pressure.
 - .3 Air flow sensor: located at the box inlet, complete with gauge taps, multiple pressure sensing ports, and an averaging chamber designed to accurately average the flow across the inlet of the box with an accuracy of within 5% with a 90° sheet metal elbow located directly at the inlet, and amplify the sensed air flow signal.

- .4 Digital controller/actuator: factory installed, connected and tested control package including a microprocessor based stand-alone digital controller capable of networking with a building automation system, personal computer, or a portable operator interface device, an electronic flow transducer, and an electronic actuator for the damper, all calibrated and factory set for maximum and minimum air flow, field adjustable and equipped with gauge taps for balancing with a standard pressure gauge.

3 EXECUTION

3.1 INSTALLATION

- .1 Installation Of Terminal Boxes:
 - .1 Provide ceiling mounted terminal boxes where shown.
 - .2 Secure each box in place from the structure by means of galvanized steel angles and hanger rods, independent of connecting ductwork.
 - .3 Connect each box with ductwork as indicated. Provide straight inlet duct the same size as the box inlet and of a length equal to a minimum of four duct diameters. Refer to the drawing detail. Coordinate final box adjustments and settings with personnel doing system testing and balancing work.
 - .4 Testing, Adjusting and Balancing: When work is complete and equipment is operating as intended, test, adjust and balance air flows and temperatures in accordance with requirements specified in the mechanical work Section entitled Testing, Adjusting, and Balancing.
 - .5 Start-Up: Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.
 - .6 Commissioning: Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.
 - .7 Demonstration and Training: Refer to the article entitled Equipment and System O&M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 3 hours of on-site operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide grilles and diffusers
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 23 31 05 – Standard Ductwork
 - .2 Section 23 33 00 – Duct System Dampers and Accessories

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI):
 - .1 ANSI/ASHRAE Standard 70, Method of Testing the Performance of Air Outlets and Air Inlets

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Price Industries Inc.
 - .2 Krueger Division of Air System Components Inc.
 - .3 Titus HVAC
 - .4 Nailor Industries Inc.
 - .5 Metalaire

- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 Grilles And Diffusers:
 - .1 Grilles and diffusers of the type, size, capacity, finish, and arrangement as shown on the drawings and as per the drawing schedule, each equipped with all required mounting and connection accessories to suit the mounting location and application.

3 EXECUTION

3.1 INSTALLATION

- .1 Installation Of Grilles And Diffusers:
 - .1 Provide grilles and diffusers where shown on the drawings. Wherever possible, grilles and diffusers are to be the product of one manufacturer.
 - .2 Unless otherwise specified connect grilles and diffusers in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
 - .3 Exactly locate grilles and diffusers to conform to the final architectural reflected ceiling plans and detailed wall elevations, and to conform to the final lighting arrangement, ceiling layout, ornamental and other wall treatment.
 - .4 Equip supply diffusers having a basic four-way or all round air pattern for operation in one, two, or three way pattern where indicated on the drawings.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide roof-mounted modular air handling units
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 23 31 05 – Standard Ductwork
 - .2 Section 23 33 00 – Duct System Dampers and Accessories

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI):
 - .1 ANSI/ARI 410, Forced-Circulation Air-Cooling and Heating Coils
 - .2 ANSI/ARI 430, Central Station Air-Handling Units
 - .3 ANSI/ASHRAE 90.1, Energy Standard for Buildings Except Low Rise Residential Buildings
 - .2 Air Movement and Control Association (AMCA):
 - .1 AMCA Standard 211, Product Rating Manual for Fan Air Performance
 - .2 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans
 - .3 Canadian Standards Association (CSA):
 - .1 CAN/CSA-C22.2 No. 236/UL 1995, Heating and Cooling Units
 - .2 CSA or ETL certification and labelling for all electrical components

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.
- .2 Shop Drawings/Product Data:
 - .1 Submit shop drawings/product data sheets for all roof-mounted modular air handling units. Include the following:
 - .1 computer generated and certified fan performance curves
 - .2 computer generated psychometric chart for each cooling coil

- .3 certified sound power data for discharge, radiated, and return positions by octave band
- .4 hardware for section-to-section site connections as applicable
- .5 dimensioned layouts
- .6 product data sheets for fan motors
- .3 Product Data:
 - .1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings.
- .4 Test and Evaluation Reports:
 - .1 Factory Test and Inspection Report: Submit with delivery of each unit a copy of the factory test and inspection report as specified in Part 2 of this Section, and include a copy of each report with O & M Manual project close-out data.
 - .2 Site Inspection and Start-Up Report: Submit a site inspection and start-up report from the manufacturer's representative as specified in Part 3 of this Section.

1.5 MAINTENANCE MATERIALS SUBMITTALS

- .1 Spare parts:
 - .1 Colour Chart and Touch-Up Paint: Submit the manufacturer's colour chart to indicate the standard colour range of paint finishes. Supply 4 L (3.5 qt) of touch-up paint with each custom made air handling unit.
 - .2 Spare Air Filters: Submit spare air filters as specified in Part 2 of this Section.

1.6 QUALITY ASSURANCE

- .1 Preconstruction Testing:
 - .1 PRE-DELIVERY FACTORY INSPECTION AND TESTING
 - .1 When each is completely assembled and ready for shipment, including assembly of shipping sections, the following factory testing is to be performed:
 - .1 a pressure test of 3.0 kPa with leakage not to exceed 1%, witnessed by the Consultant, with all normal travel expenses, including meals and accommodations if required, for two of the Consultant's staff to attend the test in the manufacturer's plant included in the Contract
 - .2 at the time of the factory pressure test, an inspection by the Consultant for defects and conformance to unit construction requirements
 - .2 Defects found which cannot be corrected while the Consultant is at the manufacturer's plant, and/or failure of the pressure test will result in rejection of the unit(s), and the unit(s) must be corrected and again examined by the Consultant at a later date but prior to shipment, and the Consultant's expenses for re-inspection are to be included in the Contract.

- .3 All factory tests and inspections are to be scheduled with the Consultant with a minimum of 7 working days written notice. Make all travel and accommodation arrangements on behalf of the Consultant, and ensure that travel tickets, itinerary, etc., are in the hands of the Consultant well before the factory visit departure date.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Daikin McQuay
 - .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
 - .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
 - .4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

- .1 Roof Mounting Modular Air Handling Units:
 - .1 Factory made, outdoor, sectional, modular air handling units as per the drawing schedule with dimensions and arrangements as shown and detailed on the drawings. Where required, air handling units are to be shipped in sections.
 - .2 Unit Construction: Unit construction is to produce a weather-proof assembly designed for 1.5 kPa (6" w.c.) positive pressure and 1 kPa (4" w.c.) negative pressure with an air leakage rate less than 1% of total capacity. Each unit is to be constructed with galvanized steel channel posts and 50 mm (2") thick, thermally broken, double wall sandwich type removable panels and access doors insulated with 50 mm (2") thick neoprene coated 48 kg/m³ (3 lb/ft³) density glass fibre insulation, with all panels, access doors, and shipping sections (as applicable) sealed with permanently applied bulb type gaskets. Additional construction features are as follows:
 - .1 Base rail and frame: a structural galvanized steel curb ready base rail with sloped drain pans supported by frame members located under all sections except duct openings.
 - .2 Inner panels: G90 galvanized sheet steel, except for cooling coil modules which are to be complete with type 304 stainless steel panels.
 - .3 Outer panels: G60 galvanized steel, each phosphatized and finished with baked equipment enamel which meets or exceeds a 600 hour salt spray resistance test in accordance with ASTM 117.
 - .4 Roof panel system: cross-broken roof cap panels designed to divert water from the top of the air handler, complete with 50 mm (2") standing seams covered with splice cap channels, and a full perimeter drip shield.

- .5 Module to module assembly: overlapping, full perimeter, insulated, internal splice joints sealed with bulb gaskets on both mating modules.
- .6 Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless-steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.
- .7 Cooling coil module drain pans: stainless steel drain pans, each constructed with a cross-break and a double slope pitch to the extended 32 mm (1¼") diameter drain connection located with a centreline a minimum of 75 mm (3") above the base rail, and complete with 50 mm (2") of insulation meeting flame spread and smoke developed ratings of CAN/ULC-S102.
- .8 Coil connection vestibule: a factory installed coil piping connection vestibule sized to suit the piping size and arrangement, of standard modular section construction and complete with a one-piece roof cap which covers both the coil section and the vestibule.
- .9 Roof curb kit: factory supplied loose with each air handler.
 - .1 A prefabricated heavy gauge galvanized steel, mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of 400mm (16") high and include a nominal 2" x 4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb.
- .3 Outdoor Air Section: Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be parallel blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 1.5 cfm / square foot of damper area at 1" differential pressure in according with testing defined in AMCA 500. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for "free" cooling. If outdoor air is suitable for "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system.
- .4 Energy Recovery

- .1 Where indicated on drawing schedule, units shall be provided with an AHRI certified rotary wheel air-to-air heat exchanger in a cassette frame complete with seals, drive motor and drive belt. The energy recovery wheel shall be an integral part of the rooftop unit with unitary construction, power supply and controls and does not require field assembly. Bolt-on energy recovery units that require field assembly and section to section gasketing and sealing are not acceptable. The energy recovery wheels supplied must meet the scheduled capacity, and air pressure drop. The wheel capacity, air pressure drop and effectiveness shall be AHRI certified per AHRI Standard 1060. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Heat Exchangers For Energy Recovery Ventilation equipment. The rooftop unit shall be designed with a track so the entire energy recovery wheel cassette can slide out from the rooftop unit to facilitate cleaning. The unit shall have 2" Merv 8 filters for the outdoor air before the wheel to help keep the wheel clean and reduce maintenance. A dirty filter switch and alarm shall be provided on the Energy wheel filter rack. The total energy recovery wheel shall have an aluminum substrate and a 3 angstrom desiccant and shall have an adjustable purge for field balancing. The rooftop unit with the energy recovery wheel shall incorporate the economizer operation. Units with economizers and energy recovery wheels shall have a bypass damper. When the unit is in the economizer mode of operation the energy recovery wheel shall stop and the bypass dampers shall be opened. The outdoor air shall be drawn through the bypass dampers to reduce the pressure drop of the outdoor airstream.
- .2 The rooftop unit shall be provided with an AHRI certified rotary wheel air-to-air heat exchanger in a cassette frame complete with seals, drive motor and drive belt. The energy recovery wheel shall be an integral part of the rooftop unit with unitary construction and does not require field assembly. Bolt-on energy recovery units that require field assembly and section to section gasketing and sealing are not acceptable.
- .3 The wheel capacity, air pressure drop and effectiveness shall be AHRI certified per AHRI Standard 1060. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Heat Exchangers For Energy Recovery Ventilation Equipment.
- .4 The rooftop unit shall be designed with a track so the entire energy recovery wheel cassette can slide out from the rooftop unit to facilitate cleaning
- .5 The unit shall have 2" Merv 8 filters for the outdoor air before the wheel to help keep the wheel clean and reduce maintenance. Filter access shall be by a hinged access door with ¼ turn latches.
- .6 The matrix design shall have channels to reduce cross contamination between the outdoor air and the exhaust air. The layers shall be effectively captured in aluminum and stainless-steel segment frames that provide a rigid and self-supporting matrix. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belt(s) of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.
- .7 The total energy recovery wheel shall be coated with silica gel desiccant permanently bonded without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.

- .8 Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning.
 - .9 Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel. Wheels shall be connected to the shaft by means of taper lock hubs.
 - .10 The exhaust air fan shall be a direct drive SWSI plenum fan. The exhaust fan shall be sized for the airflow requirements per the construction schedule. The unit controller shall control the exhaust fan to maintain building pressure. A VFD shall be provided for the exhaust fan motor, or the exhaust fan motor shall be an ECM motor. The rooftop unit shall have single point electrical power connection and shall be ETL listed
 - .11 The control of the energy recovery wheel shall be an integral part of the rooftop unit's DDC controller. The DDC controller shall have visibility of the outdoor air temperature, leaving wheel temperature, return air temperature, and exhaust air temperature. These temperatures shall be displayed at the rooftop units DDC controller LCD display. All of these temperatures shall be made available through the BACnet interface.
 - .12 The rooftop unit with the energy recovery wheel shall incorporate the economizer operation. The energy recovery wheel shall have a bypass damper. When the unit is in the economizer mode of operation the energy recovery wheel shall stop and the bypass dampers shall be opened. The outdoor air shall be drawn through the bypass dampers to reduce the pressure drop of the outdoor airstream.
 - .13 The rooftop unit (DDC controller shall provide frost control for the energy recovery wheel. When a frost condition is encountered the unit controller shall stop the wheel. When in the frost control mode the wheel shall be jogged periodically and not be allowed to stay in the stationary position.
- .5 Exhaust Fans:
- .1 Exhaust fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The exhaust fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.
 - .2 The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.
 - .3 The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The field shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor.
- .6 Direct Expansion Coils:
- .1 The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.

- .2 The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.
- .3 The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.
- .4 The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.
- .5 The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.
- .7 Filter Framing and Racks: Rigid, reinforced galvanized steel frame and side load rack assembly constructed to suit the number, type and size of individual filters comprising the filter bank, complete with top and bottom channels for sliding filters in and out, galvanized steel blank-off sheets to prevent air bypass, and galvanized steel wire grid members to prevent loaded filters from being sucked out of the filter rack.
- .8 Filters: Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2" prefilter and a 4" final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2" MERV 8 and 4" MERV 14 filters.
- .9 Variable Air Volume Control:
 - .1 The unit controller shall proportional control the ECM motors on the supply fan based on space temperature. The unit controller shall increase/decrease the speed of the supply fan in order to maintain the space temperature within its setpoint and dead band. The unit controller shall provide discharge air temperature control with the compressor modulation.
 - .2 The unit manufacturer shall install all power and control wiring.
 - .3 The supply air fan drive output shall be controlled by the factory installed main unit control system and drive status and operating speed shall be monitored and displayed at the main unit control panel.
- .10 Heating Section: The rooftop unit shall include a natural gas heating section. The gas furnace design shall be one natural gas fired heating module factory installed downstream of the supply air fan in the heat section. The heating module shall be a tubular design with in-shot gas burners.
 - .1 Each module shall have two stages of heating control.
 - .2 The module shall be complete with furnace controller and control valve capable of 10:1 modulating operation.
 - .3 The heat exchanger tubes shall be constructed of stainless steel.
 - .4 The module shall have an induced draft fan that will maintain a negative pressure in the heat exchanger tubes for the removal of the flue gases.

- .5 Each burner module shall have two flame roll-out safety protection switches and a high temperature limit switch that will shut the gas valve off upon detection of improper burner manifold operation. The induced draft fan shall have an airflow safety switch that will prevent the heating module from turning on in the event of no airflow in the flue chamber.
- .6 The factory installed DDC unit control system shall control the gas heat module. Field installed heating modules shall require a field ETL certification. The manufacturer's rooftop unit ETL certification shall cover the complete unit including the gas heating modules.
- .11 UV Lights: Unit shall be provided with UV light to support drain pan cleanliness. Access location to the UV light section shall be provided with safety shutoff switch to disable UV light upon access. A viewport shall be provided to confirm UV light operation visually.
- .12 Heat Pump Heating: The evaporator coil, condenser coil, compressors and refrigerant circuit shall be designed for heat pump operation.
 - .1 The refrigerant circuit shall contain a 4-way reversing valve for the heat pump operation. The outdoor coil shall have an electronic expansion valve to control the refrigerant flow. The unit controller shall modulate the expansion valve to maintain compressor operation within the compressor operational envelope.
 - .2 The refrigerant system shall have a pump-down cycle.
 - .3 The unit shall have a natural gas furnace for hybrid heating. When the heat pump operation cannot maintain the discharge air temperature setpoint the natural gas furnace shall temper the airstream to the discharge air temperature setpoint.
- .13 Condensing Section:
 - .1 Outdoor coils shall have seamless copper tubes, mechanically bonded into aluminum plate-type fins. The fins shall have full drawn collars to completely cover the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.
 - .2 Outdoor air coils shall be protected from incidental contact to coil fins by a coil guard. Coil guard shall be constructed of cross wire welded steel with PVC coating.
 - .3 Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit in ambient conditions up to 125°F]. Mechanical cooling shall be provided to 0°F. Heat Pump Heating shall be provided to -10°F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.
 - .4 The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material.
 - .5 The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. [The inverter compressor shall have a separate oil pump and an oil separator for each compressor that routes oil back to the compressor instead of through the discharge line.

- .6 Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.
- .7 Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.
- .8 Each circuit shall be dehydrated and factory charged with R32 Refrigerant and oil.
- .14 Electrical:
 - .1 Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.
 - .2 A GFI receptacle shall be unit mounted that is field powered.
 - .3 A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.
- .15 Controls: Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.
 - .1 The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.
 - .2 The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.
 - .3 All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.

- .4 The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to ensure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.
- .5 The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:
 - .1 Return air temperature
 - .2 Discharge air temperature
 - .3 Outdoor air temperature
 - .4 Space air temperature
 - .5 Outdoor enthalpy, high/low
 - .6 Compressor suction temperature and pressure
 - .7 Compressor head pressure and temperature
 - .8 Expansion valve position
 - .9 Condenser fan speed
 - .10 Inverter compressor speed
 - .11 Dirty filter indication
 - .12 Airflow verification
 - .13 Cooling status
 - .14 Control temperature (Changeover).
 - .15 VAV box output status
 - .16 Cooling status/capacity
 - .17 Unit status
 - .18 All time schedules
 - .19 All time schedules
 - .20 Previous alarms with time and date
 - .21 Optimal start
 - .22 Supply fan and exhaust fan speed

- .23 System operating hours
- .6 The user interaction with the keypad shall provide the following:
 - .1 Controls mode
 - .2 Cooling and heating change-over temperature with deadband
 - .3 Cooling discharge air temperature (DAT)
 - .4 Supply reset options
 - .5 Temperature alarm limits
 - .6 Lockout control for compressors
 - .7 Compressor interstage timers
 - .8 Night setback and setup space temperature
 - .9 Building static pressure
 - .10 Economizer changeover
 - .11 Currently time and date
 - .12 Tenant override time
 - .13 Occupied/unoccupied time schedule
 - .14 One event schedule
 - .15 Holiday dates and duration
 - .16 Adjustable set points
 - .17 Service mode
- .7 If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include:
 - .1 Zone sensor with tenant override switch
 - .2 Zone sensor with tenant override switch plus heating and cooling set point adjustment. (Space Comfort Control systems only)
- .8 To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:
 - .1 Airflow
 - .2 Outside air temperature
 - .3 Space temperature

- .4 Return air temperature
- .5 External signal of 1-5 vdc
- .6 External signal of 0-20 mA
- .7 Network signal
- .9 Units shall contain eight programmable input/output control ports to be controlled using the connected building automation system. These ports shall be input/output capable of utilizing the following signal types:
 - .1 mA signal (0-20 mA – Adjustable)
 - .2 VDC (0-10 VDC – Adjustable)
 - .3 10k Thermistor
 - .4 Digital on/off

3 EXECUTION

3.1 INSTALLATION

- .1 Installation Of Outdoor Modular Air Handling Units:
 - .1 Provide outdoor modular air handling units on the roof where shown.
 - .2 Provide all required rigging and hoisting/moving equipment required to move the units to the required locations. Do all rigging/hoisting/moving in accordance with the unit manufacturer's directions and details.
 - .3 Site assemble units shipped in sections in strict accordance with the unit manufacturer's instructions.
 - .4 Locate curbs on the roof where required for installation and flashing into roof construction as part of the roofing work of Division 07. Secure the air handling units in place, level, and plumb, on continuous gasketing material.
 - .5 Remove fan base hold-down clamps and all other shipping restraints and protective packaging.
 - .6 Provide seismic control and restrain for the units in accordance with the drawings and the mechanical work Section entitled Seismic Control and Restraint.
 - .7 Carefully coordinate the installation of each unit with all other trades making connections to the unit, in particular, control connections.
 - .8 Equipment and System Start-Up: Refer to requirements of the article entitled Equipment and System Start-Up in the Mechanical Work General Instructions Section.
 - .9 Manufacturer's Certification: Refer to requirements of the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.
 - .10 Commissioning: Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.

- .11 Demonstration and Training: Refer to the article entitled Equipment and System O & M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 4 hours of on-site operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

- .1 Section includes: Provide a complete building automation system expansion as further described in this Section including but not limited to the following:
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 23 33 00 – Duct System Dampers and Accessories

1.3 REFERENCES

- .1 Abbreviations used in this Specification are as follows:
 - .1 AI: analog input
 - .2 AO: analog output
 - .3 BAS: building automation system
 - .4 CPU: central processing unit
 - .5 DDC: direct digital controls
 - .6 DC: digital controller
 - .7 DI : digital input
 - .8 DO: digital output
 - .9 EEPROM: electronically erasable programmable read only memory
 - .10 Ethernet: a family of computer networking technologies commonly used in LAN's
 - .11 I/O: input/output
 - .12 LAN: local area network
 - .13 LCD: liquid crystal display
 - .14 LED: light Emitting diode
 - .15 OWS: operator's workstation
 - .16 PC: personal computer
 - .17 RAM: random access memory
 - .18 TCP/IP: transmission control panel/internet protocol
 - .19 WAN: wide area network

- .2 Definitions used in this Specification are as follows:
 - .1 Analog: a continuously variable system or value having discrete levels, and typically exists within a defined range of limiting values
 - .2 Binary: a 2-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level
 - .3 Direct Digital Control: the digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-looped control for the designated equipment and controlled variables
 - .4 BAS Network: the total digital on-line real-time interconnected configuration of BAS digital processing units, workstation(s), panels, sub-panels, controllers, devices, and associated elements individually known as network nodes, which may exist as one or more fully interfaced and integrated sub-networks, LAN, AN, or the like
 - .5 Node: a/ digitally programmable entity existing on the BAS network
 - .6 Protocol: a defined set of rules and standards governing the on-line exchange of data between BAS network nodes
- .3 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI):
 - .1 ANSI/ASHRAE Standard 135 – BACnet A Data Communications Protocol for Building Automation and Control Network
 - .2 ANSI/UL 2017 – Standard for General-Purpose Signaling Devices and Systems
 - .3 ANSI/UL 2034 – Standard for Single and Multiple Station Carbon Monoxide Alarms
 - .4 ANSI/UL 2075 – Standard for Gas and Vapor Detectors and Sensors
 - .5 ANSI/ASHRAE Standard 135 – Data Communication protocol for Building Automation and Control Systems
 - .6 ANSI/AMCA Standard 610 – Laboratory Methods of Testing Airflow Measurement Stations for Performance rating
 - .2 Canadian Standards Association (CSA):
 - .1 CAN/CSA C22.2 No. 24 – Temperature-Indicating and Regulating Equipment
 - .2 CSA C22.2 No. 24 – Temperature-Indicating and Regulating Equipment
 - .3 Underwriters Laboratories (UL):
 - .1 UL 916 – Standard for Energy Management Equipment

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.

- .2 Shop Drawings/Product Data: Submit shop drawings/product data sheets for all BAS components. As a minimum, submit the following:
 - .1 BAS network architecture diagrams, including all nodes and interconnections
 - .2 systems schematics, sequences, and flow diagrams
 - .3 points schedule for each point in the BAS, including point type, object name, expanded ID, display units, controller type, and address
 - .4 samples of graphic display screen types and associated menus
 - .5 a detailed Bill of Materials for each system or application, identifying quantities, part numbers, descriptions, and optional features
 - .6 control damper schedules including a separate line for each damper and a column for each of the damper attributes including code number, fail position, damper type, damper operator, duct size, damper size, mounting and actuator type
 - .7 control valve schedules including a separate line for each valve and a column for valves as for control dampers
 - .8 a room schedule including a separate line for each HVAC terminal unit indicating type, location and address
 - .9 details of all BAS interfaces and connections to other systems
 - .10 product data sheets or marked catalogue pages including part number, photograph and description for all BAS hardware and software
- .3 Manufacturer Reports:
 - .1 Site Inspection and Start-Up Report: Submit a site inspection and start-up report from the manufacturer's representative as specified in Part 3 of this Section.

1.5 CLOSEOUT SUBMITTALS

- .1 Submittals under this Section shall be in conformance with Section 01 77 00 and the Mechanical Work General Instructions Section.
- .2 Record "As-Built" drawings are to include:
 - .1 A schematic outline of the BAS for quick reference of the overall system scope.
 - .2 An adequate record of the work as installed, including the locations and routing of system wiring.
- .3 The Operation and Maintenance Manual is to contain:
 - .1 A hardware specification manual which gives a functional description of all hardware components.
 - .2 An operator's manual which outlines concise instructions for operation of the system and an explanation and recovery route for all system alarms.
 - .3 An engineering manual which outlines and defines system set-up, definition and application.
 - .4 A data manual which indicates the applications data programmed into the system.

- .5 System software documentation.

1.6 QUALITY ASSURANCE

- .1 All BAS components and associated enclosures and hardware must be suitable in all respects for the installation location and application.
- .2 The BAS hardware and software is to be installed by experienced personnel employed and trained by the system equipment manufacturer/supplier. All system wiring is to be installed by journeyman electricians or under direct on-site supervision of journeyman electricians.
- .3 The BAS supplier/installer is to have a branch facility with parts within a 100 km radius of the building and have available complete maintenance and support services on a 24 hour, 7 day-a-week basis.
- .4 All network controllers are to include a lifetime license for free software upgrades.
- .5 Codes and Standards: BAS work is to be in accordance with requirements of all applicable Codes and Standards.

2 PRODUCTS

2.1 OWNER FURNISHED PRODUCTS

- .1 Existing products:
 - .1 Automated Logic BAS.

2.2 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Johnson Controls Inc.
 - .2 Siemens Building Technologies Inc.
 - .3 Honeywell International Inc.
 - .4 Convergent Technologies
 - .5 Delta Controls Inc.
- .2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.
- .3 Substitution Limitations:
 - .1 No further substitutions will be permitted.
- .4 Single source responsibility: Obtain each type of sensor, valve, and control actuator from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.3 DESCRIPTION

- .1 The building automation system is to consist of a seamless extension of the existing modular, BACnet protocol, open architecture system incorporating direct digital control and monitoring of equipment and systems and consisting of all hardware and software required for the complete system.
- .2 The new system shall be connected to DCDSB's Central Building Automation System Server complete with vendor software and graphics, PCUs (Primary Control Units), PACs (Programmable Application Controllers), ASCs (Application Specific Controllers) and any required communications or interface components networked together to provide a system of connected controllers that operate as a single BAS for the entire project.
- .3 Communications with the BAS Central Server will be provided via DCDSB WAN. IP drop and appropriate IP address shall be provided by DCDSB IT Department.
- .4 The BAS is to be field expandable, with an architectural design to eliminate dependence upon any single device for alarm reporting and control execution. Failure of any single component or network connection is not to interrupt the execution of control strategies at other operational devices.
- .5 The BAS is to maintain all settings and overrides through a system re-boot, and is to incorporate, as a minimum, the following integrated features, functions and services:
 - .1 operator information, alarm management, and control features
 - .2 enterprise-level information and control access
 - .3 information management including monitoring, transmission, archiving, retrieval, and reporting functions
 - .4 diagnostic monitoring and reporting of BAS functions
 - .5 off-site monitoring and management access
 - .6 energy management
 - .7 standard applications for terminal HVAC systems
 - .8 fault detection and diagnostics software
 - .9 The BAS is to include, but not be limited to, the following:
 - .1 a personal computer based operator work station with colour monitor for colour graphic displays, and a colour printer
 - .2 standalone network automation engine(s)
 - .3 field equipment controllers
 - .4 input/output modules
 - .5 local display devices
 - .6 distributed user interfaces
 - .7 network processing, data storage and communication equipment
 - .8 all other components required for a complete and operating BAS

2.4 MATERIALS

.1 General RE: Building Automation System:

- .1 Control System Components: Control system components (field devices) other than those specified in this Section are generally specified in the mechanical work Section entitled Automatic Control Systems. Components factory installed with equipment or supplied with equipment are specified in mechanical work Sections with the equipment.

.2 BAS Architecture:

- .1 Automation Network: The BAS is to be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards are to be standard "off-the-shelf" products available through normal PC vendor channels. The BAS is to be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication. The BAS is to be compatible with other enterprise-wide networks, and where indicated, the BAS is to be connected to the enterprise network and share resources with it by way of standard networking devices and practices.
- .2 Control Network: Network automation engines are to provide supervisory control over the control network and are to support the BACnet Standard MS/TP bus communication protocol (ASHRAE SSPC-135, Clause 9). The control networks are to provide either a "peer-to-peer", master-slave, or supervised token passing communications and are to operate at a minimum communication speed of 9600 baud. DDC controllers are to reside on the control network.
- .3 Integration: The BAS is to include appropriate hardware and software to allow BACnet bi-directional data communications between the BAS and building equipment/system control panels. The BAS is to receive, react to, and return information from the equipment and systems. All data required by the application is to be mapped into the automation engine's data base and is to be transparent to the operator. Point inputs and outputs from building equipment/system control panels is to have real-time inter-operability with BAS software features such as control software, energy management, custom process programming, alarm management, historical data and trend analysis, totalization, and local area network communications.

.3 Control Dampers And Operators:

- .1 Dampers: Flanged, 100 mm (4') deep, AMCA low leakage certified aluminium dampers, parallel blade type for modulating and mixing applications, opposed blade type for open-shut service, and additional requirements as follows:
 - .1 Maximum blade length is to be 1 m (4'), and dampers greater than 2 sections wide are to be complete with a jackshaft.
 - .2 Extruded 6063T5 aluminum frame and airfoil blades, each with an integral slot to receive a gasket.
 - .3 Extruded TPE frame gaskets and extruded EPDM blade gaskets.
 - .4 Slip-proof aluminium and corrosion resistant plated steel linkage of a metal thickness to prevent warping or bending during damper operation, concealed in the frame, equipped with seal-sealing and self-lubricating bearings consisting of a Celcon inner bearing fixed on the hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in the frame.
 - .5 For cold service dampers such as fresh air intakes and exhaust air applications, above but with all 4 sides of the frame insulated with polystyrene, and the blades thermally broken and insulated with expanded polyurethane foam.

- .2 Electronic Damper Operators: Damper shaft mounted, spring return, fail safe in the normally open or normally closed position, sized to control the damper against maximum pressure or dynamic closing pressure, whichever is greater, to suit the sizes of dampers involved, and to provide sufficient force to maintain the damper rated leakage characteristics. Each operator is to be complete with:
 - .1 A damper position indicator.
 - .2 External adjustable stops to limit the length of stroke in either direction.
 - .3 A corrosion resistant adjustable mounting bracket.
 - .4 Operating arms with double yoke linkages and double set screws for fastening to the damper shaft.
 - .5 Double insulated construction requiring no ground connection.
 - .6 Factory installed colour coded and numbered wiring leads for site connection.
 - .7 Reversible mounting for either clockwise or counter-clockwise operation.
 - .8 Capable of being mechanically or electrically paralleled where required.
 - .9 Overload protected DC motor, microprocessor controlled brushless type for modulating control, brush type for on-off control.
 - .10 For operators for dampers to be connected to the building fire alarm system or to freeze protection devices, additional relays to permit the dampers to respond and go to the required position in less than 15 seconds upon receipt of a signal.
 - .11 Enclosures suitable in all respects for the environment in which they are located.
- .4 Sensors And Transmitters:
 - .1 Sensors and transmitters must be suitable in all respects for the application and mounting location. Devices are to be as follows:
 - .2 General Re: Temperature Sensors: Resistance type, either two-wire 1000 ohm nickel RTD or two-wire 1000 ohm platinum RTD, equipped with type 316 stainless steel thermowells with CRN for pipe mounting applications, and with accuracy values (includes errors associated with the sensor, lead wire, and A to D conversion), as follows:
 - .1 Room temperature, and duct temperature points, $\pm 1^{\circ} \text{C}$ ($\pm 0.5^{\circ} \text{F}$).
 - .2 All other points, $\pm 0.75^{\circ} \text{C}$ ($\pm 1.3^{\circ} \text{F}$).
 - .3 Room Temperature Sensors: Constructed for surface or recessed wall box mounting, 24 volt, and complete with the following capabilities
 - .1 An integral LCD display and either a set-point adjustment dial or set-point adjustment pushbuttons.
 - .2 Display of room temperature.
 - .3 Display and adjust room comfort set-point
 - .4 Display and adjust fan operation status via push button.

- .5 Override request via Occupancy Override pushbutton with LED status for activation of after-hours operation.
- .6 Toggle pushbutton for either °F or °C temperature indication.
- .7 Toggle pushbutton for % RH temporary display.
- .8 Provide a heavy-duty metal guard for all sensors or thermostats mounted in public areas such as stairways, vestibules, lobbies, gymnasiums and pools. On the approval of the Engineer, provide a flush-mounted stainless steel sensor in lieu of guard or cage.
- .4 Outside Air Sensors: Designed and constructed for ambient temperatures and to withstand the environmental conditions to which they are exposed, complete with:
 - .1 A NEMA/EEMAC 3R enclosure, and a solar shield.
 - .2 A perforated plate surrounding the sensor element where exposed to wind velocity pressure.
 - .3 A mounting bracket and hardware to suit the mounting location.
 - .4 For relative humidity, 0 to 100% full range accurate measurement.
- .5 Duct/Plenum Mounting Sensors: Insertion type with lock nut and mounting plate, designed to mount in an electrical box (weather-proof with gasket and cover where outside) through a hole in the duct/plenum, and easily accessible for repair or replacement.
- .6 Duct/Plenum Averaging Sensors: For ducts greater than 1.2 m (4') or for ducts where air temperature stratification occurs, averaging type sensors with multiple sensing points, and for plenums for applications such as mixed air temperature measurement to account for air turbulence and/or stratification, a continuous averaging sensor or a string of sensors with a minimum of 4 sensing points per 3.65 m (12'), and capillary supports on the sides of the duct/plenum.
- .7 Humidity Sensors: Solid-state relative humidity sensors of the Thin Film Capacitance or Bulk Polymer Design with factory pre-calibrated transmitters, and:
 - .1 Non-interactive span and zero adjustments, and a two-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
 - .2 A factory calibrated humidity transmitter which is accurate (including lead loss and analog to digital conversion) to 3% between 20 to 80% RH at 25° C (77° F) .
 - .3 An element that resists contamination.
 - .4 For outside air humidity sensors, a rain-proof perforated cover with transmitter installed in a weather-proof NEMA/EEMAC 3R or 4 enclosure with sealed fittings.
 - .5 For duct mounting applications, a type 304 stainless steel sensing probe with neoprene grommet, bushings, mounting bracket and hardware.
- .8 Carbon Dioxide Sensors: Carbon dioxide sensors for air quality control purposes are to be FCC compliant to CFR47, Part 15, subpart B, Clause A, and are to monitor zones and transmit information back to the appropriate controller via jumper selectable 0 to 20 mA, 4 to 20 mA, and 0 to 10 VDC output signals, with a maximum output current of 25 mA and a maximum output voltage of 12.5 V. Additional sensor features are as follows:
 - .1 A CO2 response time (0 to 63%) of 1 minute.

- .2 Less than 0.083% of full scale//F° temperature dependence of CO2 output.
- .3 Measurement accuracy of ± 40 ppm plus 2.0% of reading.
- .4 Long term CO2 stability of full scale for a minimum of 5 years.
- .5 CO2 non-linearity of less than 1.0% of full scale.
- .6 A relay output module.
- .7 An LCD display module.
- .8 An analog temperature module with linear 0 to 10 VDC output suitable for operating conditions of from 0 to 50° C (32 to 122 ° F).
- .9 A calibration kit (to be handed to Owner).
- .9 General Re: Differential Pressure Transmitters: Requirements for differential pressure transmitters are as follows:
 - .1 Transmitters are to be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input.
 - .2 Transmitters are to transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
 - .3 Transmitters used for flow measurement are to be sized to the flow sensing device and supplied with a tee fitting and shut-off valves in the high and low sensing pick-up lines to allow permanent ease of use connection for testing, adjusting and balancing.
 - .4 Transmitter housings are to be suitable in all respects for the mounting location, and where possible, transmitters are to be located in local control panels.
 - .5 Transmitters are to be as follows:
 - .1 Low Differential Water Pressure Transmitters, 0 to 5 kPa (0 to 20" wc): Industrial quality transmitter capable of transmitting a linear 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points, each complete with non-interactive zero and span adjustments that are adjustable from outside the cover, and performance as follows:
 - .1 Maintain accuracy up to 20 to 1 ratio turndown.
 - .2 Reference accuracy of +0.2% of full scale.
 - .2 Building Differential Air Pressure Transmitters: Industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments that are adjustable from outside the cover, and performance as follows:
 - .1 Maintain accuracy up to 20 to 1 ratio turndown.
 - .2 Reference accuracy of +0.2% of full span.

- .3 Low Differential Air Pressure Transmitters, 0 to 1.25 kPa (0" to 5" wc): equal to Industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments that are adjustable from outside the cover, and performance as follows:
 - .1 Maintain accuracy up to 20 to 1 ratio turndown.
 - .2 Reference accuracy of +0.2% of full span.
- .5 Power Monitoring Devices:
 - .1 Current measurement in amperes is to be by means of a combination current transformer and a current transducer.
 - .2 Current Transformer: The transformer is to be a cULus listed and labelled, split core, 50 to 400 Hz, 0.6 Kv Class 10 Kv BIL insulated, 5 ampere secondary transformer to monitor motor amperes with current ratio as appropriate for the system, sized to reduce the full amperage of the monitored circuit to a maximum 5 ampere signal which will be converted to a 4-20 mA DDC compatible signal.
 - .3 Current Transducer: Current to voltage or current to mA type in accordance with UL 1244, powered by a 24 VDC regulated power supply (24 VDC + 5%), and with characteristics as follows:
 - .1 Accurate to 0.5% Ripple +1%.
 - .2 Minimum load resistance 30 kOhm.
 - .3 Input 0 to 20 amperes, output 4 to 20 mA.
- .6 Status And Safety Switches
 - .1 Designed and constructed to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. each equipped with 2 sets of contacts for site interlock wiring for equipment shutdown. Switches are to be as follows:
 - .1 Current sensing switches: for run status for motor loads, each consisting of a current transformer, a solid-state current sensing circuit, adjustable trip point, solid-state switch, SPST relay, and a LED to indicate on-off status, capable of accepting overcurrent up to twice its trip point range, and calibrated to show a positive run status when a motor is operating under load and a negative status when a broken drive belt or drive coupling condition occurs.
 - .2 Air filter status switches: automatic reset type with SPST contacts rated for 2 amperes at 120 VAC, each with the appropriate scale range and differential adjustment for the intended service, and supplied with a complete installation kit including static pressure taps, tubing, fittings, and air filters.
 - .3 Air flow switches: differential pressure flow switches, bellows actuated mercury switch type or snap acting micro-switches, each with the appropriate scale range and differential adjustment for the application.
 - .4 Air pressure safety switches: manual reset type with SPST contacts rated for 2 amperes at 120 VAC, each with the appropriate scale range and differential adjustment for the intended service.

- .5 Water flow switches: manual reset differential pressure control switches constructed and designed to suit the mounting location and application, arranged to measure pressure drop across 2 different points, each adjustable and equipped with a calibrated scale, the required capillary tubing, and installation hardware.
- .6 Low temperature limit switches: manual reset, DPST snap-acting contacts rated for 16 amperes at 120 Vac, each complete with a sensing element a minimum 4.5 m (15') in length but in any case able to be installed horizontally across the duct/plenum and reach the coldest 450 mm (18") area of the installation location, and, for large areas where required, multiple switches.
- .7 Control Pilot Relays:
 - .1 Modular plug-in design with retaining springs or clips, snap-mount bases, and:
 - .1 DPDT, 3PDT, or 4PDT as appropriate for the application.
 - .2 10 ampere, 120 VAC contacts.
 - .3 An integral indicator light and check button.
- .8 Lighting Control Relays:
 - .1 Latching type with integral dry type status contacts, designed and constructed such that a power outage will not result in a change-of-state and so that multiple same state commands will simply maintain the commanded state, i.e. multiple OFF command pulses will simply keep the contacts in the OFF position.
- .9 Smoke Detectors:
 - .1 Ionization type duct mounting detectors supplied as part of the electrical work, mounting as part of the control system work, and connected to the fire alarm system as part of the electrical work.
- .10 Digital To Analog Output Converter:
 - .1 24 VAC, 500 mA converter to communicate digitally with up to 8 sensor/transmitter units and control panel within a daisy-chain network to convert the digital signal from transmitters to analog outputs to permit each transmitter to produce up to 8 dedicated 4-20 mA signals to a BAS or variable frequency drive from 1 central location which can be a maximum of 600 m (2000') from the control panel.
- .11 BMS Web Based User Interface Equipment:
 - .1 User interface is to be dedicated web based by means of a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions including scheduling, history collection, and alarming is to be resident in the BAS network automation engines to facilitate greater fault tolerance and reliability.
 - .2 The Controls Contractor shall connect the DDC network to the DCDSB WAN. All work to be coordinated and approved by DCDSB Information Technology (IT) Services Manager. A network jack adjacent to the BAS network hub shall be provided by DCDSB Configure the BAS to allow seamless communication via the DCDSB WAN.
- .12 Distributed Web Based User Interface:

- .1 All features and functions of the dedicated web based user interface described above are to be available on any computer connected directly or via a wide area or virtual private network to the BAS network, which conforms to the following specifications:
 - .1 The software is to run on the Microsoft Internet Explorer (6.0 or higher) browser.
 - .2 Minimum hardware requirements are:
 - .1 512 MB RAM.
 - .2 2.0 GHz clock speed Pentium 4 microprocessor.
 - .3 80.0 GB hard drive.
 - .4 Keyboard with 83 keys minimum.
 - .5 1024 x 768 resolution display with 64K colours and 16 bit colour depth..
 - .6 Mouse or other pointing feature.
 - .7 Security cable and lock for PC case and monitor
- .13 User Interface Application Components:
 - .1 Operator Interface: An integrated browser based client application is to be used as the user operator interface program. The system is to employ an event-driven rather than a device polling methodology to dynamically capture and present new data to the user. Additional features are as follows:
 - .1 All inputs, outputs, set-points, and other parameters as defined in Part 3 of this Section, shown on the drawings, or required as part of the system software are to be displayed for operator viewing and modification from the operator interface software
 - .2 The user interface software is to provide help menus and instructions for each operation and/or application
 - .3 The system is to support customization of the user interface configuration and a home page for each operator
 - .4 The system is to support user preferences in alarm, trend, display, and applications screen presentations
 - .5 All controller software operating parameters are to be displayed for the operator to view/modify from the user interface, and these parameters are to include set-points, alarm limits, time delays, PID tuning constants, run times, point statistics, schedules, etc.
 - .6 The operator interface is to incorporate comprehensive support for functions including but not limited to the following:
 - .1 User access for selective information retrieval and control command execution.
 - .2 Monitoring and reporting.
 - .3 Alarm, non-normal, and return to normal condition annunciation.
 - .4 Selective operator override and other control actions.
 - .5 Information archiving, manipulation, formatting, display and reporting.

- .6 BAS internal performance supervision and diagnostics.
- .7 On-line access to HELP menus.
- .8 On-line access to current BAS as-built records and documentation.
- .9 Means for controlling, re-programming, and re-configuration of the BAS operation and for the manipulation of the BAS database information in compliance with applicable Codes and Regulations for individual BAS applications.
- .7 The system is to support a list of application programs configured by the users that are called up by the Tools Menu, hyperlinks within the graphic displays, and key sequences.
- .8 The operation of the control system is to be independent of the user interface, which is to be used for operator communication only.
- .2 Navigation Trees: The system is to have a minimum of five levels of nesting, and the capability of displaying multiple navigation trees to aid the operator in navigating throughout all systems and points connected, adding custom trees, defining any logical grouping of points and arranging them on a tree in any order, and nesting groups within other groups. The navigation trees are to be "dockable" to other displays such as graphics, meaning that the trees will appear as part of the display but can be detached and then minimized to the Windows task bar or closed altogether, however, a simple keystroke will reattach the navigation to the primary display of the user interface.
- .3 Alarms: Alarms are to be routed directly from network automation engines to PC's and servers, and it is to be possible for specific alarms from specific points to be routed to specific PC's and servers. The BAS is to annunciate diagnostic alarms indicating system failures and non-normal operating conditions annunciate application alarms as required by points lists and sequences, and as a minimum, permit four categories of alarm sounds customizable through user defined wav files. The alarm management segment of the user interface is to provide, as a minimum, the following alarm functions:
 - .1 Log, date, and time of alarm occurrence.
 - .2 Generate a "pop-up" window with audible alarm to inform a user that an alarm has been received.
 - .3 Permit a user with the appropriate security level to acknowledge, temporarily silence, or discard an alarm.
 - .4 Provide an audit trail on the PC hard drive for alarms by recording user acknowledgement, deletion or disabling of an alarm, the name of the user, the alarm, the action taken, and the time/date of the alarm.
 - .5 Facilitate the ability to direct alarms to an email address or alphanumeric pager, in addition to the pop-up window described above.
 - .6 Any attribute of any object in the system may be designated to report an alarm.
- .4 Reports and Summaries: Reports and summaries are to be generated and directed to the user interface displays with subsequent assignment to printers or discs. Summaries and reports are to be accessible via standard user interface functions, and selection of a single menu item, tool bar item, or tool bar button is to print any displayed report or summary. The system is to permit the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports. As a minimum the BAS is to provide the following reports and summaries:

- .1 All points in the BAS.
 - .2 All points in each BAS application.
 - .3 All points in a specific controller.
 - .4 All points in a user-defined group of points.
 - .5 All points currently in alarm.
 - .6 All points locked out.
 - .7 All BAS schedules
 - .8 All user defined and adjustable variables, schedules, interlocks, etc.
- .5 Schedules: A graphical display for time-of-day scheduling and override scheduling of building operations is to be provided, with weekly schedules for each group of equipment with a specific time use schedule, and it is to be possible to define one or more exception schedules for each schedule including reference to calendars, with monthly calendars provided to permit simplified scheduling of holidays and special days for a minimum of five years in advance, user selected with the pointing device or keyboard. Changes to schedules made from the user interface are to directly modify the network automation engine schedule database. Selection of a single menu item or tool bar button is to print any displayed schedule. As a minimum the following functions are to be provided:
- .1 Weekly schedules.
 - .2 Exception schedules.
 - .3 Monthly calendars.
- .6 Passwords: The BAS Is to be complete with multiple-level password access protection to permit the user/manager to user interface control and display, database manipulation capabilities deemed appropriate for each user, based on an assigned password. Password access protection features are to include:
- .1 Each user is to have a user name (24 characters minimum), a password (12 characters minimum), and access levels.
 - .2 Each user may change his or her password at any time.
 - .3 When editing or entering passwords the system is not to echo the actual characters for display on the monitor.
 - .4 A minimum of one hundred unique password is to be supported.
 - .5 Operators are to be able to perform only those commands available for their respective passwords, and display of menu selections is to be limited to only those items defined for the access level assigned to the password of each user.
 - .6 The BAS is to automatically generate a report of log-on/log-off and system activity for each user, and any action that results in a change in the operation or configuration of the control system is to be recorded, including the acknowledgement and deletion of alarms.
 - .7 A minimum of five levels of access is to be supported individually or in any combination of the following:

- .1 Level 1 – view data
 - .2 Level 2 – command
 - .3 Level 3 – operator overrides
 - .4 Level 4 – database modification
 - .5 Level 5 – database configuration
 - .6 Level 6 – all privileges including password add/modify
- .7 Screen Manager: The user interface is to be equipped with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of four active display windows plus a network of user defined navigation trees.
- .8 Dynamic Colour Graphics: The graphics application program is to be an integral part of the user interface and is to include a create/edit function and a runtime function, and the system architecture is to support an unlimited number of graphic documents (graphic definition files) to be generated and executed. The graphics are to be capable of displaying and providing animation based on real-time data that is acquired, derived, or entered. Additional features include the following:
- .1 Graphics runtime functions: a maximum of sixteen graphic applications are to be able to be executed at any one time on a user interface or workstation with four visible to the user, and each graphic application is to be capable of the following functions:
 - .1 All graphics are to be fully scalable.
 - .2 Graphics are to support a maintained aspect ratio.
 - .3 Multiple fonts are to be supported.
 - .4 A unique background is to be assigned on a per graphic basis.
 - .5 The colour of all animations and values on displays is to indicate the status of the object attribute.
 - .2 Operation from graphics: it is to be possible to change values (set-points) and states in the system controlled equipment by using drop-down windows accessible via the pointing device.
 - .3 Graphic editing tool: a graphic editing tool is to be provided to permit the creation and editing of graphic files, and the graphic editor is to be capable of performing/defining all animations, defining all runtime binding, and:
 - .1 In general, facilitate the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.
 - .2 Be capable of adding additional content to any graphic by importing backgrounds in the SVG, BMP, or JPG file formats.
 - .4 Aliasing: many graphic displays representing part of the building and various building components are exact duplicates, with the exception that the various variables are bound to different field values, consequently, it is to be possible to bind the value of a graphic display to aliases, as opposed to physical field tags.

- .9 Historical Trending and Data Collection: Trend and change of value data is to be stored within the automation engines and uploaded to a dedicated trend database or exported in a selectable data format via a data export utility. Uploads to a dedicated database are to occur based on one of user-defined interval, manual command, or when the trend buffers are full. Exports are to be as requested by the user or on a time scheduled basis. The system is to be equipped with a configurable data storage sub-system for the collection of historical data which can be stored in either Microsoft Access or SQL database format. Each automation engine is to store, trend, and point history data for all analog and digital inputs and outputs as follows:
 - .1 Any point, physical or calculated, may be designated for trending, and methods of collection are to be defined time interval or a change of value.
 - .2 Each automation engine is to capable of storing multiple samples for each physical point and software variable based on available memory, including an individual sample time/date stamp, and points may be assigned to multiple history trends with different collection parameters.
- .10 Trend Data Viewing and Analysis: A trend viewing utility with access to all data points and the capability of defining trend study displays to include multiple trends is to be provided, and is to include:
 - .1 The capability of retrieving any historical database point for use in displays and reports by specifying the point name and associated trend name.
 - .2 Displays which are able to be single or stacked graphs with on-line selectable display characteristics such as ranging, colour, and plot style.
 - .3 Display magnitude (zoom capability) and units selectable by the operator at any time without reconfiguration the processing or collection of data.
 - .4 Display magnitude is to be automatically scaled to show full graphic resolution of the data being displayed.
 - .5 Trend studies are to be capable of calculating and displaying calculated variables including highest value, lowest value, and time based.
 - .6 The display is to support the user's ability to change colours, sample sizes, and types of markers.
- .11 Database Management: The BAS is to be equipped with a database manager that separates the database monitoring and management functions by supporting two separate windows. Database secure access is to be accomplished using standard SQL authentication including the ability to access data for use outside of the BAS application. Additional features are as follows:
 - .1 The database management function is to include summarized information on trend, alarm, event, and audit for backup, purge, and restore database management functions.
 - .2 The database manager is to support four tabs as follows:
 - .1 Statistics, which is to display database server information and trend, alarm (event), and audit information on the bas database.
 - .2 Maintenance, which is to be an easy method of purging records from the BAS server trend, alarm (event), and audit databases by supporting separate screens for creating a backup prior to purging, selecting the database, and allowing for the retention of a selected number of day's data.

- .3 Backup, which is to provide the means to create a database backup file and select a storage location.
- .4 Restore, which is to provide a restricted means of restoring a database by requiring the user to log into an expert mode in order to view the Restore Screen.
- .3 The status bar is to appear at the bottom of the BAS database manager tabs and is to indicate information on the current display activity with icons as follows:
 - .1 Ready
 - .2 Purging Record From Database
 - .3 Action Failed
 - .4 Refreshing Statistics
 - .5 Restoring Database
 - .6 Shrinking A Database
 - .7 Backing-Up A Database
 - .8 Resetting Internet Information Services
 - .9 Shutting Down The BAS Deice Manager
 - .10 Action Successful
- .4 The database manager monitoring functions are to be accessed through the Monitoring Settings window and are to continuously read database information once after the user has logged in.
- .5 The system is to advise the user via task bar icons and email messages when a database value has exceeded a warning or alarm limit.
- .6 The Monitoring Settings window is to have the following sections:
 - .1 General, to allow the user to set and review scan intervals and start times.
 - .2 Email, to allow the user to create and review email and telephone text messages to be delivered when a Warning or Alarm is generated.
 - .3 Warning, to allow the user to define the warning limit parameters, set the Reminder Frequency, and link the email message.
 - .4 Alarm, to allow the user to define the alarm limit parameters, set the Reminder Frequency, and link the email message.
 - .5 Database Login, to protect the system from unauthorized database manipulation by creating a Read Access and Write Access for each of the trend, alarm (event), and audit databases as well as an Expert Mode required to restore a database.
- .7 The Monitoring Settings taskbars to display the following informational icons:
 - .1 Normal, which indicates by colour and size that all databases are within their limits.

- .2 Warning, which indicates by colour and size that one or more databases have exceeded their warning limit.
 - .3 Alarm, which indicates by colour and size that one or more databases have exceeded their alarm limit.
 - .8 The BAS is to indicate via taskbar icons and email messages when a database value has exceeded a warning or alarm limit.
- .14 Network Automation Engines:
- .1 Network automation engines are to be UL/ULC listed and labelled; BACnet Testing Labs certified and labelled, fully user programmable supervisory controllers to monitor a network of a minimum of one hundred distributed application-specific controllers for a global strategy and direction and to communicate on a peer-to-peer basis with other network automation engines.
 - .2 User Interface: Each network automation engine is to have the ability to deliver a web based user interface as specified above, and all computers connected physically or virtually to the automation network are to have access to the web based user interface. Additional characteristics/requirements are as follows:
 - .1 The web based user interface software is to be imbedded in each network automation engine.
 - .2 Each network automation engine is to support a minimum of four concurrent users.
 - .3 The user is to be capable of accessing all system data through one network automation engine.
 - .4 Remote users connected to the network through an internet service provider or by telephone dial-up are also to have total system access through one network automation engine.
 - .5 Each network automation engine is to be capable of generating web based user interface graphics, and this capability is to be imbedded in the network automation engine.
 - .6 The user interface is to support the following functions using a standard version of Microsoft Internet Explorer:
 - .1 Configuration
 - .2 Commissioning
 - .3 Data archiving
 - .4 Monitoring
 - .5 Commanding
 - .6 System diagnostics
 - .7 Each network automation engine is to permit temporary use of portable devices without interrupting the normal operation of permanently connected modems.
 - .3 Processor: Each network automation engine is to be a multi-tasking, multi-user, microprocessor based real time digital control processor sized to meet requirements of the system with a minimum word size of 32 bits, and standard operating systems.

- .4 Memory: Each network automation engine is to have sufficient memory to support its own operating system, databases, and control programs to provide supervisory control for all control level devices.
- .5 Real Time Clock: Each network automation engine is to include an integrated, hardware based real time clock.
- .6 LED Indicators: Each network automation engine is to be equipped with LED indicators to identify the following conditions:
 - .1 Power, On/Off
 - .2 Ethernet Traffic, Ethernet Traffic/No Ethernet Traffic
 - .3 Ethernet Connection Speed, 10 Mbps/100 Mbps
 - .4 FC Bus A, Normal Communications/No Field Communications
 - .5 FC Bus B, Normal Communications/No Field Communications
 - .6 Peer Communication, Data Traffic Between Network Automation Engines
 - .7 Run, NAE Running/NAE in Start-up/NAE Shutting Down/Software Not Running
 - .8 Battery Fault, Battery Defective/Data Protection Battery Not Installed
 - .9 24 VAC, 24 VAC Present/Loss of 24 VAC
 - .10 Fault, General Fault
 - .11 Modem RX, NAE Modem Receiving Data
 - .12 Modem TX, NAE Modem Transmitting Data
- .7 Communications Ports: Each network automation engine is to be equipped with ports for operation of operator input/output devices such as industry standard computers, modems, and portable operator's terminals. Ports are to be as follows:
 - .1 Two USB ports.
 - .2 Two URS-232 serial data communication ports.
 - .3 Two RS-485 ports.
 - .4 One Ethernet port.
- .8 Diagnostics: Each network automation engine is to continually perform self-diagnostics, communications diagnostics, and diagnostics of all pane components, and transmit both local and remote annunciation of any detected component failure, low battery condition, and repeated failures to establish communication.
- .9 Power Failure: In the event of loss of normal power each network automation engine is to continue to operate for a user adjustable period of up to ten minutes after which there is to be an orderly shut-down of all programs to prevent the loss of database or operating system software, and:
 - .1 During a loss of normal power the control sequences are to go to the normal system shutdown conditions, and all critical configuration data is to be saved into Flash memory.

- .2 Upon restoration of normal power and after a minimum off-time delay the controller is to automatically resume full operation through a normal soft-start sequence without manual intervention.
- .15 Field Equipment Controllers:
 - .1 Each field equipment controller is to be a fully user programmable BACnet Testing Labs certified and labelled digital controller that communicates via BACnet MS/TP protocol. Each controller is to be housed in a plenum rated plastic housing with removable base to permit pre-wiring of analog and binary input/output field points without the controller in place.
 - .2 Each controller is to employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences, and are to be factory programmed with a continuous adaptive tuning algorithm that sense changes in the physical environment and continually adjusts loop tuning parameters appropriately.
 - .3 Each field equipment controller is to:
 - .1 Include troubleshooting LED's to identify the following conditions:
 - .1 Power On
 - .2 Power Off
 - .3 Download or Start-Up In Progress-Not Ready For Normal Operation
 - .4 No Faults
 - .5 Device Fault
 - .6 Field Controller Bus-Normal Data Transmission
 - .7 Field Controller Bus-No Data Transmission
 - .8 Field Controller Bus-No Communication
 - .9 Sensor Actuator Bus-Normal Data Transmission
 - .10 Sensor Actuator Bus-No Data Transmission
 - .11 Sensor Actuator Bus-No Communication
 - .2 Support universal inputs, configured to monitor any of the following:
 - .1 Analog Input, Voltage Mode
 - .2 Analog Output, Current Mode
 - .3 Analog Input, Resistive Mode
 - .4 Binary Input, Dry Contact Maintained Mode
 - .5 Binary Input, Pulse Counter Mode
 - .3 Support binary inputs configured to monitor either of the following:
 - .1 Dry Contact Maintained Mode

- .2 Pulse Counter Mode
- .4 Support analog outputs configured to output either of the following:
 - .1 Analog Output, Voltage Mode
 - .2 Analog Output, Current Mode
- .5 Support binary outputs, 24 VAC Triac.
- .6 Support configurable outputs capable of the following:
 - .1 Analog Output, Voltage Mode
 - .2 Binary Output Mode
- .7 Have the ability to reside on a master-slave/token-passing field controller bus supporting BACnet standard protocol as follows:
 - .1 Support communications, including input/output communications between the field controllers and the network automation engines.
 - .2 Support a minimum of one hundred input/output modules and field equipment controllers in any combination.
 - .3 Operate at a maximum distance of 4560 m (15,000') between the field controller and the furthest connected device.
- .8 Have the ability to monitor and control a network of sensors and actuators over a master-slave/token-passing sensor-actuator bus supporting BACnet standard protocol as follows:
 - .1 The bus is to support a minimum of ten devices per trunk.
 - .2 The bus is to operate at a maximum distance of 365 m (1200') between the field controller and the furthest connected device.
- .9 The capability of executing complex control sequences involving direct wired input/output points as well as input and output devices communicating over the field controller bus or sensor-actuator bus
- .10 Support, but not limited to, the following:
 - .1 Hot water, chilled water/central plant applications.
 - .2 Custom air handling units for special applications.
 - .3 Terminal units.
 - .4 Special programs as required for systems control.
- .11 Support a password protected local controller LCD back-lit display with six key keypad as an integral part of the field controller or as a remote device communicating over the sensor-actuator bus to permit the user to view monitored points without logging into the system, and to view and change set-points, modes of operation, and parameters
- .16 Input/Output Modules:

- .1 Input/output modules to facilitate additional inputs and outputs for use in the field equipment controllers are to be similar to the field equipment controllers but less the display and with a minimum of four and a maximum of seventeen points.
- .17 System Configuration Tools:
 - .1 System Configuration Tool: The system configuration tool is a software package supplied with the BAS to enable a computer platform to be used as a stand-alone engineering configuration tool for a network automation engine and to permit programming of field equipment controllers. The configuration tool is to provide an archive database for the configuration and application data and is to have the same look and feel at the user interface regardless of whether the configuration is being done online or offline. Additional features and characteristics are as follows:
 - .1 The tool is to include:
 - .1 Basic system navigation tree for connected networks.
 - .2 Integration of system enabled devices.
 - .3 Customized user navigation trees.
 - .4 Point naming operator parameter setting.
 - .5 Graphic diagram configuration.
 - .6 Alarm and event message routing.
 - .7 Graphical logic connector tool for custom programming.
 - .8 Downloading, uploading, and archiving databases.
 - .2 The tool is to have the capability to automatically discover field devices on connected buses and networks.
 - .3 The tool is to be capable of configuring from a library of standard applications, simulating to verify applications, and commissioning field equipment controllers and field devices.
 - .4 The tool is to be complete with a Bluetooth Wireless Technology wireless access point to enable a wireless enabled portable computer to make a temporary Ethernet connection to the automation network.
 - .2 Wireless MS/TP Converter: The Bluetooth Wireless Technology converter is to provide temporary wireless connection between the sensor-actuator bus or field-controller bus and a wireless enabled portable computer. The converter is to be powered through a connection to either the sensor-actuator bus or the field-controller bus and is to support downloading and troubleshooting field equipment controllers and field devices from the portable computer over the wireless connection. The converter is to be complete with LED indicators for the following conditions:
 - .1 Power: On/Off
 - .2 Fault: Fault/No Fault
 - .3 SA/FC Bus: Bus Activity/No Bus Activity
 - .4 Bluetooth: Bluetooth Communication Established/Bluetooth Communication Not Established
- .18 Wiring Materials :

- .1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in the appropriate Section(s) of the Electrical Work Division of the Specification.

3 EXECUTION

3.1 INSTALLATION

.1 General: Installation Of The BAS:

- .1 Provide a complete building automation system in accordance with requirements of this Section of the Specification, the mechanical work Section entitled Automatic Control Systems, the drawings, and the input/output points list(s).
- .2 Unless otherwise specified do all BAS work in accordance with the system manufacturer's instructions.
- .3 Remove all existing field and panel mounted control devices (e.g. transducers, controllers, thermostats, etc.) that have been made redundant or inoperative by the new BAS control strategies. Remove any other controls as specified or directed by the Engineer.
- .4 Provide properly sized cover plates for all openings resulting from the removal of redundant control devices. This shall be applicable to walls, ductwork and control panels. In occupied areas, cover plates shall be stainless steel.
- .5 The control sequences indicate only the principal items of equipment controlling the systems. Supplement each control system with relays and auxiliaries to enable each system to perform as specified and to permit proper operation and supervision of it.
- .6 Provide complete identification and labelling for new and existing devices and equipment.

.2 Direct Digital Control System Components:

- .1 Provide all required direct digital control hardware, software, accessories, and wiring for a complete BAS. Refer to drawing control diagrams and sequences, the points list(s), and the mechanical work Section entitled Automatic Control Systems.
- .2 Surface mount control units in mechanical, etc., rooms housing the equipment/systems to be controlled and monitored. Connect a maximum of two major mechanical systems to each field controller. Ensure that mounting surfaces do not vibrate.
- .3 Consult with the Owner and Consultant to ensure that all required input/output points are entered into the system.
- .4 All thermostats, room temperature sensors, and humidistats shall be installed at 1675mm above finished floor.

.3 Control Wiring:

- .1 Do all required BAS wiring from 15A-1P circuits terminated as part of the electrical work in junction boxes in equipment rooms/areas.
- .2 Except as specified below, install all wiring in conduit. Unless otherwise specified the final 600 mm (2') connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.
- .3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.

- .4 All wiring work is to be in accordance with the BAS manufacturer's certified wiring schematics and instructions, and the wiring standards specified in the electrical work Division of this Specification.
- .4 Identification and Labelling of Equipment And Circuits:
 - .1 Refer to the Basic Mechanical Materials and Methods Section.
 - .2 Identify BAS equipment as follows:
 - .1 Enclosures: engraved laminated nameplates with lettering such as BAS Panel CP2, or BAS Relays, or BAS E/P Transformers, with all wording listed and approved prior to manufacture of the nameplates.
 - .2 Panel points: a weather-proof input/output layout sheet for each controller with the name of each point connected to the controller, and the associated wire labelling information.
 - .3 Wiring: numbered sleeves or plastic rings at both ends of the conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings.
 - .4 Interface components: a weather-proof layout sheet clearly illustrating/identifying the purpose of each component within the enclosure such that an operator or service technician can quickly identify the exact use of each relay, transducer, contactor, etc., with each sheet fastened securely to the back of the enclosure door.
- .5 System Startup:
 - .1 Testing, Adjusting, Certification, Start-Up, Commissioning:
 - .1 Equipment and System Manufacturer's Certification: Refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.
 - .2 Start-Up: Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.
 - .3 Commissioning: Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.
- .6 Closeout Activities:
 - .1 Demonstrations and Training: Refer to the article entitled Equipment and System O & M Demonstration & Training in the Mechanical Work General Instructions Section. Include for demonstration and training sessions for each of 2 groups of 6 people as follows:
 - .1 3 full day orientation sessions at the system manufacturer's office to educate personnel on BAS architecture, hardware, and software, with an overview of BAS operation and capabilities including but not limited to operational programmes, equipment functions (both individually and as part of a total integrated system), BAS commands, advisories, alarms, and appropriate operator intervention required in responding to the BAS operation.
 - .2 2 full day sessions at the site using the BAS for a "hands-on" demonstration of all BAS functions and features with instruction regarding the chronological flow of information from field devices, contacts and sensors to the operator's work station, an overview of the communications network describing the interplay between initiating devices, field hardware panels, systems communications, and their importance within the operating BAS, and alarm indications and appropriate responses.

- .3 2 full day seasonal (summer-winter) site sessions to perform additional instruction regarding seasonal changes and how they affect the BAS.
- .2 Additional Training: Include for 2 follow-up site training and troubleshooting visits, 1 six months after Substantial Performance and the other at the end of the warranty period, both when arranged by the Owner and for a full day to provide additional system training as required.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

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

1.2 SUMMARY

- .1 This Section specifies requirements and instructions that are common to Electrical Division of the Specification and it is a supplement to each section and is to be read accordingly.
 - .1 Any item or subject which is shown, mentioned, or reasonably implied on either drawings or in the specifications, is considered to be properly and sufficiently specified and shown; and must be provided. Provide all material, labour, equipment, tools, consumables, etc. required to complete all the work of the Electrical Division
 - .2 These common works relate to all scope of work related within the Electrical Divisions which incorporates:
 - .1 Electrical Drawings
 - .2 Division 26 Electrical specification
 - .3 Division 27 Communications specifications
 - .4 Division 28 Electronic Safety and Security specifications
 - .3 These common works also have the following Sections which are applicable to all Sections within this Division and supplement this Section:
 - .1 26 05 02 – Firestopping and Smoke Seal Systems
 - .2 26 05 03 – Electrical Work Testing
 - .3 26 05 05 – Demolition and Revision Work
 - .4 26 05 48 – Vibration and Seismic Control for Electrical Systems
 - .5 26 05 53 – Identification for Electrical Systems
 - .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Division 02 Existing Conditions
 - .2 Division 09 Finishes
 - .3 Division 26 Electrical
 - .4 Division 27 Communications
 - .5 Division 28 Electronic Safety and Security
- 1.3 PRICE AND PAYMENT PROCEDURES**
- .1 Separate Prices:

- .1 Under Separate Prices on the Bid Form, identify in the applicable space, costs for the following work. Refer to the Instructions to Bidders and Bid Form for further pricing instructions and details and price title definitions.
 - .1 Alternate routing of washroom exhaust
 - .1 PROVIDE SEPARATE PRICE FOR ALTERNATE ROUTING OF WASHROOM EXHAUST TO HVAC-14 WITH INLINE RF-5 IN LIEU OF ROOFTOP EXHAUST FAN. SEPARATE PRICE SHALL INCLUDE OPTIONAL ERW SECTION FOR HVAC-14 AND FIELD FABRICATED SANITARY EXHAUST CONNECTION TO UNIT. REFER ALSO TO M001 AND M303.
- .2 Measurement and Payment:
 - .1 If a change to the work is requested, the Contractor to submit pricing for the change including an itemized list of the associated material and labour changes and costs. Apply mark-up as indicated in the Contract.
 - .2 A change must be approved by the Contractor before the work is to proceed. If work is performed without such approval, it is performed at the Contractor's or Sub-Contractors' risk.
 - .3 In the event of a disagreement by the Contractor over valuation of the change in work, resolution will follow the procedure outlined below:
 - .1 Labour hours are derived using the RSMeans Electrical Costing Book.
 - .2 Labour rates are as stated in the Instructions to Bidders.
 - .3 Material prices are "Trade" prices provided by a local supplier or distributor.
 - .4 Material requirements are obtained from field measurements.
 - .5 Major equipment prices are reasonably negotiated.
- .3 Progress Payment Breakdown:
 - .1 Submit, prior to submittal of the first progress payment draw, a breakdown of the cost of the electrical work to assist the Consultant in reviewing and approving monthly progress payment claims.
 - .2 The payment breakdown is subject to the Consultant's approval and progress payments will not be processed until an approved breakdown is in place. The breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning, and project closeout submittals.
 - .3 Breakdown to include the following line items as a minimum:
 - .1 Job costs (permits, bonds, mobilization, supervision, and job foreman)
 - .2 Demolition and relocation
 - .3 Distribution and service (panels, feeders, and main service)
 - .4 Mechanical equipment wiring (to include starters, motor control centres, disconnect switches, and wiring)
 - .5 Electric heating

- .6 Branch wiring (to include devices, cover plates, installation, and wiring)
- .7 Lighting (to include fixtures, poles, mounting, installation, and wiring)
- .8 Emergency lighting system (to include battery units, exit lights, remote fixtures, and wiring)
- .9 Lighting control system
- .10 Extra-low voltage pathways (to include cable tray, wireways, conduits, sleeves, ductbank, and firestopping)
- .11 Structured Cabling System (to include cabling, outlets, patch panels, racks, and telecommunication grounding)
- .12 Audio-visual system
- .13 Intercom and paging
- .14 Video surveillance system
- .15 Access control system
- .16 Intrusion alarm systems
- .17 Fire alarm system
- .18 Miscellaneous equipment, systems, and associated wiring

1.4 REFERENCES

- .1 Definitions:
 - .1 The following are definitions of words found in electrical work Sections of the Specification and on associated drawings:
 - .1 "concealed" – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, walls and partitions
 - .2 "exposed" – means work normally visible, including work in electrical and equipment rooms and similar spaces
 - .3 "provide" (and tenses of provide) – means supply and install complete
 - .4 "install" (and tenses of install) – means install and connect complete
 - .5 "supply" – means supply only
 - .6 "finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished
 - .7 "governing authority" and/or "regulatory authority" and/or "Municipal authority" – means all government departments, agencies, standards, rules and regulations that apply to and govern the electrical work and to which the work must adhere
 - .8 "Consultant" – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner

- .2 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is "indicated", "shown", "listed", or "noted" on the drawings.
- .3 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is "approved by", "inspected by", etc., the Consultant.
- .4 In the electrical specification, singular may be read as plural, and vice-versa.
- .2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Division. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI):
 - .1 ANSI/ASHRAE/IES 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
 - .2 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S1001 – Standard for Integrated Systems Testing

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Plan work well in advance to eliminate delivery, installation and co-ordination difficulties. Be held equally responsible with other Sections or Divisions to resolve interferences and to co-operate with other Sections to satisfactorily complete the project. Being there first will not be accepted as a legitimate reason.
- .2 Examination of site and documents:
 - .1 When estimating the cost of the work and prior to submitting a bid for the work carefully examine all the bid documents and visit the site to determine and review all existing site conditions that will or may affect the work and include for all such conditions in the bid price.
 - .2 Report to the Consultant, prior to bid submittal, any existing site condition that will or may affect performance of the work as per the drawings and specifications. Failure to do so will not be grounds for additional costs.
- .3 Drawings and Specification:
 - .1 Read the electrical work drawings in conjunction with all work drawings including but not limited to civil, landscaping, structural, architectural, sprinkler, and mechanical.
 - .2 The electrical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building is to be taken at the site. Do not scale the drawings, and do not use the drawings for prefabrication work.
 - .3 The drawings are intended to convey the scope of work and do not show architectural and structural details. Include cost for all offsets, fittings, transformations, and similar products required as a result of obstructions and other civil, architectural and structural details but not shown on the drawings.

- .4 The locations of equipment and materials shown may be altered, when reviewed by the Consultant. Include cost to meet requirements of the equipment and/or materials, other equipment or systems being installed, and of the building.
 - .5 Sections of the Electrical Division are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and the Sections are to be read as a whole.
 - .6 The electrical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.
 - .7 The electrical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.
 - .8 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the costliest arrangement will take precedence.
 - .9 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the costliest arrangement will take precedence.
- .4 Coordination:
- .1 Relation to other sections:
 - .1 Provide all cutting and patching required for the Section work by the appropriate trade at the expense of the Electrical Division, unless otherwise specified or shown. Refer to the Architectural Specifications and drawings for details of cutting and patching provisions and requirements.
 - .2 Provide all sleeves, inserts, hangers and core drilling of slabs, etc., required for completion of the Section work. Coordinate the location of inserts, sleeves, hangers, holes, back boxes, tubs, junction boxes, etc., with the respective Section into whose materials they are being installed. Extend all floor and roof sleeves 100 mm (4 in) above the finished levels, unless noted otherwise. Complete all roof sleeves with roof flashing and rain shields to ensure a weatherproof seal.
 - .3 Cut holes and install sleeves for electrical installations piercing fire, smoke, thermal, exterior, and acoustic separations to minimum sizes.
 - .1 Install firestopping and smoke seals in accordance with Section 26 05 02 – Firestopping and Smoke Seals.
 - .2 Seal all gaps on both sides of the separation by a qualified tradesman using materials and methods described in the applicable specification section, to maintain the appropriate rating, acoustic, thermal bridge, or water resistance. All costs for such will be paid for by the Electrical Division.
 - .3 If an existing penetration is not properly sealed to these standards, either provide new penetration for work and seal appropriately, or seal entire opening including existing penetrations. Where multiple Divisions are penetrating the same separation, group services and share sealing costs where appropriate.

- .4 Where access doors are required for electrical installations, supply types with self opening screwdriver lock and positive latching mechanism to the appropriate Division 09 subtrade for installation by them in the walls or ceiling. Pay all cost for installation by Division 09. Access doors are required where electrical equipment is located behind non-accessible surfaces and where access to, or servicing of the equipment is necessary. The access door size and fire rating must be approved by the Contractor. Refer to the Architectural Specifications for details of access door installation requirements. Provide installations to avoid the need for access doors where indicated.
- .5 Deliver all electrical equipment and fixtures to the site with the specified finish. Provide touch up painting of electrical equipment scratched on site. Finish painting of primed electrical equipment and all concealed or exposed conduit, boxes, etc., as required will be provided by Division 09.
- .6 Immediately wrap and seal in plastic "bubble" wrap all fixtures, equipment, and system components delivered to the site and not contained in sealed cardboard cartons. Following installation, the items will be protected from dirt, dust, and damage with similar plastic wrap or protective enclosures until energized and put into full operation.
- .7 Coordinate installation of switches, thermostats, and other devices together at one common location with installing Sections and obtain approval on site from the Contractor of exact arrangement.
- .2 Work in existing building:
 - .1 Complete all demolition and revision work in accordance with Section 26 05 05 – Demolition and Renovation Work.
 - .2 Visit the site to examine the existing conditions and make necessary allowances in bid price for demolition, removal, relocation, re-routing and reconnection of existing electrical equipment and wiring as required for the execution and completion of this project. In general, relocate existing services as required to accommodate new work and architectural changes. In areas being totally renovated, provide all remaining electrical demolition work and replace existing installations with new as shown. Remove all existing redundant installations prior to final acceptance. Include in the bid price extra charges for premium time and temporary provisions, if required, to complete the work as described and according to the schedule provided.
 - .3 Install all conduit and feeders through the existing building along routes shown on the drawings or approved on site by the Owner and Contractor. New installations will not necessarily be allowed along shortest routes but should follow routes indicated or corridors or routes of other services where possible if not shown.
 - .4 Unless noted otherwise, all existing electrical equipment and cabling which has not been removed or identified to be turned over to the Owner will become the property of the Division (for disposal or removal from the site as applicable) and have an appropriate salvage value included in the bid amount.
 - .5 Clean and paint, as appropriate, existing electrical equipment removed and indicated for re-use on this project. Refurbish or replace as required before re-installation.
 - .6 Re-routed as required wiring location in areas being altered or demolished, by re-feeding outlets or equipment required to remain in service to maintain the continuity of these services.

- .7 Coordinate sequence of removal and relocation of existing equipment and wiring with the other Sections and conform to the requirements and conditions outlined.
 - .8 Provide adequate protection to existing cabling and equipment throughout the project and particularly where cabling and electrical equipment have become exposed to mechanical injury or moisture in the course of alterations or new construction.
 - .9 In some instances, new outlets and equipment are shown in the same location as the existing outlets, these may be fed through the existing conduits provided that the conduits and cabling are in good condition and are acceptable to the Electrical Authority as reusable. All unused conduit entrance openings will be sealed.
- .3 Power Interruptions:
- .1 Keep service and distribution system power interruptions to a minimum. Coordinate power interruptions with the Owner and all other Subcontractors. Provide to the Owner written application for electrical interruptions from the Electrical Division indicating the date, time, and estimated duration of the interruption. Submit application for approval of the power interruptions to the Owners and Contractor at least two weeks prior to the requested shut-down date.
 - .2 Prior to each shutdown or interruption, again inform the Owner in writing seventy-two hours in advance of the proposed shutdown or interruption and obtain written approval to proceed. Do not shutdown or interrupt any system or service without such written approval.
 - .3 Perform work associated with shutdowns and interruptions as continuous operations to minimize the shutdown time and to reinstate the systems as soon as possible and prior to any shutdown, ensure that all materials and labour required to complete the work for which the shutdown is required are available at the site.
- .5 Planning and layout of the work, and associated drawings:
- .1 Properly plan, coordinate, and establish the locations and routing of services with all subcontractors affected prior to installation such that the services will clear each other as well as any obstructions, including structural components of the building. Unless otherwise specified, the order of right-of-way for services is to be as follows:
 - .1 piping requiring uniform pitch
 - .2 piping 100 mm (4 in) diameter and larger
 - .3 large ducts (main runs)
 - .4 electrical cable tray and bus duct
 - .5 conduit 100 mm (4 in) diameter and larger
 - .6 piping less than 100 mm (4 in) diameter
 - .7 smaller branch ductwork
 - .8 conduit less than 100 mm (4 in) diameter

- .2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install conduit, raceway, and similar services as high as possible to conserve headroom and/or ceiling space. Install cable tray used for extra-low voltage cables as low as possible where removable finished ceilings are installed. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.
- .3 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to your work.
- .4 All junction boxes, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
- .6 Permits, Fees, And Certificates:
 - .1 Apply for, obtain and pay for all permits required to complete the electrical work.
 - .2 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.
- .7 Workplace Safety:
 - .1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage, and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required and maintain one copy at the site in a visible and accessible location available to all personnel.
 - .2 Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/ insurance board and fall protection regulations.
 - .3 Asbestos, Mould, Lead Paint, PCBs, or other hazardous material: If at any time during the course of the work asbestos containing materials, black mould, lead paint, or any other such materials are encountered or suspected, immediately report the discovery to the Contractor and cease all work in the area in question. Do not resume work in affected areas until the material is properly identified as non-hazardous or the situation has been properly corrected with written approval from the Owner.

1.6 SUBMITTALS

- .1 Submittals under this Division to be in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Regulatory Communications:
 - .1 Forward to the Contractor copies of all correspondence and instructions from the Electrical Authority or any other Authority having Jurisdiction for clarification and action.
- .3 Shop Drawings/Product Data:
 - .1 Shop drawings are those prepared specifically for the Project. Product data sheets are copies of manufacturer's standard catalogue or literature.

- .2 Shop drawings and product data sheets must confirm that the product proposed meets all requirements of the Contract Documents.
- .3 Submit for review Shop Drawings and Product Data sheets, in electronic PDF format, covering all items or equipment to be installed under the Contract (faxed and generic documents are not acceptable). Shop drawings and product data sheets to show all physical properties, relevant performance, and installation information. The drawings and data required to generally be as outlined under each Section of the Specification but will not be restricted to the items listed. Distribute reviewed Shop Drawings and data sheets to other relevant Sections as required for completion of their related work.
- .4 All submitted Shop Drawings and data sheets must have been reviewed in detail by the Contractor and must bear their stamp. Should the drawings not have been reviewed and stamped, they will be rejected immediately.
- .5 Each shop drawing or product data sheet is to be properly identified with the project name and the product drawing or specification reference, for example "Lighting Fixture F1", and all shop drawing or product data sheet dimensions are to be either metric or imperial to match dimensions on the drawings.
- .6 Equipment will not be accepted on site until review of shop drawings and data sheets is complete. shop drawings or data sheets marked "Reviewed as Modified" are conditionally approved such that the Contractor to ensure equipment satisfies all Contract requirements. Delivery of equipment may proceed but final, corrected shop drawings and data sheets must be submitted prior to close of Contract.
- .7 This review is for the sole purpose of ascertaining conformance with the general design concept. This review will not mean that the reviewer approves the detail design inherent in the shop drawing, responsibility for which will remain with the Section submitting same, and such review does not relieve the Electrical Division of their responsibility for efforts or omissions in the Shop Drawings and data sheets or of their responsibility for meeting all requirements of the Contract Documents. The Electrical Division is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to the fabrication processes or to techniques of construction and installation, for all quantities indicated and for co-ordination of the work of all Sections.

1.7 CLOSEOUT SUBMITTALS

- .1 Submittals under this Section shall be in conformance with Section 01 77 00 – Closeout Procedures.
- .2 Operation and Maintenance Manuals:
 - .1 Forward to the Contractor "Maintenance and Instruction Manuals" within four (4) weeks of substantial completion of the project.
 - .2 Provide all closeout submittals in a digital format. Organize all individual electronic documents in directories similar to the tabs in a binder and filenames in plain English describing of the contents within each file. Provide all documents in unsecured PDF format with searchable text. Provide all audio and video content encoded in a format that can be viewed using standard codecs freely available on the most current version of Microsoft Windows operating system.
 - .3 Each manual will contain, but not be restricted to, the following information:
 - .1 each shop drawing (revised as per the reviewed drawings)
 - .2 each product data sheet (revised as per the reviewed drawings)

- .3 equipment parts list
- .4 recommended list of spare parts
- .5 operating and maintenance instructions
- .6 equipment installation details, construction and performance data
- .7 list of all manufacturing and equipment service depots including address, email and telephone numbers
- .8 Electrical Authority final inspection certificate
- .9 emergency lighting test results
- .10 fire alarm verification certificate and test report
- .11 fire alarm audibility report
- .12 integrated systems testing report
- .13 telecommunications cabling test results including summary and comprehensive full results
- .14 any other certificates, approval letters, etc.
- .4 Provide qualified technicians to instruct the Owner's Representatives in the operation and maintenance of the systems and equipment included in the Electrical Division.
- .3 Warranty Documents:
 - .1 Provide to the Consultant, all specified warranties, extended warranties, and free manufacturer extended warranties as applies to each individual section.
 - .2 The warranty period(s) commences on the date of Substantial Performance of the Work and shall be valid for the full duration specified.
 - .3 Submit warranties to the Consultant prior to Final Payment Certification.
- .4 Record Documents:
 - .1 As-Built Drawings:
 - .1 During the progress of the work the Electrical Division will always keep on the site, a complete and separate set of prints and will note thereon clearly, neatly, accurately and promptly all Architectural, Structural, Mechanical and Electrical changes, revisions and additions to the work and deviations from the Contract Documents.
 - .2 Include accurate locations, depth, size, content, and type of all below grade pathways in these as-built drawings.
 - .3 Indicate also on the as-built drawings the location of access panels or removable ceiling tiles which cover equipment or junction boxes which may require future access or where conduit or wiring for future use is located.
 - .4 Prepare the final as-built drawings by a qualified draftsman in AutoCAD at the contractor's expense as an electronic copy and one hard copy to be submitted to the Contractor at the completion of the project with an application for a Certificate of Total Performance.

- .5 Submit as-built drawings in electronic format. All documents will be in both AutoCAD and unsecured PDF format.
- .5 Software:
 - .1 Submit copies of all software and licences required for operation and maintenance of equipment provided. Work with owner's representative to install, set up, and configure provided software on designated workstations or servers. Install, set up, and configure provided firmware or operating systems on designated equipment.
 - .2 Provide to Owner's representative all configuration requirements prior to installation including temporary credentials with level of administration access required, operating system, list of IP addresses required with mapping to tag or unique description, firewall configurations, and any other information to successfully install software or equipment.
 - .3 Pay for any software, firmware and operating system subscription fees for the warranty period and setup online accounts in conjunction with Owner's representative.
 - .4 Provide all software, firmware, and operating system user guides, installation manuals, cybersecurity certificates, and documentation in unsecured searchable PDF format.
 - .5 Prior to warranty completion, update or upgrade all installed software to most current version compatible with equipment installed. During warranty period if any cybersecurity threats or known vulnerabilities to software are provided by the equipment manufacturer or relevant third-party software company, send immediate notification to Owner with instructions to patch or update software, firmware, or operating system.

1.8 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 All work carried out under this Contract will comply with, but not be limited to the requirements of the latest edition of the following codes and regulations:
 - .1 Ontario Electrical Safety Code complete with Bulletins and Amendments.
 - .2 Ontario Building Code complete with Supplemental Bulletins and its referenced standards.
 - .3 Applicable Standards from CSA, ULC, and from other standards organizations indicated herein.
 - .4 All applicable Federal, Provincial, Municipal and Industry standards and regulations.
 - .2 All electrical items are to be certified and bear the stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, or bear a stamp to indicate special electrical authority approval.
 - .3 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.
- .2 Qualifications:
 - .1 Installer's:
 - .1 Installer/Applicator/Erector to have a minimum of 5 years' continuous Canadian experience successfully completing projects similar in size and complexity as the Work of this Division. Submit proof of experience upon Consultant's request.

- .2 Provide all work for Division 26 Electrical by qualified journeyman electricians or apprentices, holding valid provincial Certificates of Qualification, and be supervised by a competent foreman.
- .3 Provide all work for Division 27 Communications and Division 28 Electronic Safety and Security by qualified technicians with documented certifications by manufacturers of equipment being installed and be supervised by a competent foreman.
- .4 The work of the Electrical Division will be reflected in the quality of installations - any unsatisfactory installations will be removed and replaced accordingly.
- .5 Provide all changes or alterations to the installations of this project required by an authorized Inspector of an Authority Having Jurisdiction in accordance with the terms and conditions of Contract.

.3 Certifications:

- .1 Obtain all permits and certificates bearing upon this Trade and pay all fees and charges for same.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials of this Division in accordance with Section 01 61 00 – Common Product Requirements.

1.10 PROJECT CONDITIONS

.1 Existing Conditions:

- .1 Visit the site of the building and examine the existing conditions in relation to the work to be done. The Electrical Division to be responsible to allow for any requirements which could have been revealed during such examinations.
- .2 Prepare a complete set of Interference drawings in co-ordination with other Sections for all typical or critical locations to indicate site installation conditions where space is limited. Use field measurements to indicate accurate dimensions and configurations of all Electrical services in relation to Structural and Architectural conditions as well as Mechanical services. Coordination with other Sections in the preparation of Drawings and layout of the related work is imperative. Submit these interference drawings to the Contractor for review prior to proceeding with any related work, according to normal Shop Drawing procedure.

1.11 WARRANTY

- .1 All materials and installations of the Electrical Division will be guaranteed for a period of one year from the date of final acceptance of the work unless otherwise specified, regardless of the extent of equipment manufacturer's warranties.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Alternate Manufacturers:

- .1 In some sections of this specification, materials and equipment are specifically described and named by manufacturer for the purpose of establishing a minimum standard of materials, product quality and other specified requirements.

- .2 The project systems design as per the Drawings and Specifications is based on the specified manufacturer's equipment but is intended to be appropriate for equivalent equipment of all other manufacturers contained listed in the Approved Manufacturers list within each Section.
- .3 Products of manufacturers listed as "Alternates" are subject to product data and shop drawing review to ensure that they are equivalent to the products of the specified manufacturer. Alternate manufacturer's equipment will conform to the space limitations imposed by the project and the intent as outlined in this Specification and Drawings.
- .4 The Electrical Division is encouraged to submit alternative proposals of manufacturers not listed in the Approved Manufacturers List of proposals or modified design with appropriate costs, delivery, and system design adjustments which they feel may be advantageous considerations for the project.

3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of each Section depends.
 - .2 Do not proceed with installation until all wet work such as concrete and painting has been completed and thoroughly dried.
 - .3 Report in writing to the Consultant/Project Manager any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of each Section.
 - .4 Do not proceed with Work of each Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .5 Commencement of work implies acceptance of existing conditions and work by other Sections.

3.2 PREPARATION

- .1 Protection of in-place conditions:
 - .1 Provide temporary protection of adjacent areas and surfaces by means of masking (enclosures) where necessary to prevent contamination by Work of each Section.

3.3 INSTALLATION

- .1 Installation of equipment:
 - .1 Unless otherwise specified all equipment is to be installed in accordance with the equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.
 - .2 Ensure that proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Remove and replace any equipment which does not meet this requirement.
- .2 Scaffolding, Rigging, And Hoisting:

- .1 Unless otherwise specified or directed, supply, erect and operate all scaffolding, rigging, hoisting equipment and associated hardware required for your work. Immediately remove from the site all scaffolding, rigging, and hoisting equipment when no longer required.

3.4 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Conduct field inspection and testing as specified in Section 01 40 00
- .2 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Consultant at no additional cost to the Owner.
- .3 Manufacturer Services:
 - .1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for the equipment/system manufacturer's authorized representative to visit the site to examine the installation, and when any required corrective measures have been made, to certify in writing to the Consultant that the equipment/system installation is complete and in accordance with the equipment/system manufacturer's instructions.

3.5 SYSTEM STARTUP

- .1 Perform all testing in accordance with Section 26 05 03 – Electrical Work Testing.
- .2 Conduct acceptance tests to demonstrate that the equipment and systems meet the specified requirements. Conduct tests as soon as conditions permit. Make all changes, adjustments or replacements required as the preliminary tests may indicate.
- .3 Operate all the equipment under normal conditions for a minimum period of five days as a start-up test. Defects disclosed must be repaired and tests repeated until pronounced satisfactory.
- .4 Conduct final acceptance tests in the presence of the Contractor. Invite Consultant and Owner to attend with a minimum of one week's notification.
- .5 Provide the services of one journeyman electrician and all ladders, tools, consumables, and associated equipment to assist the Contractor in carrying out the test.

3.6 ADJUSTING

- .1 Adjust moving or operating parts to operate/function smoothly and properly.

3.7 CLEANING

- .1 Clean work area daily in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .2 Remove all excess materials from site as Work proceeds and at completion.
- .3 On completion of the Work remove all tools, containers, surplus materials, equipment, waste, etc.; and leave site neat, clean, and tidy to the satisfaction of the Owner.

- .4 Clean and make good surfaces soiled or otherwise damaged because of Work of each Section at no additional cost to the Owner.
- .5 Leave surfaces clean and ready for subsequent Work.

3.8 CLOSEOUT ACTIVITIES

- .1 Equipment and System Commissioning:
 - .1 After successful start-up and prior to Substantial Performance, commission the electrical work in accordance with requirements of CSA Z320, Building Commissioning. Use commissioning sheets included with the CSA Standard, and any supplemental commissioning sheets required. Submit final commissioning data sheets, project closeout documents, and other required submittals.

3.9 PROTECTION

- .1 Protect installed materials to prevent damage by other trades for the duration of the construction period. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01 and Section 26 05 00 Common Work Results for Electrical.

1.2 SUMMARY

- .1 This Section specifies fire stopping and smoke seal requirements that are common to electrical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.3 REFERENCES

- .1 Acronyms/Abbreviations:
 - .1 MSDS: Material Safety Data Sheet
- .2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC-S101 Standard Method of Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC-S115 Standard Method of Fire Tests of Firestop Systems

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 26 05 00 Common Work Results for Electrical.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets and MSDS for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements

1.5 CLOSEOUT SUBMITTALS

- .1 Submittals under this Section shall be in conformance with Section 26 05 00 Common Work Results for Electrical.
- .2 Test and Evaluation Reports:
 - .1 Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer:

- .1 Installer shall have a minimum of 5 years' continuous Canadian experience successfully completing projects similar in size and complexity as the Work of this Section. Submit proof of experience upon Consultant's request.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 A/D Fire Protection Systems "FIREBARRIER"
 - .2 Tremco Fire Protection Systems "TREMstop"
 - .3 3M "Fire Barrier"
 - .4 Hilti Firestop Systems
 - .5 Specified Technologies
 - .2 Requests for substitutions shall be made in conformance with Section 26 05 00 Common Work Results for Electrical.

2.2 MATERIALS

- .1 Firestopping and Smoke Seal System Materials
 - .1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115, Standard Method of Fire Tests of Firestop Systems and CAN/ULC-S101, Standard Method of Fire Endurance Tests of Building Construction and Materials for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding fire rated construction.
 - .2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with the firestopping manufacturer's recommendations and the ULC tested assembly.

3 EXECUTION

3.1 PREPARATION

- .1 Abide by the following requirements:
 - .1 examine substrates, openings, voids, adjoining construction and conditions under which the firestop and smoke seal system is to be installed, and confirm compatibility of surfaces
 - .2 verify penetrating items are securely fixed and properly located with the proper space allowance between penetrations and surfaces of openings
 - .3 report any unsuitable or unsatisfactory conditions to the Contractor and Consultant in writing, prior to commencement of work, and note that commencement of work will mean acceptance of conditions and surfaces

- .4 mask where necessary to avoid spillage and over coating onto adjoining surfaces, and remove stains on adjacent surfaces

3.2 INSTALLATION

- .1 Where electrical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of CAN4-S115 (ratings F, FT, FH, and FTH as required), CAN/ULC-S101, and all other governing authorities to seal the penetrations.
- .2 Application: Conform to the following application requirements:
 - .1 use an experienced applicator approved by the manufacturer of the firestopping material manufacturer
 - .2 prime substrates in accordance with the product manufacturer's written instructions
 - .3 provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing
 - .4 tool or trowel exposed surfaces to a neat, smooth, consistent finish
 - .5 remove excess compound promptly as work progresses and upon completion
 - .6 at all cable transit locations, seal the perimeter of the angle iron framing on both sides of the wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal

3.3 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Notify the Consultant when the work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of the work by the Municipal Building Inspector prior to concealing or enclosing work. Make any corrections required.
- .2 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.

3.4 CLOSEOUT ACTIVITIES

- .1 Certification:
 - .1 On completion of the firestopping and smoke sealing installation submit a letter of assurance to the Consultant certifying that the firestopping and smoke sealing installation has been carried out throughout the building to all electrical service penetrations and that the installation has been done in strict accordance with the requirements of the Provincial Building Code, any applicable local Municipal Codes, ULC requirements, and the manufacturer's instructions.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01 and Section 26 05 00 Common Work Results for Electrical.

1.2 SUMMARY

- .1 This Section specifies requirements, criteria, methods and execution for electrical demolition work that are common to one or more electrical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - .1 CSA S350 Code of Practice for Safety in Demolition of Structures

2 EXECUTION

2.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Examine all work of other Sections upon which the Work of this Section depends.
 - .2 Report in writing to the Consultant/Project Manager any defects of surfaces or work prepared by other Sections which affect the quality or dimensions of the Work of this Section.
 - .3 Do not proceed with Work of this Section until all unsatisfactory conditions have been rectified and site conditions are ready to receive work.
 - .4 Commencement of work implies acceptance of existing conditions and work by others.

2.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Provide temporary protection of adjacent areas and surfaces by means of masking (enclosures) where necessary to prevent contamination by Work of this Section.
- .2 Disconnection and Removal of Existing Electrical Work
 - .1 Where indicated on the drawings, disconnect and remove existing electrical work, including hangers, supports, etc. Disconnect at the point of supply, remove obsolete connecting services and make the system safe. Cut back obsolete conduit behind finishes and cap unless otherwise specified.
 - .2 The scope and extent of the demolition or revision work is only generally indicated on the drawings. Estimate the scope, extent and cost of the work at the site during the bidding period scheduled site visit(s).

- .3 Where deemed necessary by the Owner and Consultant, existing shafts, walls, and inaccessible ceilings will be opened by the Owner to permit site visit inspection of services to be removed/revised as part of the work but usually concealed behind such construction.
- .4 Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at the site during bidding period site visits will not be allowed.
- .5 If any re-design is required due to discrepancies between the electrical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between the electrical drawings and actual site conditions are of a minor nature, the required modifications are to be done at no additional cost.
- .6 Where existing electrical services extend through, or are in an area to serve items which are to remain, maintain the services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during the renovation work, so as to be concealed behind new or existing finishes.
- .7 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused.
- .3 Interruption to and Shut-Down of Electrical Services and Systems
 - .1 Co-ordinate all shut-down and interruption to existing electrical systems with the Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning.
 - .2 Upon award of contract, submit a list of anticipated shut-down times and their maximum duration.
 - .3 Prior to each shut-down or interruption, inform the Owner in writing seventy-two hours in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.
 - .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.
- .4 Roofing Work
 - .1 Where roof revisions and/or replacements are part of the project, include for disconnecting, lifting, or temporarily removing electrical equipment and electrical connections to other roof mounted equipment as required to permit completion of the roofing work, and for re-installing/re-connecting the equipment when the roofing work is complete.

2.3 CLEANING

- .1 Complete cleaning of this Section in accordance with Section 26 05 00 Common Work Results for Electrical.

2.4 PROTECTION

- .1 Protect installed materials to prevent damage by other trades for the duration of the construction period. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide wire and cable, including but not limited to the following:
 - .1 This Section, "Wire and Cable", shall apply to all systems of this Contract. Variations or alterations of the requirements for a system, will be specified in that system section.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 26 05 53 – Identification for Electrical Systems
 - .2 Section 26 05 33 – Raceway and Boxes for Electrical Systems
 - .3 Section 27 10 00 – Structured Cabling

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Provide local motor and equipment disconnecting switches or devices for all items regardless of Electrical Code exceptions for mechanical equipment, architectural equipment, Owner purchased equipment and system control panels. The wiring for equipment schedules and drawings do not indicate these disconnecting switches or devices. Some equipment items have integral disconnect switches provided and pre-wired with the equipment. In case of equipment manufacturer supplied disconnecting switches, issue a full credit to the contract to delete the switches specified under this section.
- .2 Wiring for Mechanical Equipment:
 - .1 Refer to the "Wiring for Mechanical Equipment Schedule", for the schedule of devices and wiring to be provided.
 - .2 Wiring for mechanical equipment as described in the specification and as indicated on the drawings are based on the specified mechanical equipment. Wiring for this equipment shall not commence until approved wiring diagrams have been obtained
 - .3 Provide all required 120 V control equipment and wiring. Only line voltage components built-in to the equipment by the manufacturer or included under the controls or Equipment Sections of mechanical work will be provided by the Mechanical Division. In general, the Mechanical Division will provide all low voltage (24 V or less) control equipment and wiring and all pneumatic control devices and tubing unless otherwise indicated.
 - .4 Should alternate equipment other than the specified equipment be substituted all alterations to the wiring incurred by the said substitution will be provided at the Mechanical Division's expense. All changes and costs incurred by the substituted equipment, will be subject to the Contractor's approval.

- .5 Remote push buttons, pilot lights, and control devices in finished areas shall be heavy duty oil tight devices and contact blocks in flush wall mounted boxes 1100 mm (43 in) above floor level, and finished with stainless steel covers.
- .3 Wiring for Architectural/Owner Purchased Equipment:
 - .1 Provide labour and materials to supply power to Architectural or Owner purchased equipment and make the necessary electrical connections. Provide an approved receptacle circuit termination device, disconnect switch, etc. to suit the item requirements. Also install and wire remote control devices for this equipment as noted on the drawings. Refer to notes on the Electrical Drawings and the Equipment Wiring Schedules for further details. Wiring requirements as indicated are based on the specified equipment. Wiring for this equipment shall not commence until approved equipment shop drawings identifying connection point, outlet requirement, rating and wiring diagram have been received.
 - .2 Provide a power supply to each electrically operated door, dock leveller, etc., terminating in a disconnect switch at the equipment connection point. The equipment supplier will provide the control devices, starters, limit switches, etc., for installation. Complete the wiring between components according to the equipment supplier's wiring diagram.

2 PRODUCTS

2.1 MATERIALS

- .1 Distribution And Branch Circuit Conductors
 - .1 Conductors to and including 10 AWG are to be solid or stranded type. Conductors larger than 8 AWG are to be stranded. All conductors are to be constructed from 98% conductive copper and are to be approved for 600 volts. Conductors are to be colour coded, factory identified on the insulation with the manufacturer's name, conductor size and metal, voltage rating, and CSA type and designation. Conductors are to be as follows:
 - .1 "T-90 Nylon" single conductor in accordance with CSA C22.2 No. 75, Thermoplastic-Insulated Wires and Cables, 90° C (195° F) rated, PVC insulated and nylon covered.
 - .2 "RW-90" single conductor in accordance with CAN/CSA C22.2 No. 38, Thermoset-Insulated Wires and Cable, 90° C (195° F) rated, X-link polyethylene insulated.
 - .3 "AC-90" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (195° F) rated, X-linked polyethylene insulated conductors, a concentric ground conductor, and an interlocking aluminium armour jacket.
 - .4 "A90 ISO-BX" flexible cable to CSA C22.2 No. 51, Armoured Cable, with 90° C (195° F) rated, X-linked polyethylene insulated conductors, a concentric bare ground conductor, an insulated ground conductor, and an interlocking aluminium armour jacket.
 - .5 "FAS" cable in accordance with requirements of CSA C22.2 No. 208, Fire /Alarm and /Signal Cable, FAS90 shielded or un-shielded as required, 90° C (195° F) rated, consisting of a copper conductor, silicone rubber insulation, and a polyolefin outer jacket.
 - .6 Equal to Nexans Canada "Corflex" II RA90 flexible cable in accordance with requirements of CSA C22.2 No. 123, Aluminium Sheathed Cable, consisting of single or multiple copper conductors with X-link polyethylene insulation enclosed in a liquid and vapour-tight solid corrugated aluminium sheath and, as required, an overall PVC jacket.

- .7 Equal to Nexans Canada "Firex II" TECK 90 cable in accordance with requirements of CSA C22.2 No. 131, Type TECK 90 Cable, consisting of single or multiple copper conductors with X-link polyethylene insulation enclosed in a liquid and vapour-tight solid corrugated aluminium sheath and, where required, an overall PVC jacket.
- .2 Low Voltage (24 Volt) Conductors
 - .1 "T-90" or "RW90" stranded copper conductors as specified above.
 - .2 Equal to Nexans Canada "Securex II" FAS/LVT/FT1300 volt wire to CSA C22.2 No. 208, Fire /Alarm and Signal Wire, 105° C (220° F) rated, consisting of solid copper conductors (stranded for control wiring), flame retardant PVC insulation, an aluminium/Mylar optional shield with a #22 AWG tinned copper insulation and a drain wire, and, if required for the application, interlocking aluminium armour with or without an overall jacket.
 - .3 Communications Cable:
 - .1 All cabling used for Ethernet, Telephone, or other IP-based systems shall follow cabling requirements as outlined in 27 10 00 Structured Cabling.
- .3 Connectors
 - .1 Conductors in Conduit: Except as noted, CSA certified flame resistant thermoplastic, colour coded twist type connectors to suit the system voltage and wire gauge.
 - .2 Conductors 3/0 AWG and Larger: Long barrel, double crimp, compression type lug connectors, unless otherwise specified.
 - .3 Armoured Cable: Except as noted, proper squeeze type connectors and plastic anti-short bushings at terminations in accordance with requirements of CSA C22.2 No. 18.3, Conduit, Tubing and Cable Fittings.
 - .4 Corflex/Teck Cable: Connector and termination hardware supplied by the cable manufacturer to suit the application.
- .4 Conductor Pulling Lubricant
 - .1 Equal to Ideal Industries "Yellow 77" or "ClearGlide", as required.

3 EXECUTION

3.1 INSTALLATION

- .1 Conform to the following conductor installation requirements:
 - .1 Conductor Routing: Conductor routing indicated on the drawings is schematic and approximate. Determine exact routing and conductor lengths at the site. Route conductors to avoid interference with other work. Unless otherwise specified or shown install conductors parallel to building lines.
 - .2 Conductor Pulling: When pulling conductors into conduit or duct use lubricant and ensure that the conductors are kept straight and are not twisted.
 - .3 Securing/Supporting Conductors: Conform to the following requirements:
 - .1 neatly secure exposed conductors in equipment enclosures with proper supports and/or ties

- .2 support flexible armoured cable in ceiling spaces and stud walls with steel two hole cable straps to Code requirements
- .4 Conductor Splicing: Generally, conductor splicing is not permitted unless otherwise approved by the Consultant, and if approved splicing is subject to the following conditions:
 - .1 splicing is permitted to extend existing conductors
 - .2 for thermoplastic insulated conductors, splices are to be made within an approved electrical box with mechanical compression connectors to suit the type and size of conductors, and the box(es) are to be properly identified and locations are to be indicated on "as-built" drawings.
 - .3 where multiple conductors are spliced:
 - .1 use properly sized Wing Nut connectors, or approved equal, for up to two 8 AWG or three 10 AWG conductors
 - .2 use pressure type sleeve cable connectors, splices, tee's, etc. for all larger size connections and terminations
 - .4 insulate all bare surfaces of splices with Scotch No. 33 tape, heat shrink sleeving, or equivalent.
 - .5 conductors connected to ground rods for service or equipment grounding or to building structural or architectural elements to be terminated, connected and spliced using:
 - .1 a thermoweld process
 - .2 an approved non-mechanical compression type connectors where serviceable
 - .6 install service and feeder conductors as continuous lengths without breaks, measured and cut based on field-measured dimensions.
 - .7 do not splice "Corflex" cable unless justified by cable pulling tension calculations and when approved by the Consultant, and, if approved, locate splices where directed by the Consultant
- .5 Conductor Termination:
 - .1 Where a single solid conductor is terminated in a device under one screw or clamping mechanism, no additional terminating hardware is required.
 - .2 Where multiple or stranded conductors are terminated in a device under one screw or clamping mechanism, self insulated crimp cable ends or approved equal shall be used up to and including 10 AWG sized conductors. Approved compression lugs shall be used for larger conductor sizes.
- .6 Grounding and bonding conductors:
 - .1 Insulated grounding or bonding conductors shall be the same type as the line conductors.
 - .2 Each feeder and branch circuit shall be provided with a separate ground conductor sized in accordance with Electrical Code regulations. All 120 V or 347 V (single phase) branch circuits shall be provided with a separate neutral conductor for each circuit.
- .2 Installation of distribution and branch circuit conductors

- .1 Install all required conductors.
- .2 Non-Fire Rated Conductors: Unless otherwise specified herein or on the drawings, non-fired rated conductors are to be used as follows:
 - .1 conductors underground inside or outside the building, and in non-climate controlled areas – RW-90
 - .2 unless otherwise specified, conductors within stud wall construction, and in furniture systems to luminaries and wiring devices – AC90 flexible armoured cable, maximum 6 m (20 ft) run permitted
 - .3 for conductors in accessible ceiling spaces (not walls) to luminaries - AC90 flexible armoured cable, maximum 3 m (10 ft) run permitted
 - .4 for conductors except as specified above or elsewhere in the Specification or on the drawings – T90 Nylon or RW90
- .3 “Corflex” Cable Installation Requirements: Install “Corflex” cable in accordance with the manufacturer’s instructions, including the following requirements:
 - .1 support and secure overhead suspended “Corflex” cable on a system of cable tray where indicated
 - .2 secure individual cables to cable tray, or where shown, directly to building surfaces by means of single screw non-ferrous clamps
 - .3 ground and bond single conductor cable at both ends where the sheath currents do not affect the cable ampacity
 - .4 for certain areas, where the sheath currents will reduce the cable ampacity, ground and bond the cable at the supply end and isolate the cable at the load end as recommended by the cable manufacturer, and provide a 3/0 AWG green TW ground conductor for each cable, all as per Section 10 of the Electrical Code
- .4 “Teck” Cable Installation Requirements: Install “Teck” cable in accordance with the manufacturer’s instructions, including the following requirements:
 - .1 support and secure overhead suspended “Teck” cable tray where indicated
 - .2 secure individual cables to cable tray or, where shown, directly to building surfaces by means of single screw non-ferrous clamps
 - .3 terminate cable with lugs and termination kits supplied with the cable
- .5 “NMD-90” Cable Installation Requirements: Install NMD-90 cable in accordance with the manufacturer’s instructions, including the following requirements:
 - .1 install only in areas where combustible construction is used
 - .2 all cabling to be concealed, no surface or exposed cabling is permitted
 - .3 secure using only approved clips to joists or studs, do not compress or damage cable jacket
 - .4 secure cables every 1.5 m (5 ft) when run on the sides of joists or studs and 300 mm (12 in) from each outlet box

- .5 where cables pass through a hole in a joist or a stud, bore the hole 32 mm (1.25 in) back from the face of the stud or joist, or protect the cables from screws or driven nails by using approved protection plates
- .6 keep cables a minimum of 25 mm (1 in) from heating ducts or use insulation installed between the conductors and heat ducts
- .7 where cables run through or along metallic studs, joists, sheathing or cladding, ensure that the cables are:
 - .1 protected from mechanical damage both during and after installation
 - .2 protected by an insulation insert secured to the opening in the stud
- .8 protect cables from mechanical damage and from driven nails and screws when they are installed behind baseboards or horizontally behind cupboards
- .9 where communication cables are to be installed in joists or studs, maintain a minimum separation of 50 mm (2 in); cables may not share same pass-through hole
- .6 Conductor Sizing:
 - .1 do not use conductors smaller than 12 AWG in systems over 30 volts.
 - .2 conductor sizes indicated on the drawings are minimum sizes and must be increased, where required, to suit length of run and voltage drop in accordance with the voltage drop schedule found at the end of this Section.
 - .3 all branch circuit wire feeding a 20 A protected lighting circuit to be minimum 10 AWG wire.
 - .4 all branch circuit wiring feeding a 15 A protected circuit which is over 45 m (150 ft) in length to be minimum 10 AWG wire.
 - .5 do not use conductors smaller than 8 AWG for exterior luminaire wiring.
- .3 Voltage Drop:
 - .1 Voltage drop in power and control conductors shall be in accordance with the requirements of the Electrical Code. Size conductors, splicing kits, and termination lugs accordingly when sizes are not identified.
 - .2 Maximum branch wiring distance from panel to load in metres for 120 V single-phase system at 2% voltage drop based on indicated wire size:

Breaker Size (A)	15	20	30	40	50
Max load at 80% (A)	12	16	24	32	40
12 AWG	16.8	12.2	-----	-----	-----
10 AWG	25.9	19.0	-----	-----	-----
8 AWG	39.6	30.4	12.9	-----	-----
6 AWG	62.4	47.2	32.0	23.6	19.0
4 AWG	99.0	73.1	50.2	38.1	30.4
2 AWG	-----	114.3	77.2	57.9	47.2
1 AWG	-----	-----	96.0	73.1	57.9
1/0 AWG	-----	-----	-----	85.3	68.5
2/0 AWG	-----	-----	-----	102.8	80.7
3/0 AWG	-----	-----	-----	-----	95.2

- .3 Maximum branch wiring distance from panel to load in metres for 120 V single-phase system at 3% voltage drop based on indicated wire size:

Breaker Size (A)	15	20	30	40	50
Max load at 80% (A)	12	16	24	32	40
12 AWG	24.4	18.3	-----	-----	-----
10 AWG	38.1	29.0	19.1	-----	-----
8 AWG	59.4	44.2	30.5	22.9	-----
6 AWG	91.4	70.1	47.2	35.1	28.2
4 AWG	-----	109.7	73.2	54.9	42.7
2 AWG	-----	-----	114.3	85.3	68.6
1 AWG	-----	-----	-----	103.6	85.3
1/0 AWG	-----	-----	-----	128.0	102.9
2/0 AWG	-----	-----	-----	-----	122.9

3.2 SITE QUALITY CONTROL

.1 Site Tests and Inspections:

- .1 Conduct field inspection and testing as specified in Section 26 05 00

- .1 Feeders and branch circuits rated 100 amperes or greater shall be checked with a 1000 V Meggar for 15 seconds before energization.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide raceway and boxes for electrical systems, including but not limited to the following:
 - .1 Electrical conduit system throughout the project unless indicated otherwise. The conduit systems shall consist of all the necessary conduit, fittings, fastenings, boxes, special supports, etc.

1.3 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 EMT: Electrical Metallic Tubing
 - .2 FRE: Fibreglass Reinforced Epoxy
 - .3 GRC: Galvanized Rigid Metal Conduit
 - .4 PVC: Polyvinyl Chloride
- .2 Definitions:
 - .1 Conduit - The definitions of "Conduit" (Rigid Metal, Rigid PVC, Rigid FRE, Flexible, and Electrometallic Tubing) as defined in the Electrical Safety Code. Other definitions shall be as follows.
 - .2 Slabbed Conduit - Conduit which is installed within a monolithic concrete floor slab. No slabbed conduit shall be allowed to be installed for this project - use underground conduit where approved.
 - .3 Underground Conduit - Conduit or duct which is installed below the finished earth grades or below the lower edge of an on grade or subgrade floor slab.
- .3 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 26 05 43 Underground Ducts and Ductbank

2 PRODUCTS

2.1 MATERIALS

- .1 Conduit, Connectors and Fittings:
 - .1 Use conduit, connectors, and fittings as standard in the trade, unless noted herein or on the drawings to be of a specific type, manufacturer, trade name, series or catalogue number.
- .2 Galvanized Rigid Metal Conduit (GRC):
 - .1 All fittings to be threaded type. Supply bushings with insulated plastic lining for all conduit terminations.

- .2 Electric Metallic Tubing (EMT):
- .3 All fittings to be steel set screw or raintight type. Supply bushings with insulated plastic lining for all conduit terminations.
- .3 Flexible Conduit:
 - .1 All box connections to have either a nylon lined connector or be provided with an insuliner sleeve. Include sealing ring for fully sealed connection for liquid tight type.
 - .2 Supply metallic liquid tight type for all exposed flexible conduit.
 - .3 Supply non-metallic type flexible conduit for inside concrete block walls.
 - .4 Concealed flexible conduit to be approved galvanized steel or aluminum (where approved) interlocking type, minimum size 12 mm (1/2 in).
- .4 Rigid PVC:
 - .1 Use approved rigid PVC fittings with solvent cement connections for all joints.
- .5 Outlet Boxes:
 - .1 Use outlet boxes, junction boxes, etc. of the types approved for the application. Use the following types for the noted applications:
 - .1 Recessed boxes in concrete or masonry - Type MBD or MBS boxes.
 - .2 Surface mounted with EMT conduit - Type 1110 or 2020 "Utility" box.
- .6 Miscellaneous:
 - .1 Rigid Metal Expansion Joint - Crouse Hinds "XJ" series with bonding strap or equivalent.
 - .2 Rigid PVC Expansion Joint - Scepter "O" Ring expansion joint "EJ" series or expansion coupler "EC" series, to suit expected length of movement.

3 EXECUTION

3.1 INSTALLATION / APPLICATION

- .1 Application
 - .1 Electric Metallic Tubing (EMT):
 - .1 Conduit sizes 103 mm (4 in) and less, where not specified or required to be otherwise due to special applications or conditions.
 - .2 To carry branch circuit wiring from local distribution or lighting panels to area circuit junction boxes above ceiling systems.
 - .2 Flexible conduit:
 - .1 As branch circuit wiring from area circuit junction boxes above ceiling systems to light fixtures and from outlet boxes to suspended fixtures.
 - .2 Restrict flexible conduit to less than 3600 mm (12 ft) in length. Suitably clip and support every 900 mm (3 ft) in length the flexible conduit used above ceiling systems.

- .3 As a raceway in stud walls or partitions.
- .4 Do not use flexible conduit where conduit is run exposed.
- .3 Liquid tight flexible conduit:
 - .1 As the raceway between the distribution conduit and equipment terminal boxes of vibrating and rotating equipment.
 - .2 Restrict length to be less than 600 mm (24 in).
- .4 Rigid PVC or Rigid FRE conduit
 - .1 As an underground raceway for building services or as a slabbed conduit where approved.
- .5 Rigid PVC conduit
 - .1 As underground raceways for branch circuit wiring to exterior connections.
- .6 Rigid PVC duct (DBII)
 - .1 Use in sizes 50 mm (2 in) and larger where encased in concrete or direct buried for underground communication utilities services.
- .7 Use corrosion resistant conduit where indicated on the drawings.
- .8 Do not use aluminum conduit on this project.
- .2 Installation
 - .1 Where more than one type of product or method of installation could apply, the most restrictive products and methods of installation shall take precedence.
 - .2 All conduit connections to be as tight as possible. Failure to tighten any conduit connections in block, tile or concrete elements will result in the element being removed and reinstalled at this Section's expense.
 - .3 Do not use the conduit system as the ground path for the building wiring system. Supply all wiring systems with a separate copper ground conductor sized accordingly to ensure ground path continuity.
 - .4 Conceal conduit in all finished wall areas but may be run exposed in service and equipment rooms.
 - .5 Where conduit is run exposed, run parallel to the building lines. Supply grouped concentric bends where two or more conduits are installed.
 - .6 Do not install conduit horizontally in masonry walls.
 - .7 Lay out all conduits and install to avoid the proximity of heating pipes and ducts. Do not run conduit within 900 mm (3 ft) of such pipes and ducts.
 - .8 Plug conduit ends during construction with plastic push pennies. Cap conduits stubbed for future use with conduit caps and seal, if below grade.
 - .9 Rigidly and securely support conduit systems with conduit straps to the building structure. Support multiple conduit runs, if not easily attached to the building structure directly, by Unistrut hanger assemblies. Bailing wire or flexible metal strapping will not be accepted.

- .10 Extend conduits stubbed through equipment bases a minimum of 38 mm (1½ in) above the base.
- .11 Install two 32 mm (1¼ in) spare empty conduits stubbed into the ceiling space from the top of all recessed panelboards. Terminate in suitable junction box with blank cover labelled accordingly.
- .12 Install a nylon pull cord in all empty conduits. Adhere tags at both ends indicating system and destination. Maintain a pull cord in systems conduits used only to partial capacity.
- .13 Colour code all conduit systems throughout the building during installation with a patch of paint at all junction and pull boxes and points of concealment as follows:
 - .1 Black – Power Distribution (also indicate specific source/panel)
 - .1 Black/Green – 600/347 V Normal
 - .2 Black/Blue – 208/120 V Normal
 - .2 Red – Fire Alarm System (also indicate circuits)
 - .3 Orange – Emergency/Standby Power System (also indicate specific source/panel)
 - .1 Orange/Green – 600/347 V Emergency/Standby
 - .2 Orange/Blue – 208/120 V Emergency/Standby
 - .3 Orange/Purple – Uninterruptible Power
 - .4 Yellow – Public Address/Intercom/Audio-Visual Systems
 - .5 Green – Security System
 - .6 Purple - Controls
 - .7 Blue – Telecommunications System
- .3 Rigid PVC Conduit:
 - .1 Bend on site using a non-flame type heat source to accommodate the required contours.
 - .2 Use conduit fittings, couplings, etc. that are watertight type, fastened with an approved cement.
 - .3 Do not penetrate fire rated walls, floors, or ceilings.
- .4 Partition Walls:
 - .1 Feed all conduit in demountable, prefabricated or standard stud partition walls into the wall from the ceiling. Make no connections from the floor or walls unless shown on drawings. Terminate conduit in a junction box in the ceiling space within 900 mm (3 ft) of the ceiling system penetration point.
 - .2 Restrict flexible conduit in demountable or prefabricated partitions to a maximum 25 mm (1 in) size.
- .5 Outlet Boxes:

- .1 The location of outlets, fixtures, panels, etc., as shown on the drawings, are approximately correct, but the Consultant reserves the right to alter the location of any number of them up to 3000 mm (10 ft) without incurring extra cost, if altered before installation is commenced on any individual item.
- .2 In general, Use 100 mm (4 in) octagon boxes for light fixture outlets.
- .3 In concrete slabs or walls, use boxes greater than 50 mm (2 in) deep.
- .4 In general, in fire rated partitions, install outlet boxes with openings no larger than 160 cm² (25 in²) in area. Install outlet boxes on opposite side or same side of a fire rated partition offset at least one stud space to maintain the integrity of the fire separation.
 - .1 Refer to code plans indicating fire rated partitions
 - .2 Where openings exceed this criteria, install intumescent material that comply with ULC fire rated assemblies.
- .5 Use watertight with screw fittings and watertight gaskets to install outlet boxes outside of the building.
- .6 In general, install outlet boxes of adequate size and required dimensions for all outlet and conduit junctions.
- .7 Rigidly secure all outlet boxes in position by approved methods. For those intended for hanging fixtures, supply with fixture studs, self aligning type for sloping ceilings.
- .8 Outlet boxes designated for future use, install with blank-metal coverplates. Install coverplates, on outlet boxes designated for other than future wiring devices, in time to be painted over by the painting Section.
- .9 Place all pull boxes and terminal boxes in inconspicuous but accessible locations.
- .10 Centre all outlets, panelboards, lighting control, panels and equipment on construction panels, wood paneling or boarding, ceiling tile, etc.
- .11 Install components or devices such as lighting controls and receptacles or thermostats, etc., which occur one above the other in the same general location, in the same vertical line.
- .12 Install adjacent items such as panels and fire hose cabinets, etc., with the tops of their trims in line.
- .13 Locate clocks, bells, horns, speakers, etc. as shown or specified. However, mount these items symmetrically in paneling or tiles, and bear proper relationship to doors, ventilation grilles, etc. Where specific heights are not covered, discuss the relation with, and approved by, the Consultant.
- .14 In no case shall luminaires, pipes, ducts or other elements be allowed to obstruct clocks, grilles, exit lights, etc.
- .15 Mount recessed or surface ceiling mounted components to replace full tiles where possible or be centred on the tile or grid intersections.

- .16 Locate lighting controls on the latch side of door or primary leaf within 150 mm (6 in) of the jamb or sidelight. Where light controls are shown on hinge side of single doors, in cases where glazing makes placing the controls on the latch side not possible, ensure that lighting controls are within 150 mm (6 in) beyond door in fully open position and no part extends behind the open door. Verify door swings and primary leaves on double doors before proceeding with installation of the control box and associated conduit/wiring.
 - .17 Ensure all outlet boxes are installed with vapour barrier protection integral with specific wall or ceiling construction. For each outlet box installed which pierces a vapour barrier, supply an appropriately sized vapour barrier box surrounding outlet box to seal all air leaks and maintain vapour barrier continuity.
 - .18 In finished areas of the building, conceal as much conduit/wiring as possible. Where in this Section's opinion it is necessary or advantageous to run wiring on the surface, obtain approval from the Consultant before proceeding. Install all surface raceways as metal and manufactured by Wiremold unless otherwise indicated. Install surface raceways at size to suit conductors being carried. Use only approved components, fittings, and methods of securing, joining and supporting surface raceways and outlet boxes. Where surface mount raceways and outlet boxes are used, paint to match the specific wall or ceiling finish by the painting Section.
- .6 Mounting Height:
- .1 Where receptacles or other devices interfere with heating equipment, mount horizontally in the toespace below the heating unit unless otherwise noted.
 - .2 For mounting heights of the various system devices not indicated herein refer to the specific system Section or drawing detail.
 - .3 Verify mounting heights of outlet boxes in special or decorative wall systems prior to rough-in.
 - .4 For exact mounting heights and requirements of outlets and devices built into millwork or architectural furnishings, refer to elevations and details shown on the architectural drawings. Verify with millwork Section prior to rough-in.
- .7 Conduit Seals:
- .1 In areas where conduits pass through walls or other building surfaces in which different temperatures exist (i.e. refrigerated spaces or exterior walls and insulated ceilings or roofs, etc.), seal off the conduits with appropriate materials and methods to prevent breathing and subsequent condensation. Complete the sealing such that moisture is not trapped at the seal.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01 and Section 26 05 00 Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide lighting control, including but not limited to the following:
 - .1 Work to include all labour, materials, tools, appliances, control hardware, sensors, wiring, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational standalone lighting control system, as described herein.
 - .2 All lighting controls shall meet or exceed all locally-enforced energy codes including all mandatory control requirements for Ontario Building Code supplemental standard SB-10 and ASHRAE 90.1.
 - .3 Control lighting in all spaces within the building and all exterior lighting using the lighting control system. Manual lighting controls may be used where indicated specifically on the drawing.
 - .4 This section to be read in conjunction with the Lighting Narrative in drawing package and Lighting Narrative Room Designations shown on layout drawings. Refer to Lighting Fixture Schedule on drawings for details about fixture drivers, wattage, fixture mount controls, and dimming methods.
 - .5 Include control of receptacles in conference rooms, print rooms, classrooms and break rooms as described in ASHRAE 90.1 and SB-10.
 - .6 Examine all general specification provisions and drawings for related electrical work required as work under this section.
 - .7 All lighting control is subject to functional testing. Test all lighting control devices and control system to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with this section and the manufacturer's installation instructions.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Division 25 Integrated Automation
 - .2 Section 26 27 26 Wiring Devices
 - .3 Section 26 50 00 Lighting
 - .4 Section 26 52 00 Emergency Lighting

1.3 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 DALI: Digital Addressable Lighting Interface
 - .2 DMX: DMX512 is a digital communications interface
 - .3 HMI: Human Machine Interface
 - .4 NO/NC: Normally Open/Normally Closed contacts

- .2 Definitions:
 - .1 Dual Technology - sensors that combine both passive infrared and another technology into one sensor.
 - .2 Normally Occupied Spaces - rooms or spaces within the building that are likely to be occupied for 30 minutes or more by a building user.
 - .3 Occupancy sensor - a motion detecting device used to detect the presence of a person to automatically control lights or temperature or ventilation systems. The sensors use infrared, ultrasonic, sound, microwave, Bluetooth or other technology.
 - .4 Photosensor - an electronic device that detects the prevailing light level and sends the information either as an analog or a stepped digital output as a relative representation of the light level.
 - .5 Vacancy Sensor - works like an occupancy sensor; however, lights must be manually turned ON, but will automatically turn OFF when motion is no longer detected. For the purposes of this scope of work the use of Occupancy and Vacancy are equivalent.
- .3 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):
 - .1 ASHRAE 90.1 Energy Standard for Buildings Except Low Rise Residential Buildings
 - .2 Canadian Standards Association (CSA):
 - .1 CSA C22.2 No. 141 Emergency Lighting Equipment
 - .3 Underwriters Laboratories (UL):
 - .1 UL 924 Standard for Emergency Lighting and Power Equipment

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, fixtures, HVAC systems, and building management systems.

1.5 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 26 05 00.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
- .3 Shop Drawings:
 - .1 Complete sets of shop drawings shall be submitted indicating the following:

- .1 Wiring/Wireless schematics for typical and standalone room types in this project. (i.e. classroom, private office, lobby, open office, boardroom, etc.).
- .2 Multi-button wall switch button configurations for each switch.

1.6 CLOSEOUT SUBMITTALS

- .1 Submittals under this Section shall be in conformance with Section 26 05 00.
- .2 Test and Evaluation Reports:
 - .1 Submit cybersecurity report or documentation as specified in Part 2 of this Section.
 - .2 Submit manufacturer's inspection reports and verifications that the Work of this Section is correctly installed.
- .3 Training Material:
 - .1 Electronic versions of training slides.
- .4 Software:
 - .1 Submit copies of all software and licences required for operation and maintenance of equipment provided.
 - .2 Provide all software, firmware, and operating system user guides, installation manuals, cybersecurity certificates, and documentation in unsecured searchable PDF format. Provide list of all initial credentials used including passwords to configure system in an encrypted format.
 - .3 Provide list of all software, firmware, and operating system licence and subscription recurring fees with the Owner's credentials used to set up accounts. All pricing should be current as of submission date. Include unit cost increases for upgrading or adding additional components beyond what is included in this scope.

1.7 QUALITY ASSURANCE

- .1 All sensors, accessories and components must have a recognized certification mark (such as CSA or ULC) or a recognized field evaluation mark by Electrical Authority as designated by the Electrical Code.
- .2 All control functions shall operate independent of network connectivity. Controls shall not require connection to the building network or the internet to operate. All dimming preferences and last known switch or dimming level shall not be dependant on network connection.
- .3 On restoration of power to controlled fixtures, lighting level shall return to dimming level set before power loss within 5 seconds. If fixture was off prior to loss of power, fixture shall remain off after power restoration.
- .4 All installation components shall have an installed base of more than 200 successful sites.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

- .1 Comparable Products from manufacturers listed herein will be accepted provided they meet requirements of this Specification:

- .1 Fifth Light/Cooper
- .2 Encellium
- .3 Hubbell
- .4 Leviton
- .5 Lutron
- .6 nLight/Accuity
- .7 Signify/Phillips
- .8 WattStopper/Legrand

- .2 Requests for substitutions shall be made in conformance with Section 26 05 00.

2.2 PERFORMANCE/DESIGN CRITERIA

- .1 Cybersecurity

- .1 Complete all communications in a secure manner to prevent unauthorized users from making control decision or manipulating data. Prevent unauthorized users from installing malware onto the system via any communications gateway, mobile application, wireless interface, Human-Machine Interface (HMI), or accessible port.

- .2 Supply report or documentation detailing cybersecurity assessment of the software, firmware, communications gateway, mobile applications, wireless interface, HMI, annunciators, remote devices, diagnostic tools, and any other associated accessories detailed in this Section. Cybersecurity documentation or assessment report to include:

- .1 known vulnerabilities present in the assets
- .2 guide to solutions to reduce cyber threats
- .3 identify the attack surface and attack vectors
- .4 assets' cyber resiliency to threats and risks including:
 - .1 ransomware
 - .2 data leaks
 - .3 phishing
 - .4 malware
 - .5 insider threats
 - .6 cyberattacks

- .5 list with contact information of all 3rd party hardware and software used that are not directly supported by the vendor

- .6 inclusion of any 3rd party hardware or software component does not allow the vendor to exclude that component

2.3 OPERATION

- .1 Controls:
 - .1 Ensure that drivers used by lighting manufacturer are compatible with lighting control system or incur all costs for replacement to a compatible unit at no additional cost to the project.
 - .2 The system shall operate with multiple users in harmony and not react adversely to manual override inputs. Do not impede personal lighting control and the ability to adjust light levels on a per fixture basis.
 - .3 The following is the hierarchy of lighting control. Any function higher on the list supersedes any function lower.
 - .1 Life Safety control
 - .2 Lower and upper trim settings
 - .3 Manual Local Control
 - .4 Occupancy
 - .5 Time of Day programming
 - .6 Daylight Harvesting
 - .7 Demand Response

2.4 MATERIALS

- .1 Occupancy Sensors:
 - .1 Line voltage
 - .1 Wall switch mount sensors in normally occupied spaces:
 - .1 White,
 - .2 0-10 V dimming,
 - .3 Dual technology,
 - .4 Minimum IR coverage 50 m² (500 ft²), and
 - .5 Minimum two manual activation buttons to be 160 mm² (0.25 in²) or larger.
 - .2 Wall switch mount sensors in normally unoccupied spaces with more than one fixture:
 - .1 White,
 - .2 Two relays,
 - .3 Passive Infrared technology,
 - .4 Minimum IR coverage 50 m² (500 ft²), and

- .5 Minimum two manual activation buttons to be 160 mm² (0.25 in²) or larger.
- .3 Wall switch mount sensors in normally unoccupied spaces with one fixture:
 - .1 White,
 - .2 One relay,
 - .3 Passive Infrared technology, and
 - .4 Minimum one manual activation button to be 160 mm² (0.25 in²) or larger.
- .2 Low Voltage
 - .1 Ceiling mount sensors – Dual Technology
 - .1 Ultrasonic technology
 - .2 Minimum IR coverage 100 m² (1000 ft²) 360° with adaptable corridor coverage up to 9.75 m (32 ft) when mounted at 3 m (10 ft) above finished floor
 - .2 Ceiling mount sensors – Passive Infrared only
 - .1 Minimum IR coverage 100 m² (1000 ft²) 360° when mounted at 3 m (10 ft) above finished floor.
 - .3 Wall mount sensors
 - .1 Dual technology
 - .2 Rotatable knuckle mount for aiming (with lock in place)
 - .3 Mounting plate for octagonal or square wall box
 - .4 Minimum IR range of 13.5 m (45 ft) at 90° coverage when mounted 3 m (10 ft) above finished floor
 - .4 Fixture mount sensors
 - .1 Refer to lighting fixture schedule for specific details.
- .2 Line Voltage Wall Controls:
 - .1 In finished spaces, supply commercial grade rocker-type switches to match the voltage and amperage level of the circuit supplying the fixtures. Supply 3-way or 4-way switches when shown on the drawings. Provide white nylon cover plates.
 - .2 Where loads are connected to emergency power, switches shall be red in colour, otherwise colour shall be white.
 - .3 Supply cover plate suitable for the number of gangs shown on the drawings.
- .3 Low Voltage Wall Controls:
 - .1 Dimming wall switch
 - .1 Supply dimming wall switch consists of one of the following options. The same type shall be used in all areas of the scope of work, and the switch type will not change from area to area.

- .1 a multi-button switch with each ON and OFF activation surface greater than 325 mm² (0.5 in²) and separate raise/lower slider or buttons,
 - .2 a single or multi-button switch with ON/OFF toggle surface greater than 650 mm² (1 in²) and separate raise/lower slider or buttons,
 - .3 a single dual-zone switch with separate ON and OFF activation zones with a surface greater than 1300 mm² (2 in²), or
 - .4 a two-button switch with each ON and OFF activation surface greater than 650 mm² (1 in²).
- .2 For switches without separate raise/lower slider or pushbuttons, supply the ON/OFF buttons to raise or lower dimming level with a push and hold:
- .1 Pushing the top of the switch will turn lighting on. Push and hold of the top of the switch will gradually raise the dimming level of the lighting.
 - .2 Pushing the bottom of the switch will turn lighting off. Push and hold of the bottom of the switch will gradually lower the dimming level of the lighting.
- .3 Supply white cover plate suitable for the number of gangs shown on the drawings.
- .2 Non-dimming wall switch
- .1 Supply non-dimming wall switch consists of one of the following options. The switch shall match as closely to the dimming version above.
 - .1 a single dual-zone switch with separate ON and OFF activation zones with a surface greater than 1300 mm² (2 in²), or
 - .2 a two-button switch with each ON and OFF activation surface greater than 650 mm² (1 in²).
 - .2 Supply white cover plate suitable for the number of gangs shown on the drawings.
- .3 Multi-button/Scene Switch
- .1 Supply low voltage momentary pushbutton switches in multi-button (up to 8 in single gang) configuration. Wall switches shall include the following features:
 - .1 Supply buttons that are large enough to be engraved. Engrave first set of buttons on each switch.
 - .2 Include bi-level LEDs to indicate dimming levels.
 - .3 When room lighting is off, illuminate ON button.
 - .4 All activation buttons to be 160 mm² (0.25 in²) or larger.
 - .2 Default button text, unless noted on the drawing, shall be as follows.
 - .1 ON
 - .2 OFF
 - .3 Raise

- .4 Lower
- .5 Meeting
- .6 Present
- .7 Confer
- .8 Cleaning
- .3 Layout of buttons shall have logical arrangement. All configurations are subject to review in shop drawings.
 - .1 ON shall be on top of switch and OFF shall be at the bottom of switch.
 - .2 Place "raise" always higher than "lower" and are adjacent.
 - .3 ON/Raise-on-hold combination button and OFF/lower-on-hold combination button can be used if programming will allow multiple function.
 - .4 Icons may be used in place of text when appropriate and approved.
- .4 Power/Relay Modules:
 - .1 Supply either power/relay modules that are centralized, multi-room, standalone, or integrated units that house one or multiple relays or dimming modules for controlling fixture, zone, room, or area lighting. Supply control input from lighting control devices. Connect multiple modules for the same control zone to allow seamless operation of controls in that space.
 - .2 Low voltage sensors and wall controls to communicate with power/relay module(s) that will operate lighting within the room being controlled.
 - .3 Modules:
 - .1 Communications capability with low voltage sensors or manual controls within the control zone
 - .2 Minimum two lighting relays are required for non-dimmable drivers
 - .3 When dimming is required, use dimming technology to suit fixture or lamp being dimmed
 - .4 The module may be incorporated or integrated into a driver.
- .5 Receptacle Control:
 - .1 Use receptacle control in all classrooms, meeting rooms and break rooms as minimum requirement as per ASHRAE 90.1.
 - .2 Equip these control zones with a relay/power supply to control at least 50% of the receptacles within the space.
 - .3 Controlled receptacles to be green in colour.
 - .4 Control either through remote relay panel with multiple control zones or individual local units. Supply relays certified by a testing authority for this function at the rated full amperage of the circuit. Relay designated as lighting relays are not acceptable to switch plug loads unless they have been separately certified as suitable for plug loads.

- .5 Default control of plug-load relays is by occupancy within the corresponding lighting control zone.
- .6 Relay panels shall be controlled via time-of-day control and shall be schedule to shut-off during non-operational hours.
- .7 Plug-in type power bars with integrated switching cannot be used to meet this requirement.

2.5 ACCESSORIES

- .1 Spare Components:
 - .1 Supply and turn over to the owner, after six month service visit, 10 % spare (rounded up) wiring devices, sensors, buttons, control stations, relay modules and relays to allow minor future expansion and ongoing maintenance of lighting control system. Installer may use spare components to adjust owner's requirements during final testing, one month, and six month visits. These spare components are not a replacement for defective components covered under warranty.

3 EXECUTION

3.1 INSTALLATION

- .1 The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors, layout is based on coverages in the design basis. Install additional sensors and power supplies/relays as required to provide coverage in the respective control group.
- .2 Locate and aim sensors within each space as required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Place sensors to have 90% or greater coverage of the controlled zone to accommodate all occupancy habits of single or multiple occupants at any location within the space.
 - .1 Place occupancy sensors to eliminate activation (or minimize activation, in the case of multiple entries) from outside the space with doors open.
- .3 Allow sensors in same control zone to work in conjunction with one another through wired connections. In rooms with movable dividers, incorporate sensors on dividers that subdivide control zones when dividers are closed and consolidate control zones when dividers are open.
- .4 For lighting on emergency circuits in corridors, open areas, or other paths of egress install modules that bring lighting to full output on loss of normal power, fire alarm, or programmed event. At conclusion of event, return lighting brightness to level set before event or normal time-of-day programming.
- .5 Non-switch type wall mounted sensors to be mounted at 3 m (10 ft) or 300 mm (12 in) below ceiling, unless otherwise noted.
- .6 Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.
- .7 For occupancy sensors with ultrasonic sensors, mount the unit on a vibration free surface and install a minimum of 610 mm (24 in) away from supply ducts and wall mounted discharge ducts.

- .8 When installing occupancy sensors in areas where the area is too large to cover with sensors shown on drawings or the space has obstructions that do not meet the minimum coverage requirements, then multiple sensors shall cover space to ensure that the proper coverage is achieved without additional cost to the owner.
- .9 When an area is served by lighting of multiple fixture types or daylighting zones, a separate dimming or relay zone shall be provided for each fixture type and daylighting zone.
- .10 When serving areas with high ceilings or exterior areas, sensors should be placed at manufacturer's recommended height for coverage and spacing.
- .11 Interconnect modules, controls, and sensors via plenum-rated (FT-6) low-voltage network wiring, when routed in plenum, or via wireless connections. Free-air cabling to be neatly supported every 1.5 m (5 ft) to avoid cable laying on ceiling tile. Where cabling route is in exposed space conceal control cabling after any suspension, and suspension cable colour to match power cable colour.
- .12 Connect all power/relay modules and relay panels either wired or wirelessly to a networked central control unit either directly or through a series of sub-controllers.
- .13 Systems Integration:
 - .1 Connect the following to the lighting control system:
 - .1 Building Automation System
 - .2 Fire alarm system alarm status
 - .3 Loss of normal power signal

3.2 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Conduct field inspection and testing as specified in Section 26 05 00.
 - .2 Field Testing:
 - .1 Upon completion of the installation, the system shall be completely tested by field technician who will verify all adjustments and sensor placement to ensure a trouble-free lighting control system and compliance with ASHRAE 90.1 functional testing standards.
 - .2 Each device shall be numbered, labeled and recorded. Tests shall be conducted to ensure that entering the space shall ensure that lighting shall be activated as per requirements and the vacating a space will cause the lighting to turn off within 30 minutes.
 - .3 After one month and six months of customer use, the installer and/or manufacturer shall return to the site and make any required adjustments to location, control, sensitivity and timing as required by the users based on their feedback. Provide suitable feedback forms to owner's representative two weeks prior to visit. Schedule visits with owner's representative.
- .3 Functional Testing:
 - .1 Perform functional testing in accordance with ASHRAE 90.1 functional testing requirements. Provide final lighting control narrative and room-by-room control requirements.

- .2 The individual(s) responsible for the functional testing are not directly involved in either the design or construction of the project and show documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.
- .3 At a minimum perform the following procedures:
 - .1 Confirm the placement, sensitivity and time out adjustments for occupancy sensors yield acceptable performance, lights turn off only after space is vacated and do not turn on unless space is occupied.
 - .2 Confirm that time switches and programmable schedule controls are programmed to turn the lights off.
 - .4 Lighting control system to be complete, operational and have fully passed functional testing completed within 7 calendar days of full occupancy.
- .2 Manufacturer Services:
 - .1 Have manufacturer's technical representative inspect the Work at suitable intervals during application, and at conclusion of the Work of this Section, to ensure the Work is correctly installed. Submit manufacturer's inspection reports and verifications that the Work of this Section is correctly installed.

3.3 CLOSEOUT ACTIVITIES

- .1 Software:
 - .1 Install, set up, customize, and configure all included software, firmware or operating systems on designated equipment to suit the intended operation.
 - .2 Submit to Owner's representative all configuration requirements prior to installation including temporary credentials with level of administration access required, operating system, list of IP addresses required with mapping to tag or unique description, firewall configurations, minimum hardware or connection specifications, and any other information to successfully install software or equipment.
 - .3 Change all usernames and passwords from default for all administrative levels. New passwords to be minimum 12-characters with a unique randomly-generated combination of upper case, lower case, symbols, and numbers or as appropriate for the user interface.
 - .4 Pay for any software, firmware, and operating system licence and subscription fees for the warranty period and setup accounts with Owner's credentials.
 - .5 Prior to warranty completion, update or upgrade all installed software to most current version compatible with equipment installed. During warranty period if any cybersecurity threats or known vulnerabilities to software or firmware are provided by the vendor or relevant third-party software company, send immediate notification to Owner with instructions to patch or update software, firmware, or operating system.
- .2 Demonstration and Training:
 - .1 Include the on-site demonstration and training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem-solving diagnosis of the lighting control system.
 - .2 Include manufacturer 12-month (from building occupancy) toll-free telephone support for technical questions concerning troubleshooting, re-programming, and technical issues.

- .3 Demonstration and training to consist of one half-day on-site session organized by manufacturer at approximately one month after owner occupancy. Contact owner representative within 3 weeks after occupancy to schedule appropriate time and review of trainer generated agenda. Turn over all electronic and hardcopy of all slides and handouts used in training presentation to the owner.
- .4 Hands-on demonstration of on-site components to include:
 - .1 Lighting controls software
 - .2 Lighting Control Unit locations and interfaces
 - .3 Scene controls in applicable spaces
 - .4 Overall manual controls for trim level
 - .5 Any associated mobile or web applications

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions and the General Requirements of Division 01 and Section 26 05 00 Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide Wiring Devices, including but not limited to the following:
 - .1 Receptacles
 - .2 Coverplates
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 26 05 33 - Raceways and Boxes for Electrical Systems
 - .2 Section 26 09 23 - Lighting Controls
 - .3 Section 27 05 28 - Pathways for Communications Systems

1.3 REFERENCES

- .1 Abbreviations and Acronyms:
 - .1 AFCI: Arc Fault Circuit Interrupter
 - .2 GFI/GFCI: Ground Fault Circuit Interrupter
 - .3 UPS: Uninterruptible Power Supply
- .2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 26 05 00 Common Work Results for Electrical.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
 - .1 Special devices not listed in the Schedule of Wiring Devices.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable Manufacturers:
 - .1 Hubbell
 - .2 Legrand - Pass & Seymour
 - .3 Eaton - Arrow Hart
 - .4 Bryant
 - .5 Leviton
 - .2 Comparable Products from manufacturers not listed herein will be accepted provided they meet requirements of this Specification.
- .2 Requests for substitutions shall be made in conformance with Section 26 05 00 Common Work Results for Electrical.
- .3 Products listed here are based on products and part numbers manufactured by Hubbell and indicate a level of quality and technical specification and is not an endorsement of the manufacturer.

2.2 MATERIALS

- .1 All wiring devices and will be white in colour unless noted otherwise. Device part numbers shown represent required component series and are not meant to be exact part number or identify colour. The following special colours will be used:
 - .1 Red – Standby, Emergency or Essential Power
 - .2 Orange – UPS Power
 - .3 Green – Controlled Circuit
 - .4 Blue – Surge Suppression
 - .5 Black – Special receptacle not in CSA 5-15R or 5-20R configurations
 - .6 If an outlet exhibits more than one of the above properties, then a clear permanently-mounted label will be placed above the device stating all the other functions or properties of this wiring device.
- .2 Schedule of Wiring Devices
 - .1 Standard Devices

Description	CSA/NEMA Configuration	Hubbell Part Number
15 Ampere, 120 Volt, Toggle Type Switch, Heavy Duty (Series includes Single pole, double pole, 3-way, 4-way, locking, pilot light, etc.)	n/a	1200 Series
20 Ampere, 120 Volt, Toggle Type Switch, Heavy Duty (Series includes Single pole, double pole, 3-way, 4-way, locking, pilot light, etc.)	n/a	1220 Series
15 Ampere, 347 Volt, Toggle Type Switch, Heavy Duty (Series includes Single pole, 3-way, and 4-way)	n/a	18200 Series
20 Ampere, 347 Volt, Toggle Type Switch, Heavy Duty (Series includes Single pole and 3-way)	n/a	18220 Series
15 Ampere, 120 Volt, Duplex Receptacle (Series includes standard, tamper resistant, isolated ground, weather resistant, corrosion resistant, etc.)	5-15R	5262 Series
20 Ampere, 120 Volt, T-Slot, Duplex Receptacle (Series includes standard, tamper resistant, isolated ground, weather resistant, corrosion resistant, etc.)	5-20R	5362 Series
15 Ampere, 120 Volt, GFCI Duplex Receptacle	5-15R	GFRST15
20 Ampere, 120 Volt, T-Slot, GFCI Duplex Receptacle	5-20R	GFRST20
15 Ampere, 120 Volt, GFCI Weather Resistant Duplex Receptacle	5-15R	GFWRST15
20 Ampere, 120 Volt, T-Slot, GFCI Weather Resistant Duplex Receptacle	5-20R	GFWRST20
30 Ampere, 120/250 Volt, Dryer Receptacle, Black	14-30R	HBL9430A
50 Ampere, 120/250 Volt, Range Receptacle, Black	14-50R	HBL9450A
20 Ampere, 120 Volt, Locking Single Receptacle, Black	L5-20R	2310
20 Ampere, 250 Volt, Locking Single Receptacle, Black	L6-20R	2320

.2 Special mounting and accessories

- .1 Flat Panel Display Wall box – 2-gang recessed FPTV Connection Enclosure Hubbell NSAV62M. Provide steel cover. Provide standard power kit and 1-gang decorator wall plate for Audio Visual or Telecommunications. For use with surface mounted flat screen displays only.
- .2 Quad receptacle types are not permitted and will be substituted for two duplex receptacles ganged together.
- .3 Provide other special wiring devices as noted on the drawings to the same quality as those listed within the “Schedule of Wiring Devices”.

.3 Receptacle Control

- .1 Controlled receptacles should be clearly identified with green colour, controlled symbol, and the words “CONTROLLED” on the receptacle face of each receptacle being controlled. A clear permanently-mounted label will be placed above the receptacle stating “THIS OUTLET CONTROLLED BY OCCUPANCY”.
- .2 Receptacle within the following spaces must be controlled wired or wirelessly via lighting control system as detailed in Section 26 09 23 Lighting Controls: conference rooms, rooms used primarily for printing and/or copying functions, breakrooms, and classrooms.

.4 Interval Timers

- .1 Provide Tork A560MHW or equivalent, SPDT type rated at 20 Ampere, 120 Volt AC complete with 60-minute spring wound twist timer with positive off position and 5-minute graduated faceplate for control of equipment as shown on the drawings.

.5 Coverplates

- .1 Coverplates for wall mounted wiring devices in finished areas will be smooth 302 stainless steel type.
- .2 In unfinished areas or surface mounted devices, coverplates will be galvanized type with rounded corners and back boxes will be cast type.
- .3 Provide gasketed ‘While-in-Use’ or Extra Duty polycarbonate cover Hubbell RW58300 for all devices exposed to weather or water splashing. Cover will have ability to install padlock to restrict access and removal of installed plugs.
- .4 Provide proper ganged coverplates and backboxes for all grouped outlets. Provide internal barriers between receptacles from different panels, and between receptacles and extra low voltage outlets.

3 EXECUTION

3.1 INSTALLATION

- .1 All switches controlling a connected load in excess of 10 amperes will be 20 ampere rated type.
- .2 Mounting heights of the wiring devices will be as follows unless subject to special installation conditions, or otherwise indicated on floor plans or dimensioned interior elevations (Mounting heights refer to the centre of the outlet box):

- .1 Light Switches and Control Devices 1100 mm (43").
- .2 Wall Outlets and Receptacles 460 mm (18") or 150 mm (6") above countertop or back splash as applicable.
- .3 In barrier-free spaces and suites, mount light switches and control devices at 1050 mm (41.5") above finished floor.
- .3 Coverplates will be installed flush and level.
- .4 Install wiring devices after wall construction and painting is complete.
- .5 All wiring devices shown as being relocated on drawings will be replaced with new device and coverplate and will be connected to the existing circuit.
- .6 Install all wall switches with the OFF position down. All CSA 5-15R and 5-20R configuration receptacles will be installed so the ground is in the bottom position.
- .7 Where electrical outlets and wall mounted heating units occur at the same height and location, the outlets will be mounted below or beside the heater, unless noted otherwise.
- .8 Work top mounted outlets will be above floor monument type securely fastened to work surface using a threaded connection to conduit system. Provide all required fittings, inserts and accessories required for approved mounting and connection.
- .9 Outlets installed in millwork will be standard wall mounted versions, flush mounted into face of the appropriate vertical surface. Refer to millwork elevations and sections for further details.
- .10 Install Tamper Resistant receptacles in dwelling units and child care facilities or other areas where children may be present including hotel guest rooms, preschools, and elementary education facilities.
- .11 Receptacles not on isolated ground will have a green bond wire bonded to the device grounding terminal, the back box it is located in, and bonded to the branch circuit panelboard ground bus.
- .12 Prior to rough-in for wall outlets for flat screen displays, coordinate mounting height such that flat screen mounting bracket is not interfering with wall outlet. Care should be taken to ensure wall outlet is completely behind flat screen display when mounted. If outlet is completely behind flat screen cover will not be installed.
- .13 All outlets installed in exterior locations will be weather resistant type and will be protected with an Extra Duty or while-in-use cover for allowing outlet to be covered even while in use.

3.2 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 When installation is complete, test operation of all devices. All defective devices shall be replaced and all defective wiring shall be repaired.
 - .1 Switches should be operated to ensure load is switching as expected.
 - .2 For CSA 5-15R and 5-20R configuration receptacles should be tested with handheld plug-in receptacle tester for open circuits, and reversed wiring. GFCI test shall be completed on all GFCI receptacles and circuits.
 - .3 For receptacles of other configurations, a multimeter shall be used to perform similar tests.

- .2 Non-Conforming Work:
 - .1 Defective materials or quality of work, whenever found, at any time prior to acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight or errors.
 - .2 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to the satisfaction of the Project Manager at no additional cost to the Owner.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide electric heaters, including but not limited to the following:
 - .1 Force Flow Heaters

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - .1 CSA C22.2 No. 46 – Electric Air Heaters

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 01 33 00 - Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
 - .2 Submit product data sheets for electric heaters, including accessories.
- .3 Test and Evaluation Reports:
 - .1 Start-Up Report: Submit a site start-up report from the manufacturer's representative as specified in Part 3 of this Section.

1.5 CLOSEOUT SUBMITTALS

- .1 Submittals under this Section shall be in conformance with Section 26 05 00.
- .2 Warranty Documents:
 - .1 Shall be in conformance with Section 26 05 00.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:
 - .1 Acceptable manufacturers are:

- .1 Ouellet
- .2 Chromalox
- .3 Stelpro
- .2 Requests for substitutions shall be made in conformance with 26 05 00.
- .3 Single source responsibility: Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.2 MATERIALS

- .1 General:
 - .1 Electric heaters are to be certified and labelled in accordance with requirements of CSA C22.2 No. 46
 - .2 Electric heaters are to be complete with automatic reset high limit temperature control, baked epoxy/polyester powder coat finish, and in accordance with the drawing schedule.
- .2 Forced Flow Heaters
 - .1 Surface mounted or recessed cabinet heaters as shown, each complete with:
 - .1 Enclosure: steel cabinet and removable steel front panel with integral louvers and grille with rounded corners.
 - .2 Heating element: tubular steel heating element with aluminium fins
 - .3 Fan and motor: steel fan wheel, direct driven by means of a motor conforming to requirements of the mechanical work Section entitled Basic Mechanical Materials and Methods, and complete with a fan delay to purge the heater of residual heat.
 - .4 Integral thermostat: factory installed, tamperproof, adjustable thermostat.
 - .5 Enclosure accessories: factory supplied enclosure accessories as indicated on the floor plan drawings and/or heater schedule.

3 EXECUTION

3.1 INSTALLATION

- .1 Room Electric Heaters:
 - .1 Install room electric heaters where shown, complete with all required accessories as indicated.
 - .2 Confirm exact locations prior to electrical rough-in.
 - .3 Where remote thermostats are indicated, provide the thermostats and all required control wiring and accessories. Unless otherwise indicated, locate thermostats 1.4 m (5') above the floor, and confirm exact thermostat locations prior to roughing-in.

3.2 SYSTEM STARTUP

- .1 Perform all Equipment and System Start-up as per Section 26 05 00.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide disconnect switches.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 26 28 13 Fuses

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - .1 CSA – C22.2 No. 4 – Enclosed and Dead-Front Switches

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 01 33 00 - Submittals.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for disconnect switches and accessories proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules, and Specification:
 - .1 Acceptable manufacturers are:
 - .1 Rockwell Automation/Allen-Bradley
 - .2 Eaton
 - .3 Siemens
 - .4 Schneider Electric
- .2 Requests for substitutions shall be made in conformance with Section 26 05 00

- .3 Single source responsibility: Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.2 MATERIALS

- .1 All disconnect switches are to be in accordance with requirements of CSA – C22.2 No. 4.
- .2 Disconnect Switches:
 - .1 Heavy-duty front operated switches each in accordance with CSA – C22.2 No. 4, each complete with a red handle suitable for padlocking in the “off” position, and a NEMA/ EEMAC enclosure.
 - .2 Fusible units are to be complete with fuse clips in accordance with CSA-C22.2 No. 39, Fuseholder Assemblies and to suit fuse types specified below.
 - .3 Unless otherwise scheduled or specified fuses are to be equal to English Electric Ltd. HRC fuses, Form I Class “J” for constant running equipment and Form II Class “C” for equipment that cycles on and off.
 - .4 Provide viewing window that will allow visibility of the position of the blades.
 - .5 Enclosures: Unless otherwise specified, contactor enclosures are to be in accordance with the following NEMA/EEMAC ratings:
 - .1 All enclosures located in sprinklered areas – Type 2.
 - .2 All enclosures exposed to the elements – Type 3R, constructed of stainless steel.
 - .3 All enclosures inside the building in wet areas – Type 3R, constructed of stainless steel.
 - .4 All enclosures in washdown or food preparation areas - Type 12X, constructed of stainless steel.
 - .5 All enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application.
 - .6 All enclosures except as noted above – Type 1.

3 EXECUTION

3.1 INSTALLATION

- .1 Disconnect Switches:
 - .1 Install all required disconnect switches in accordance with drawing plans, schedules, details, and requirements of the Specification.
 - .2 Install fuses for fusible disconnects.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide motor starters, including but not limited to the following:
 - .1 Motor Starters
 - .2 Accessories
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 26 28 13 Fuses

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 Canadian Standards Association (CSA):
 - .1 CSA-C22.2 N0. 14 – Industrial Control Equipment
 - .2 CAN/CSA-60947-4-1 – Low Voltage Switchgear and Controlgear-Part 4-1: Contactors and Motor Starters-Electromechanical Contactors and Motor Starters
 - .3 CAN/CSA-C22.2 No. 248.1 – Low-Voltage Fuses
 - .4 CSA-C22.2 No. 106 – HRC-Miscellaneous Fuses

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 26 05 00.
- .2 Product Data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements
 - .2 Submit product data sheets for all products specified in this Section. Include all construction and performance details.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

- .1 Acceptable starter manufacturers are:
 - .1 Rockwell Automation/Allen-Bradley
 - .2 Danfoss
 - .3 Eaton
 - .4 Siemens
 - .5 Schneider Electric
- .2 Requests for substitutions shall be made in conformance with Section 26 05 00.
- .3 Single source responsibility: Obtain each type of product in this Section from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

2.2 MATERIALS

- .1 Motor Starters: Motor starters are to be in accordance with all standards listed in Part 1 of this Section.
 - .1 General: General requirements for motor starters are as follows:
 - .1 All motor starters must be capable of starting the associated motors under the imposed loads.
 - .2 Confirm that starter voltage matches the motor prior to ordering.
 - .3 Unless otherwise specified, all motor starters (and disconnect switches) are to have a 50,000 symmetrical SCIA (short circuit interrupting ampacity).
 - .4 Equip starters with accessories and modifications as per the drawing motor starter schedule.
 - .5 Equip every starter associated with a building fire alarm system fan shutdown with a double voltage relay with suitable coil voltage.
 - .2 Single Phase Motor Starters: Unless otherwise specified or scheduled single phase motor starters are to be manual motor starting switches, each suitable in all respects for the motor it controls and complete with a neon "ON" pilot light, a snap action toggle operator designed to prevent the switch from being held closed under a sustained motor overload, an enclosure to suit the application, and properly sized thermal overload protection which can be reset by moving the toggle to the "OFF" position.
 - .3 Starters For Three Phase Motors Less Than 25 HP: Unless otherwise specified, starters for 3-phase motors less than 25 HP are to be combination "quick-make" and "quick-break" fused disconnects and full voltage non-reversing across-the-line starters, each complete with a properly sized thermal overload relay per phase, a 120 volt holding coil, and an enclosure to suit the application.
 - .4 Starters For Three Phase Motors 25 HP to 150 HP: Unless otherwise specified, starters for 3-phase motors 25 HP to 150 HP are to be reduced voltage, non-reversing, auto-transformer type starters complete with 1 properly sized thermal overload relay per phase, and an enclosure to suit the application.

- .5 Starters For Three Phase Motors 150 HP and Larger: Unless otherwise specified, starters for 3-phase motors 150 HP and larger are to be reduced voltage, non-reversing, closed transition "wye-delta" starters complete with 1 properly sized thermal overload relay per phase, and an enclosure to suit the application.
- .6 Starters For 2-Speed Double Winding Motors: Generally, as specified above but suitable for the motor and equipped with a 45 second time delay to permit the equipment to coast down to low speed before it is operated at low speed.
- .7 Starters For 2-Speed Single Winding Motors: Generally, as specified above but suitable for the motor and equipped with a 45 second time delay to permit the equipment to coast down to low speed before it is operated at low speed.
- .8 Starters For Reversible Motors For Cooling Towers: Generally as specified above but suitable for the motor and equipped with a 45 second time delay to allow the fan(s) to coast down to a stop before being operated in reverse rotation.
- .9 Enclosures: Unless otherwise specified, contactor enclosures are to be in accordance with the following NEMA/EEMAC ratings:
 - .1 All enclosures located in sprinklered areas – Type 2.
 - .2 All enclosures exposed to the elements – Type 3R, constructed of stainless steel.
 - .3 All enclosures inside the building in wet areas – Type 3R, constructed of stainless steel.
 - .4 All enclosures in washdown or food preparation areas - Type 12X, constructed of stainless steel.
 - .5 All enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application.
 - .6 All enclosures except as noted above – Type 1.

2.3 ACCESSORIES

- .1 Fuses
 - .1 Fuses: Unless otherwise scheduled or specified, English Electric Ltd. HRC fuses, Form I Class "J" for constant running equipment and Form II Class "C" for equipment that cycles on and off.
- .2 Warning Signs
 - .1 Supply warning signs at starter locations where required, for example: "Motor is Under Remote Control and May Start At Any Time Without Warning".
 - .2 Appropriately sized white PVC warning signs with red lettering, screw holes, and stainless steel screws.

3 EXECUTION

3.1 INSTALLATION

- .1 Installation Of Motor Starters and Accessories:
 - .1 Unless otherwise shown or specified, provide a starter for each item of motorized equipment as indicated on the drawings. Refer to the drawing Motor Starter Schedule.

- .2 Single Phase Motor Starters: Unless otherwise specified or shown on the drawings, mount single phase motor starters adjacent to the equipment they serve.
- .3 Warning Signs: Install with stainless steel screws.
- .2 Interface with Other Work:
 - .1 Electrical Wiring Work For Mechanical Work
 - .1 Refer to the electrical work Section entitled Basic Electrical Materials and Methods.

END OF SECTION

1 GENERAL

1.1 SUMMARY

- .1 The lighting fixtures shall be provided complete with lamps, ballasts, drivers, lenses, etc., and they shall be compatible with the various building elements that affect the installation and operation of the units.

1.2 REFERENCES

- .1 Fluorescent ballasts shall be in accordance with CSA Specification No. C82.1 and CBM Standards.
- .2 Provide fixtures that will meet the requirements of the various active government incentive programs such as Save-on-Energy, High Performance New Construction prescriptive path, etc.

1.3 SUBMITTALS

- .1 Shop drawings for luminaires indicating lighting performance details, fixture construction details, air control and ductwork connection details, etc., and pictures of each type of lighting fixture shall be submitted for review.
- .2 Shop drawings shall be submitted for LED drivers, ballasts, and bulbs for all fixtures to be installed. These shall be submitted separately from the lighting fixtures being installed and should indicate each fixture the product is installed.
- .3 Fixture(s) which have been specially designed or altered shall have a full scale mock-up built and submitted for co-ordination and design review when requested by the Project Manager.
- .4 Mock-up fixtures must have engineering drawings submitted for approval, after the mock-up has been approved.
- .5 Fixtures shall not be released prior to review of the shop drawings. Cancellation charges will not be paid for changes to fixtures made before the fixture cuts have been reviewed.

1.4 QUALITY ASSURANCE

- .1 All lighting fixtures and components must be CSA approved, ULC approved, or approved by Special Inspection from the Electrical Safety Authority.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Light fixtures must be shipped in individual containers. The fixtures must be stored in a dry area protected from the elements and physical damage.

1.6 WARRANTY

- .1 Incandescent lamps shall be warrantied for three months from date of final acceptance, LED lamps and drivers for minimum 5 years, all other lamps and ballasts for a minimum 1year warranty period.

2 PRODUCTS

2.1 LED LIGHT FIXTURES

- .1 LED monochrome lighting fixture shall have lighting that shall a minimum CRI of 85 for regularly occupied spaces, a minimum CRI of 70 for exterior, and a minimum of 75 for all other spaces. All lighting shall have IESNA LM-79 and LM-80 testing reports and life calculations based on TM-21. Exterior and interior area lighting shall have a minimum efficacy of 80 lumens per watt.
- .2 LED drivers shall have minimum lifespan equal or better than the lifespan of the projected L70 lifespan of the LED lamps it serves. Drivers shall be integrated into the fixture if serving only that fixture or remote if the driver serves more than one fixture. All drivers shall be dimmable using 0-10V dimming technology unless noted otherwise. LED drivers shall have high power factor.
- .3 All LED lighting and drivers used in exterior or unheated applications shall provide start-up and operation in temperatures from -30 °C to +50 °C.
- .4 Colour-changing LED lighting controllers shall allow DMX interface to allow colour-changing and intensity controls.

2.2 LAMPS

- .1 All lamp sizes and types shall be as designated on the "Fixture Schedule" or as required by the fixture manufacturer.
- .2 Where identical fixture types are installed in the same room or area, lamps shall have no variation in colour temperature.
- .3 Self-contained lamps are lamps that include both the light source (LED or fluorescent) and the driver/ballast in one fixture and which installs into a standard incandescent socket. These lamps shall provide a lumen output comparable to their incandescent counterpart and shall have a colour temperature that closely matches the remaining fixtures in the space and a CRI>80.
- .4 Provide as spares, 10% of each type of incandescent, fluorescent and compact fluorescent, HID, self-contained lamps installed and turn over to the Owner upon occupancy of the building.

2.3 LENSES

- .1 All flat plastic lenses shall be a minimum 3.2 mm (1/8") thick acrylic type with no mid-span sag.
- .2 All special lenses shall be as specified in fixture schedule.

2.4 ACCESSORY PRODUCTS

- .1 Air control and slot provision where applicable shall be fully co-ordinated with the Mechanical [Contractor/Sub-Contractor] for a fully compatible installation. Set dampers to fully blank of air slots where instructed.

2.5 SOURCE QUALITY CONTROL

- .1 Lighting fixtures shall be provided with all auxiliary components and mounting hardware required for installation in the building as intended. Verify all catalog numbers with descriptions given including mounting, lamp type and quantity.

3 EXECUTION

3.1 INSTALLATION

- .1 Ensure that both recessed and surface mounted light fixtures mounted as part of a suspended ceiling system are adequately supported. Fixtures shall not be suspended directly from the ceiling system supporting grid, but must be supported directly from the building structure.
- .2 Surface mounted fixtures on T-Bar ceilings may be supported using a minimum of two "Caddy" IDS clips from the ceiling suspension grid and which are also separately connected to the building structure.
- .3 Co-ordinate the requirements of the ceiling system supports with the Ceiling Sub-Contractor prior to fixture installation. Fixture safety chains or wires shall also be provided as required by regulatory agencies. The method of attaching suspension wires and safety chains or wires to fixtures and building elements, shall be discussed with and approved by the Project Manager prior to installation. Where the structural system is to have a fireproofing material applied, attach all structural system fasteners in advance of the fireproofing.
- .4 Pendant mounted fixtures shall have a deep canopy cover to fully cover the supporting outlet box and render it inconspicuous. Provide a self-aligning type cover and support for fixtures mounted to sloped surfaces.
- .5 Electrical wiring or components shall not be attached to the ceiling system suspension wires.
- .6 For exact details of fixture installation in valances, bulkheads, millwork, etc., refer to the Architectural Drawings.
- .7 All electrical fixtures are to be delivered to the site with the specified finish. Where required colour or finish is not available from the fixture manufacturer, the Contractor shall obtain such from an approved paint shop.

3.2 FIELD QUALITY CONTROL

- .1 Check all lighting fixtures prior to their installation to ensure that they are the specified and approved fixtures for the project. Check the fixture catalogue number, frame and mounting arrangement, lens type, reflector type, lamp socket position, lamp type, fixture operating voltage, etc.
- .2 The locations of fixtures are shown generally on the electrical drawings. For accurate locations refer to the architectural reflected ceiling plans (indoor) or landscape drawings (outdoor).

3.3 CLEANING

- .1 Clean all lenses and interior of all fixtures.

END OF SECTION

1 GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Comply with General Conditions of the Contract, Supplementary Conditions and requirements of Division 01. This section will also comply with 26 05 00 Common Work Results for Electrical.

1.2 SUMMARY

- .1 Provide Exit Lighting as shown on the drawings and in the lighting fixture schedule. Exit Lighting will be fed from an AC voltage dedicated circuit and a DC voltage source connected to the emergency battery lighting system.
- .2 Provide complete 12 volt DC emergency battery lighting system for the building areas indicated. The emergency battery units will be located as indicated on the drawings. The emergency battery system will provide emergency power automatically on failure of the normal power supply system. When the normal power supply system is restored, the emergency battery unit will restore itself automatically to the charging condition.
- .3 Related Sections:
 - .1 Section 26 05 19 Wire and Cable
 - .1 Section 26 05 33 Raceway and Boxes for Electrical Systems

1.3 REFERENCES

- .1 Reference Codes and Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 CSA C22.2 No. 141 Emergency lighting equipment
 - .2 CAN/CSA C860 Performance of internally lighted exit signs.
 - .3 Ontario Building Code
 - .4 Ontario Electric Safety Code

1.4 SUBMITTALS

- .1 Complete sets of shop drawings will be submitted indicating the following:
 - .1 System components, specifications, and dimensions.
 - .2 Battery Calculations.
 - .3 Wiring schematics.
- .2 For Closeout submittals provide the following:
 - .1 Emergency lighting runtime test report

2 PRODUCT

2.1 APPROVED MANUFACTURERS

- .1 Listed below are manufacturers that will provide complete emergency and exit lighting systems. Equivalent emergency and exit lighting systems by other manufacturers and/or engine manufacturer may be accepted subject to review by the consultant. Emergency and Exit Lighting by the following manufacturers will be considered for use on this project:

- .1 Aimlite
- .2 Beghelli
- .3 Emergi-lite
- .4 Lumacell
- .5 Stanpro>

2.2 EXIT LIGHTING

- .1 Housing: cold rolled steel minimum 1.0 mm (1/25 in) thick, die-cast or anodized extruded aluminum frame, white finish c/w universal mounting system.
- .2 Face and back plates: extruded aluminum alloy white colour.
- .3 Graphic: Green "running man" pictogram.



- .4 Lamps: LED type, 120 V AC and DC emergency power source, maximum 5 watts consumption.
- .5 Designed for minimum 50,000 hours of continuous operation without re-lamping.
- .6 Exit lighting arrows: exit lighting will be capable of no arrows or configuration with arrows facing left, right, up, down, upper right, upper left, lower right, or lower left. "Running man" pictogram will also be capable of facing either right or left. Refer to drawings for orientation required for each exit lighting unit.
- .7 Photoluminescent Exit signage is not permitted.

2.3 EMERGENCY BATTERY UNITS

- .1 The self-powered battery units will be a sheet steel ventilated type enclosure with a removable front cover. The cabinets will be painted with a corrosion resistant undercoat inside and have a low gloss white enamel exterior finish. The side panel of the battery cabinets will contain an AC on light, charge light and test switch. A supply line fuse will be provided inside the cabinet. The emergency battery unit will be rated for 120VAC power supply and be equipped with a grounded plug and power cord, minimum 4' in length for power supply connection.

- .2 The emergency batteries will be long life sealed lead-acid (SLA) type and be VRLA technology totally maintenance free with a minimum life expectancy of 10 years.
- .3 All emergency battery lighting heads on unit battery and remote will be LED type.
- .4 The battery capacity will be sized to supply the number of fixtures indicated on the drawings, plus have an additional 50 watts spare capacity for future heads. The batteries will be capable of providing power to the fixtures for 30 minutes without dropping below ninety-one (91) percent of the rated battery voltage.
- .5 The emergency battery charger will be a solid state, fully automatic rectifier type with Hi and Lo charging rates to re-charge the batteries to their rated capacity from a discharged condition in less than 24 hours.
- .6 The emergency battery units will be complete with the following options:
 - .1 Electrolyte low level alarm.
 - .2 Battery disconnect switch (70 % of normal voltage).
 - .3 Time delay relay to maintain emergency lighting for 10 minutes, powered from the battery charger, following restoration of normal power.
 - .4 Auto test and automated self-diagnostic circuitry complying with CSA and building code requirements.
- .7 Mounting platforms and accessories will be provided for a permanent and safe installation of the battery unit.

3 EXECUTION

3.1 EXIT LIGHTING

- .1 Ensure that exit lighting AC circuit breaker is locked in on position
- .2 Install exit lighting as indicated, in accordance with building code requirement.

3.2 EMERGENCY BATTERY UNITS

- .1 Provide grey coloured conductors in a separate conduit system, for the DC wiring. The wire will be sized to limit voltage drop to furthest fixture to 5 percent. Connect battery units to remote lamp heads and exit lighting emergency sockets in an approved manner.
- .2 Emergency lighting will be so arranged that the failure of any one lamps will not leave in total darkness the area normally illuminated by it.
- .3 Unit equipment will be installed in such a manner that it will be automatically actuated upon failure of the power supply to the normal lighting in the area covered by that unit equipment.
- .4 Install battery unit mounting shelf at 2000 mm (80 in) above finished floor.
- .5 All battery units will have a logged runtime test completed prior to occupancy to ensure compliance with building code requirements.

END OF SECTION

1 GENERAL

1.1 SUMMARY

- .1 Provide electrical equipment and appliances of the types specified herein and shown on the drawings. The Contractor shall provide collars and tailpieces to enable service connectors to be made by specified trades.

1.2 SUBMITTALS

- .1 Equipment and device shop drawings shall be submitted for review.

2 PRODUCTS

2.1 BATTERY CLOCKS

- .1 Supply and install a total of 10 battery operated indicating clocks at locations instructed on site. Clocks shall be Edwards Cat. No. 2941-5BS, single face, surface mounting 300 mm diameter round clock with convex shatterproof crystal, grey finish case, black/red Arabic numerals and white face in a 12/24 hour style II arrangement with two number rings, black minute and hour hands, red sweep second hand and 1.5V quartz crystal movement. Install a 1.5V 'C' size alkaline battery in each clock and mount to a suitable hanger and secure with an appropriate safety chain."

2.2 ELECTRIC HEATING UNITS

- .1 Provide complete electric heating units including all accessories and controls as specified on the drawings.

3 EXECUTION

.1 INSTALLATION

- .1 Install surge suppressors adjacent to protected device or panel and hard wired into power supply circuit. Connect units in accordance with manufacturer's instructions and install disconnect and overcurrent protection as required by Electrical Safety Authority.
- .2 Mount clocks at 2400 mm or 300 mm (8'-0" or 1'-0") below ceiling whichever is lower. Install using an appropriate clock hanger and provide a safety chain.
- .3 Install all electric heaters, controls and associated equipment in accordance with the manufacturer's instructions and Electrical Safety Code regulations.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

- .1 Comply with the General Conditions of the Contract, the Supplementary Conditions, Division 01 – General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.2 SUMMARY

- .1 Section includes: Provide pathways for communications and other extra low voltage systems, including but not limited to the following:
 - .1 Internal building horizontal pathways, service provider pathways, and exterior pathways.
 - .2 Outlet boxes, cover plates, conduits, cable trays, pull boxes, sleeves, backboards, telecom rooms, shafts, fish wires, innerduct, cable hooks, firestopping, cable managers, service fittings, and direct buried ducts.
- .2 Related sections: The following is included for reference only and shall not be presumed complete:
 - .1 Section 07 84 00 - Firestopping
 - .2 Division 21 - Fire Suppression
 - .3 Division 22 - Plumbing
 - .4 Division 23 - Heating, Ventilating, and Air Conditioning (HVAC)
 - .5 Section 26 05 19 - Wire and Cable
 - .6 Section 26 05 33 - Raceway and Boxes for Electrical Systems
 - .7 Section 26 27 26 - Wiring Devices

1.3 REFERENCES

- .1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction
 - .1 American National Standards Institute (ANSI)/ Telecommunications Industry Association (TIA):
 - .1 ANSI/TIA 569 – Telecommunications Pathways and Spaces
 - .2 ANSI/TIA 606 – Administration Standard for Telecommunications Infrastructure
 - .2 Ontario Building Code
 - .3 Ontario Electrical Safety Code

1.4 SUBMITTALS

- .1 Submittals under this Section shall be in accordance with Section 26 05 00.
- .2 Product Data:

- .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this Section. Include printed technical data, installation instructions and general recommendations for all materials and components. Include certification indicating compliance of materials with project requirements

- .1 Fire Rated Pathways

2 PRODUCTS

2.1 MANUFACTURERS

- .1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

- .1 Acceptable Manufacturers:

- .1 Fire-rated Pathways:

- .1 STI EZ-Path

- .2 Hilti Firestop Speed Sleeve

- .2 Requests for substitutions shall be made in conformance with Section 26 05 00.

2.2 MATERIALS

- .1 Internal Distribution:

- .1 Interior conduit to be EMT unless specifically noted or required to be otherwise.

- .2 Exterior conduit to be PVC unless specifically noted or required to be otherwise.

- .3 Conduit not indicated as to size to be 25 mm (1 in) minimum.

- .4 LB fittings are not allowed under any conditions.

- .2 Distribution Terminations:

- .1 Provide 19 mm (3/4 in) fire retardant painted (all six sides) plywood wall mounted equipment mounting backboards as shown for telecommunications rooms.

- .2 Provide conduits terminated with an insulated bushing to area ceiling spaces and telecom rooms as shown for zone conduit or sleeve installations.

- .3 Outlets:

- .1 Wall outlets consist of standard deep single gang outlet boxes unless otherwise indicated. Provide blank coverplates for all un-used outlets.

- .2 Coverplates complete with appropriate jacks are provided by extra low voltage systems providers.

- .4 Fire-Rated Cable Pathways:

- .1 Fire-Rated Pathway device modules are comprised of steel pathway with self-adjusting intumescent foam pads allowing 0% to 100% cable fill without removal of intumescent material.

- .2 Quantity and size of pathway are based on the fill area listed on the drawings or minimum sizes listed below. Provide uniform sized of devices where more than one device is required at same location.
- .3 Unless noted on the drawings, the minimum clear space sizes are:
 - .1 160 cm² (25 in²) for telecommunications rooms
 - .2 for cable tray penetrations, provide minimum size equal to cross-sectional area of cable tray
 - .3 80 cm² (12.5 in²) in corridors without cable trays
 - .4 8 cm² (1.25 in²) for room penetrations

3 EXECUTION

3.1 INSTALLATION

- .1 Install empty raceway system, including distribution system, fish wire, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves, cable tray, service poles, miscellaneous and positioning material to constitute complete system.
- .2 Run parallel to building lines all horizontal and vertical pathways. Do not route diagonally for extended distances.
- .3 Since cabling for communications is subject to many add/moves/changes in future, install pathways in locations that are readily accessible in future and route below ductwork and piping in ceiling spaces. Coordinate installation of pathways with Division 21, Division 22, and Division 23 to minimize interference and maximize accessibility to pathways.
- .4 Horizontal data cables from telecommunications rooms patch panels have limitation of cable length of 90 m (297 ft). Optimize pathways to minimize cable length.
- .5 Protect installed products and components from damage during construction.
- .6 Repair damage to adjacent materials caused by pathways for communications systems installation
- .7 Bury underground service ducts a minimum of 900 mm (36 in) below finished grade.
- .8 Restrict installation of conduits as follows:
 - .1 60 m (200 ft) maximum no bends
 - .2 45 m (150 ft) maximum with equivalent of one 90° bend
 - .3 30 m (100 ft) maximum with equivalent of two 90° bends
 - .4 20 m (65 ft) maximum with equivalent of three 90° bends
 - .5 No more than three 90° bends are allowed in any section of conduit run
- .9 Install all conduits with large radius bends. Minimum bending radii is 10 times the diameter.
- .10 Mounting heights of the communications outlets unless otherwise noted are as follows:
 - .1 Standard wall outlet 460 mm (16 in) or 150 mm (6 in) above countertop or splash back
 - .2 Wall mounted telephones outlets 1100 mm (43 in) to centre of backbox

- .3 When mounting adjacent to other devices at same location, communications outlet box to match installation height of adjacent outlet box used for wiring device
- .11 Refer to the systems conduit diagrams for details of distribution and outlet conduit, cabinet and backboard requirements and to floor plans for component and outlet locations.
- .12 Contact Owner's systems service providers as appropriate to verify all incoming conduit sizes, prior to proceeding with installations. Modify provisions accordingly to suit their specific requirements. Co-operate with appropriate installation personnel during construction and give sufficient notice of construction progress to allow scheduling of their installations. Systems installation companies/contractors generally supply and install distribution cable, terminals, equipment and connectors to complete systems installations. Co-ordinate and arrange for all work to suit construction phasing as appropriate.
- .13 Install nylon pull cords in all empty conduits and tag and identify both ends appropriately. Maintain a pull cord in all conduit systems used only to partial capacity.
- .14 Firestopping
 - .1 Install at all fire separations Fire-Rated Pathway device modules to allow future cables to be installed through fire separation. Prepare and install device module as per manufacturer's instructions.
 - .2 Use Fire-Rated Pathway device module only for extra low voltage systems cabling and do not use for line voltage applications.

END OF SECTION

1 GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Comply with General Conditions of the Contract, Supplementary Conditions and requirements of Division 01. This section will also comply with 26 05 00 Common Work Results for Electrical.

1.2 SUMMARY

- .1 Provide alterations to the existing fire detection and alarm system to suit the specific building requirements as indicated in this scope of work.
- .2 The existing fire alarm control panel, fire alarm devices, and existing components are to be reused and expanded to suit this scope of work. The system alterations will consist of new and relocated initiating devices, signalling devices, supervisory circuits, and components as specified herein.
- .3 At the completion of the scope of work, the modified fire alarm system will be a fully functional system and will be compliant with all local, provincial, and federal codes and standards.
- .4 Modify the existing fire alarm graphics to suit changes.
- .5 Connect devices to existing fire alarm system with wire and conduit as required by code, standards, and equipment manufacturer. Provide any components, expansion cabinets, re-programing, and make any modifications necessary to the fire alarm control panel.
- .6 Related Sections:
 - .1 Section 08 30 00 Specialty Doors and Frames
 - .2 Division 21 Fire Suppression
 - .3 Division 23 Heating, Ventilating, and Air Conditioning (HVAC)
 - .4 Division 25 Integrated Automation
 - .5 Section 26 05 19 Wire and Cable
 - .6 Section 26 05 33 Raceway and Boxes for Electrical Systems
 - .7 Section 26 05 53 Identification of Electrical Systems

1.3 REFERENCES

- .1 Reference Codes and Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.
 - .1 CAN/ULC S524 Installation of Fire Alarm Systems
 - .2 CAN/ULC S536 Inspection and Testing of Fire Alarm Systems
 - .3 CAN/ULC S537 Verification of Fire Alarm Systems
 - .4 CAN/ULC S561 Installation & Services for Fire Signal receiving Centre Equipment

- .5 CSA B44.1/ASME-A17.5 Elevator and Escalator Electrical Equipment
- .6 ANSI S1.40 Specifications for Acoustical Calibrators
- .7 Technical Standards & Safety Authority (TSSA)
- .8 Ontario Fire Code (OFC)
- .9 Ontario Building Code (OBC)
- .10 Ontario Electrical Safety Code (OESC)

1.4 QUALITY ASSURANCE

- .1 In the case of any discrepancy between these specifications, the project drawings, and any applicable local codes, the installed Fire Alarm / Life Safety System will comply with the most stringent requirement.
- .2 Provide passive fire alarm graphic displays at annunciator and control panel location. Fabrication of the graphic display will be by an approved signage supplier or the fire alarm supplier.
- .3 Employ fully trained mechanics who are regularly employed in the field of graphics design and/or sign production to create the fire alarm zoning graphic.

1.5 SUBMITTALS

- .1 Submittals under this Section will be in accordance with General Conditions, Section 01 33 00 – Submittals, and Section 26 05 00 - Common Work Results for Electrical.
- .2 Submit the following as part of the Shop Drawings:
 - .1 System component numbers and dimensions.
 - .2 Wiring schematics indicating expanded and/or new loops.
 - .3 Battery Size Calculation.
 - .4 Fire Alarm Zoning Graphic.

1.6 RELATED WORK

- .1 Coordinate work in this Section with all related Sections. Work and/or equipment provided in other Sections and related to the fire detection and alarm system will include, but not be limited to:
 - .1 Air handling and smoke exhaust system fan control circuits and status contacts to be provided by the HVAC control equipment as part of Division 25 Integrated Automation and connected to Fire Alarm System by this Section.
 - .2 Dry pipe/deluge sprinkler system release valve control circuits and supervision contacts will be provided by Division 21 Fire Suppression and connected to Fire Alarm System by this Section.

1.7 SYSTEM OPERATION

- .1 All fire alarm stations, thermal detectors, products of combustion detectors, notification appliances, sprinkler system flow switches, and sprinkler/standpipe tamper switches will be fully supervised.

- .2 All integrated life safety system equipment will be arranged and programmed to provide an integrated system for the early detection of fire, the notification of building occupants, the automatic summoning of the local fire department, the override of the HVAC system operation, and the activation of other auxiliary systems to inhibit the spread of smoke and fire, and to facilitate the safe evacuation of building occupants. In all operating modes, the processing of fire alarms will have the highest priority.
- .3 The system will contain all required components for alarm receiving circuits and signal circuits as shown on the drawings. The system will be so arranged that the operation of any manual pull station or automatic thermal or smoke detector or sprinkler flow switch will activate system signalling sequence. All system circuits, wiring and devices will be fully supervised for faults. A circuit fault such as an open or ground or actuation of a valve tamper switch will sound the trouble signal but will not cause a false alarm.

1.8 SYSTEM PROVISIONS

- .1 The system will display both alarm and trouble indications from each fire alarm detection zone. The activities of the system will be complete with custom labels, indicating the exact location of the activity, and will be displayed on the fire alarm control panel and remote annunciator panels.
- .2 As a result of alarm conditions received the fire alarm control panel will automatically operate specified control points such as transmitting a signal to the fire signal receiving centre to summon the fire department, or stopping recirculating fan systems, etc.

2 PRODUCTS

2.1 GENERAL

- .1 Provide all modifications and additions to the existing installations to incorporate the new control equipment and other work and comply with the latest codes and regulations. Consult the manufacturer to verify the existing system provisions and include all necessary modifications to comply with the system requirements as described.
- .2 Replace all existing system wiring as required to comply with new system specified requirements. Upgrade existing wiring arrangements to suit zoning changes, the addition of initiating and signal devices in existing areas, etc. Existing conduit and raceways may be used for new wiring where appropriate.
- .3 All equipment and components will be the manufacturer's current model. The materials, appliances, equipment and devices will be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling fire alarm system. The authorized representative of the manufacturer of the major equipment, such as control panels, will be responsible for the satisfactory installation of the complete system. Provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications.
- .4 The system will utilize node-to-node, direct wired, multi-priority peer-to-peer network operations. The system will utilize electronically addressed, smoke detectors, heat detectors and input/output modules as described in this specification.
- .5 All integrated life safety system equipment will be arranged and programmed to provide an integrated system for the early detection of fire, the notification of building occupants, the automatic summoning of the local fire department, the override of the HVAC system operation, and the activation of other auxiliary systems to inhibit the spread of smoke and fire, and to facilitate the safe evacuation of building occupants. In all operating modes, the processing of fire alarms will have the highest priority.

2.2 CONTROL PANEL

- .1 The existing Fire Alarm Control Panel (FACP) is a Mircom FX-2000 control panel.
- .2 Consult the manufacturer to verify existing system provisions and the compatibility of the new control equipment with existing system and provide all necessary modifications to existing wiring or control panel accordingly.

2.3 SYSTEM CONFIGURATION

- .1 Each addressable analog loop will be circuited so device loading is not to exceed 80 % of loop capacity in order to allow for the addition of future devices.
- .2 Provide alarm receiving modules as required in the control panel for all alarm receiving circuits. Modules will include an individual amber trouble lamp for each alarm receiving circuit to indicate the source of any faults.
- .3 The alarm receiving circuits will have Class "A" operation. A single break or grouped fault in the wiring to any initiating device will cause a trouble signal but will not affect detection of an alarm from any initiating device while this fault exists.
- .4 Provide supervisory receiving modules as required in the control panel for all supervisory circuits. Modules will include individual alarm and trouble lamps for each supervisory circuit to indicate circuit condition.
- .5 The supervisory circuits will have Class "B" operation. A single break or ground fault in the wiring to any initiating device will provide a trouble signal. A supervisory circuit alarm condition will activate trouble sequence only.
- .6 Provide audible signal circuit modules as required in control panel for all signal circuits. Modules will include individual alarm and trouble lamps for each signal circuit to indicate the circuit condition.
- .7 Provide auxiliary control relay modules as required in control panel for all auxiliary control circuits. Modules will include individual trouble lamps for each circuit and supervised on-off-auto control switch for manual circuit operation override.
- .8 The signal and auxiliary control circuits will have Class "B" operation. A single break or ground fault in the wiring to any audible signal or control device will produce a trouble signal.
- .9 Provide sufficient spare capacity to assure that the addition of five (5) audible devices can be supported without the need for additional control components (power supplies, signal circuit modules, batteries, etc.)
- .10 Provide sufficient spare capacity to assure that the addition of three (3) visual devices can be supported without the need for additional control components (power supplies, signal circuit modules, batteries, etc.)
- .11 Provide a dedicated 24 V DC circuit as required to feed all auxiliary relays required for inductive loads. Circuits will be supervised via an end-of-line relay and addressable input module. Auxiliary relays will not derive their power from the starter or load being controlled

- .12 Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings will be DPDT and rated for 10 amperes at 115 V AC. A single relay may be energized from a voltage source of 24 V DC, 24 V AC, 115 V AC, or 230 V AC. A red LED will indicate the relay is energized. A metal enclosure will be provided.

2.4 SYSTEM DEVICES

- .1 All new and existing/re-used system devices will be fully compatible with existing control equipment and match in operation and performance characteristics of the existing system. All signal devices and manual pull stations will be identical in appearance and function. All accessories will be supplied by the fire alarm manufacturer.
- .2 Provide system devices where indicated on the drawings and described below.
 - .1 Manual Pull Stations types include:
 - (1) Manual Station, Single Stage, single-action pull lever, extruded aluminum with NO/NC contacts.
 - .2 Manual Pull stations will include these accessories where required:
 - (1) Where surface mounted, use a vendor approved surface wall box.
 - (2) Where indicated on drawings provide a vendor approved polycarbonate shield and frame that fits easily over manual pull station. The shield will have integrated battery-operated horn.
 - (3) Use manufacturer-approved manual pull station lowering kit to adjust height of existing manual pull stations.
 - .3 Automatic thermal detectors types include:
 - (1) Fixed and Rate of Rise Heat Detector. 57 °C (135 °F), separate mounting base.
 - (2) Fixed and Rate of Rise Heat Detector. 90 °C (194 °F), with addressable module.
 - (3) Fixed Temperature Heat Detector. 57 °C (135 °F), separate mounting base.
 - (4) Fixed Temperature Heat Detector. 90 °C (194 °F), with addressable module.
 - .4 Where indicated to provide a fire detector, provide suitable thermal detector listed above.
 - .5 Automatic smoke detectors types include:
 - (1) Photoelectric Area Type with separate mounting base
 - (2) Photoelectric Type Duct Smoke Detector with housing, Form-C shut down relay and LED remote indicator and sampling tubes to suit duct dimensions and key-operated remote test station. Provide wall mount remote indicator minimum 300 mm (1 ft) below ceiling at detector location.
 - (3) Photoelectric Smoke and Fixed Temperature Type- intelligent multi-sensor detector. The smoke detector will be modular and allow for replacement of the photoelectric chamber
 - (4) Ionization, Photoelectric and Heat Type - multi-sensor detector with a separate mounting base.
 - .6 The intelligent Analog detectors will be suitable for mounting on any detector-mounting base.
 - (1) Standard Detector Mounting Bases - The base will be capable of supporting one Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.

- (2) Relay Detector Mounting Bases – The base will be provided for area smoke detectors as indicated on plans to provide a remote alarm indication or perform auxiliary functions as applicable. Relay bases to be 4 wire version with end of line relay. Power source for relay activation to be run separately from detection circuit to allow multiple unit operation. The relay will be a bi-stable type and selectable for normally open or normally closed operation. The position of the contact will be supervised
 - (3) Isolator Detector Mounting Bases – The base's respective detector processor will control the operation of the isolator base. Following a short circuit condition, each isolator/detector will be capable of performing an internal self-test procedure to re-establish normal operation.
- .7 Input modules will have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED will flash to confirm communication with the loop controller. A red LED will flash to display alarm status.
- (1) Single Input Module - (Waterflow Detectors, Tamper Switches etc.) The Single Input Module will provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The single input module will support the following circuit types: Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.), Normally-Open Active Latching (Supervisory, Tamper Switches).
 - (2) Dual Input Module - The Dual Input Module will provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The dual input module will support the following circuit types: Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.), Normally-Open Active Latching (Supervisory, Tamper Switches).
 - (3) Single Input Signal Module - The Single Input (Single Riser Select) Signal Module will provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module will be capable of generating its own "ring tone". The single input signal module will support the following operations: Audible/Visible Signal Power Selector (Polarized 24 V DC @ 2 A).
 - (4) Control Relay Module - The Control Relay Module will provide one form "R" dry relay contact rated at 2 A @ 24 V DC to control external appliances or equipment shutdown. The control relay will be rated for pilot duty and releasing systems. The position of the relay contact will be confirmed by the system firmware.
- .8 End of Line Resistors complete with a flush stainless steel coverplate appropriately marked and must be CSA or CAN/ULC approved.
- .3 Provide appropriate wire guard installed over detector for detector protection where shown on drawings.
- .4 Notification appliances will be as follows:
- .1 Horns: with a field selectable peak output of $L_A = 97$ dB at 10 feet at high output and $L_A = 92$ dB at low output. Horn to have a red finish. Horn output to be set at $L_A = 97$ dB unless noted otherwise. When surface mounted use surface wall box with a colour to match device.
 - .2 Strobes: synchronized strobe with a field selectable output of 15, 30, 75 or 110 cd; complete with red finish. To be selected for 15 cd unless noted otherwise noted on plans. When surface mounted use surface wall box with a colour to match device. Strobes in sleeping rooms will have minimum output of 177 cd.

- .3 Combination Horn-Strobes: with a field selectable peak output of $L_A = 97$ dB at 10 feet at high output and $L_A = 92$ dB at low output. Unit to be complete with a synchronized strobe with a field selectable output of 15, 30, 75 or 110 cd. Horn/strobe to have a red finish. Horn output to be set at $L_A = 97$ dB and strobe to be selected for 15 cd unless noted otherwise. When surface mounted use surface wall box with a colour to match device. Strobes in sleeping rooms will have minimum output of 177 cd.
- .4 Magnetic door hold-open devices: flush wall type and floor mounted type rated 120 V AC. Connect door holder/closer units and magnetic door lock units provided by Hardware Supplier to fire alarm auxiliary control circuit for proper operation. Electromagnetic door holders will be 100 % compatible for the purposes intended.
- .5 Trim Plates: Provide trim plates for two-gang or 100 mm (4 in) square boxes.
- .5 Fire alarm system manufacturer to modify existing system to include one (1) spare additional signal circuit.
- .6 Fire Alarm Zoning Graphic
 - .1 Provide Fire Alarm Zoning Graphic to replace existing.
 - .2 Sample Graphic
 - (1) Submit a sample of the graphic to the Consultant prior to the colouring and final framing process for approval.
 - .3 Rejections
 - (1) Defective materials or workmanship whenever found at any time prior to final acceptance of work will be rejected regardless of previous inspection. Inspection will not relieve responsibility but is a precaution against oversight and error.
 - .4 Colour
 - (1) Building walls: Black
 - (2) Symbols and Text: Black ("You are here" marker to be red).
 - (3) Zones: Each zone to be a different colour as selected by the graphic designer to ensure contrast between adjacent zones and text. Text colour should be changed to white if contrast improves text legibility when placed on dark background colour.
 - .5 Materials will be new and in perfect condition, free from defects impairing physical or appearance performance.
 - .6 Graphic: 450 mm x 600 mm (18 in x 24 in) or sized to match existing in high impact styrene with screened graphics. Zone colours will be as selected by the Consultant from the standard range samples provided by the supplier of the graphic.
 - .7 Frame: Clear anodized aluminum picture frame with nominal 19 mm (3/4 in) face width.
 - .8 Protective Covering: Minimum 3 mm (1/8 in) thick, non-glare acrylic.
 - .9 Text font will be a light sans serif typeface and have a minimum text size of 10 point. All text should be upright and horizontal regardless of the rotation of the plan.

.10 The following information is required to be shown on the fire alarm zoning graphic:

- (1) All exterior and interior walls,
- (2) All stairs and elevators,
- (3) All door openings,
- (4) Exit door locations indicated with arrows pointing out from door and "Exit" label,
- (5) "You are here" marker and text,
- (6) North arrow,
- (7) Annunciator panel location(s),
- (8) Fire alarm zones and zone designations, and
- (9) Legend.

.11 Floor plan shall be rotated and oriented such that when viewing the graphic, and standing in directly in front of it, the direction the viewer is looking towards is up on the floor plan.

3 EXECUTION

3.1 GENERAL

- .1 The entire system will be installed in accordance with the latest edition of CAN/ULC-S524 and the approved manufacturer's manuals and wiring diagrams. Furnish all labour, conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for a complete, functional life safety fire alarm system. Provide all necessary power supply, interconnecting and remote signal wire in dedicated conduit throughout and installed in accordance with the manufacturer's wiring diagrams and the requirements of the Building Code, Electrical Code, and Inspection Authorities. All penetration of floor slabs and fire separations will be fire stopped in accordance with all local fire codes.
- .2 Take alternate measures in co-ordination with the Owner during any temporary interruption or reduction of fire alarm detection or signalling to ensure the safety of the building occupants. These measures shall be approved by the local fire department and be conveyed to them in writing in accordance with the requirements of the Fire Code.

3.2 WORK WITH EXISTING FIRE ALARM PANEL

- .1 Consult the manufacturer to verify the existing system provisions, the compatibility of the new control equipment with existing system and provide all necessary modifications to existing wiring or control panel accordingly, to accommodate the system alterations and comply with the system requirements.
- .2 Remove all special modifications upon completion of system wiring and device upgrade. All existing auxiliary control circuits will be reconnected to new control to operate in the specified manner
- .3 The manufacturer will supply reasonable amounts of technical information with respect to any changes necessary to accommodate the system alterations.
- .4 Modifications to the fire alarm control panel to accommodate the system alterations will be by the manufacturer's technician.
- .5 Provide all rewiring and modifications to existing circuit arrangements to comply with the new system circuit zoning, devices and wiring requirements.

- .6 It is the intention to install new fire alarm devices and wiring without any interruption of the existing fire alarm system protection to occupied areas of the building in the building. Maintain fire alarm system operation during construction in accordance with Ontario Fire Marshall's *Guidelines for Maintaining Fire Safety During Construction in Existing Buildings*. Any required testing of the fire alarm system during construction must be proceeded by a warning and announcement to the appropriated supervisory personnel. Arrange the time and duration of testing with the Owner to cause minimal disturbance and inconvenience to all concerned.
- .7 Take alternate measures in co-ordination with the owner during any temporary interruption or reduction of fire alarm detection or signalling to ensure the safety of the building occupants such as a fire watch. These measures will be approved by the local fire department and be conveyed to them in writing in accordance with the requirements of the Authority Having Jurisdiction (AHJ).

3.3 WIRING

- .1 Fire alarm system wiring will be sized and colour coded in accordance with manufacturer's and Electrical Code requirements, (minimum 14 AWG - signal and control circuits, minimum 18 AWG - annunciation, minimum 16 AWG detection and supervisory circuits, minimum 12 AWG power supply).
- .2 All fire alarm system wiring will be provided with a separate insulated ground conductor sized in accordance with Electrical Code regulations. All signal and auxiliary wiring will be installed as standard Class 'B' type in a separate conduit system and an alarm receiving wiring will be installed as Class 'A' type in two runs of conduit in accordance with this specification and Electrical Code requirements complete with recessed device boxes for approved component mounting.
- .3 Use fire rated mineral insulated cable as noted and/or required to meet Building Code regulations.
- .4 Connect auxiliary control circuits to the system to provide proper equipment operation. Provide in-line fuse protection at control panel for all auxiliary control circuits.
- .5 Wiring connections will be made as shown on drawings. Final connection to panel will not be applied to the circuit until the representative of the manufacturer has approved the connections to the control equipment.
- .6 Wiring requirements for shielding certain conductors from others or routing in a separate raceway will be as recommended by the manufacturer's documentation and included in the bid.

3.4 INSTALLATION

- .1 Mounting heights of equipment will be as follows:

Device	Mounting Height
Manual Pull Stations	1100 mm (43 in) to centre of back box New stations installed at existing locations will be re-positioned to new mounting height.
Audible Signals (wall mounted)	2300 mm (90 in) or 300 mm (12 in) below ceiling, to top of device, whichever is lower.

Device	Mounting Height
In-suite Audible Signals with Silencing	1050 mm (41 in) to centre of back box
Visual Signals (wall mounted)	2300 mm (90 in) to top of lens.
Panels	2000 mm (80 in) to top of trim.
End of line resistors	1800 mm (6 ft) to centre of device.

- .1 New devices installed at existing locations will also be mounted at these mounting heights.
- .2 Locate detectors as shown considering spacing and mounting requirements contained in CAN/ULC-S524. Locate detectors away from radiating surfaces or positions affected by ventilation grilles.
- .3 End-of-line resistors will be furnished as required for mounting as directed by the manufacturer. These devices are not shown on plans but shall be located in public spaces.
- .4 Connect supervisory device contacts to the system to indicate a trouble condition on the appropriate supervisory zone. Connect auxiliary control circuits to the system to provide proper equipment operation. Provide in-line fuse protection at control panel for all auxiliary control circuits.
- .5 Connect auxiliary control circuits to the system to provide proper equipment operation. Provide in-line fuse protection at control panel for all auxiliary control circuits.

3.5 FIELD QUALITY CONTROL

- .1 The manufacturer will make a complete inspection of all installed fire alarm equipment including each and every component such as signal devices, initiating devices, annunciation and control equipment, etc. in accordance with CAN/ULC-S537 to ensure the following:
 - .1 That the system is complete and in accordance with the specifications.
 - .2 That the system is connected according to ULC requirements.
 - .3 That the system is installed in accordance with the manufacturer's recommendations.
 - .4 That the regulations concerning the supervision of components have been adhered to.
- .2 Any subsequent changes to conform to the above will be done with technical advice supplied by the manufacturer.
- .3 The manufacturer will supply reasonable amounts of technical information with respect to any changes necessary. During the period of inspection by the manufacturer, this Section will make available to the manufacturer, appropriate staff as designated by the manufacturer.

- .4 On completion of the inspection, the manufacturer will provide the Consultant with a certificate together with detailed inspection record sheets, confirming that the system is installed in accordance with the above outlined requirements. The manufacturer will also confirm in writing that all authorized building personnel have been instructed as to system operation, maintenance procedures, etc.
- .5 All costs involved in this inspection both from the manufacturer and this Section's work, will be included with the total tender price.
- .6 It will be the responsibility of this Section to assure that construction debris does not adversely affect any sensing devices installed as part of this project. Should it be deemed necessary by the Consulting Engineer, End-User, or AHJ, this Section will be responsible for the cleaning of all smoke detectors prior to final acceptance.

3.6 THIRD-PARTY VERIFICATION

- .1 Verification shall be carried out in accordance to CAN/ULC-S537 Verification of Fire Alarm Systems. The Third-party verifier shall provide a Verification Certificate and Verification Report to show compliance with CAN/ULC-S537 Verification of Fire Alarm Systems.
- .2 Verification must be carried out by an agency (or individual) acceptable to the Authority Having Jurisdiction, who can demonstrate they have the sufficient training or experience, and who is not the installing contractor, fire alarm manufacturer, or involved in the design or installation of the fire alarm system.
- .3 All fire alarm system testing and verification will use only safe, non-damaging test methods in accordance with CAN/ULC-S536. Open flame or smoke will not be used for any on-site testing of detection devices for proper operation.

3.7 AUDIBILITY TESTING

- .1 All rooms within the scope of work shall be tested with a professional sound level meter that has an accuracy of ± 1.5 dB. Sound level meter used in testing shall be the same for all areas of the building for both with alarm and without. Tester will be calibrated immediately before and after the audibility measurements are taken based on ANSI S1.40, Specifications for Acoustical Calibrators.
- .2 Sound level measurements shall be taken in accordance to CAN/ULC-524 Appendix C - Sound Level Measurements with the following additional requirements.
 - .1 Tester will perform all tests with all doors and windows closed and when unusual noises are not present.
 - .2 Tester will perform test to get ambient noise level without alarm to measure ambient sound level and perform the test again with the with alarm to measure alarm sound level.
 - .3 All test results should be tabulated showing the following columns: room number/name, building code minimum sound level, ambient noise level, and alarm noise level

3.8 FIREWATCH

- .1 If during the course of construction, the fire alarm system or zones within the building are required to be fully or partially shut down for any period of time, provide a Firewatch for all the affected areas in accordance with the Fire Code during that time period. This Firewatch should be in place for the entire duration of the shutdown.

3.9 SEQUENCE OF OPERATION

- .1 All fire safety within the building will follow the requirements set out in the building's existing Fire Safety Plan.
- .2 The overall operation of the existing fire alarm panel will not change. All new or relocated devices added to the system shall function in the same manner as all other existing devices.

END OF SECTION